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# Oxford consensus on primary cam morphology and femoroacetabular impingement syndrome: part 1—definitions, terminology, taxonomy and imaging outcomes

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## ABSTRACT

**Introduction** Primary cam morphology is a mostly benign bony prominence that develops at the femoral head-neck junction of the hip, but it is highly prevalent in many athlete populations. In the small proportion of athletes for whom it is not benign, the resulting hip osteoarthritis can be debilitating. Clinicians, athletes, patients and researchers do not yet agree on important primary cam morphology elements. We aimed to ascertain and improve the level of agreement on primary cam morphology definitions, terminology, taxonomy and imaging outcome measures.

**Methods** To collect and aggregate informed opinions, an expert panel—the Young Athlete's Hip Research Collaborative—rated primary cam morphology definition, terminology, taxonomy and imaging outcome statements through an online Delphi exercise followed by an online meeting to explore areas of tension and dissent. Reporting followed Conducting and REporting DELphi Studies. **Results** A diverse and inclusive Delphi panel (n=65 for rounds 1 and 2, representing 18 countries; 6 stakeholder groups; 40% women) agreed on 35 of 47 statements in 4 domains, while surfacing areas of tension and dissent. This Delphi panel agreed on four key issues essential to moving research and clinical care forward around primary cam morphology. They agreed on: (1) definition, confirming its conceptual attributes (tissue type, size, location, shape and ownership); (2) terminology—use 'morphology' and not terms with a negative connotation like 'lesion', 'abnormality' or 'deformity'; (3) taxonomy, distinguishing between primary and secondary cam morphology, and (4) imaging outcomes, a continuous bone/cartilage alpha angle on radial femoral head-neck MRI for primary cam morphology aetiology research.

**Conclusion** This consensus provides athletes, patients, clinicians and researchers with a strong foundation to guide more precise communication, better clinical decision-making and higher value research about primary cam morphology and its natural history.

## EXECUTIVE SUMMARY FOR CLINICIANS AND RESEARCHERS

Primary cam morphology (PCM) is a mostly benign bony prominence that develops at the femoral head-neck junction of the hip and is highly prevalent in many athlete populations. In some athletes for whom it is not benign, the resulting symptoms and eventual hip osteoarthritis can be debilitating. The Oxford Consensus Study (part 1) equips clinicians and researchers in sport and exercise medicine, musculoskeletal rehabilitation and sports science fields to practice more precise communication, pursue better clinical decisions, and produce higher value research about PCM and its natural history. This study's focus on the definitions, terminology, taxonomy and imaging outcome measures of PCM opens the door for clearer conversations about the morphology and its natural history with athletes, parents, coaches and patients; conversations that normalise what is happening with the athlete's hip—'...a bony bump in your hip that is a common and normal response to training—the vast majority of athletes never have problems. However, some athletes living with this morphology could develop symptoms (femoroacetabular impingement (FAI) syndrome), and potentially hip osteoarthritis in the long term.'

Applying this consensus, clinicians and researchers should prioritise conversations with athletes and patients that:

Clarify the concept of primary cam morphology and its natural history, using a clear definition: primary cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction of the hip, which changes the shape of the femoral head from spherical to aspherical. Development likely begins in early adolescence, occurring most often in asymptomatic male athletes in both hips.

Validate athletes' and patients' experiences through consistent, positive terminology; use 'morphology', 'prominence' or 'bump' when referring to the morphology; avoid 'lesion', 'deformity' and 'abnormality'—words that could amplify the need for unnecessary interventions; consider the possible negative connotation of 'syndrome'.



Apply a consistent taxonomy for cam morphology that distinguishes between primary and secondary cam morphology: primary cam morphology develops during skeletal maturation in young adolescents (with no current or previous hip disease), as a normal physiological response to high-load sporting activity, and is largely benign; secondary cam morphology develops secondary to primary (hip) disease—an important distinction that empowers athletes and patients to embrace normality and their 'happy hips'.



Describe the alpha-angle on radiographs or 3D imaging, depending on the clinical and/or research context, to measure (operationalise) the morphology: the preferred outcome measure for research on primary cam morphology aetiology is a cartilage or bone alpha angle as a continuous variable on radial MRI along the axis of the femoral neck, using 30° intervals from 12 o'clock to 11 o'clock positions, reported per hip, per person or both. In addition to reporting the morphology as a continuous alpha angle (in degrees), a dichotomous alpha angle (using a threshold of  $\geq 60^\circ$ ) can be useful in clinical practice or research.

The Oxford Consensus Study mobilised an international and multidisciplinary community of clinicians, researchers, patient and public partners, research methodologists, journal editors and funders. This learning community—the Young Athlete's Hip Research (YAHiR) Collaborative—will continue to collaborate to:

- ▶ Coproduce knowledge, prioritising minoritised populations and focusing on questions that matter to athletes and patients.
- ▶ Develop open and easy-access resources for clinicians, researchers, athletes and patients.
- ▶ Implement the Oxford consensus while addressing areas of tension and dissent through respectful scholarly discourse.
- ▶ Measure its performance based on realistic and coagreed deliverables.

## INTRODUCTION

Although PCM is mostly an inconsequential bony prominence that develops at the femoral head-neck junction of the hip, it is highly prevalent in many athlete populations.<sup>1–3</sup> In those few athletes for whom it is not benign, the resulting hip osteoarthritis can be debilitating.<sup>4</sup> This predominantly benign morphology thus places existing and potential athlete-patients at risk of future hip disease.

Clinicians and researchers cannot currently predict with accuracy whose PCM will be inconsequential and who will end up with a total hip replacement, hence the need for research to determine the risk factors for poor outcome. Existing research is mired in confusion partly because clinicians, athlete-patients and researchers have not agreed on a conceptual or operational definition of PCM, key terminology or a taxonomy of subtypes.<sup>5</sup>

The YAHiR collaborative is an international multiprofessional stakeholder group that aims to add research value and reduce research waste on conditions affecting the young athlete's hip. The current focus is PCM and its natural history. Some have defined 'natural history' as the 'uninterrupted progression'<sup>6</sup> of a person's condition, including being asymptomatic for life. It is important to recognise that 'progression' for a person with PCM might also include the curtailment of hip disease by treatment. Therefore, we have included a broader range of outcomes in our use of the term natural history in this study. A preliminary concept analysis we recently published,<sup>5</sup> identified four key areas for further attention: it (1) proposed a new conceptual definition for the morphology based on five defining attributes; (2) spotlighted

inconsistent and troublesome terminology, while also commending the important Warwick Agreement from a small and selective expert panel<sup>7</sup>; (3) introduced taxonomy distinguishing between primary and secondary cam morphology; and (4) exposed the challenges of operationalising the hip morphology.

However, publication of a concept paper in isolation does not guarantee dissemination, clinical uptake, impact on research or benefit to patients. The urgent current need is for clinicians, athlete-patients and researchers to engage with, challenge and improve the above-mentioned four key elements and prioritise a research agenda for this field. If not, communication will remain imprecise, clinical decision-making will be compromised and research waste will continue.

Here, we report on our overarching aim to inform a more rigorous, inclusive and evidence-based approach to research on PCM and its natural history. The specific objectives of the research were to:

1. Ascertain the level of agreement among experts on definitions, terminology, taxonomy and imaging outcome measures for research on PCM.
2. Work towards agreement and highlight residual disagreements on a set of research priorities on conditions affecting the young person's hip focusing primarily on PCM and its natural history.
3. Hold two education events to engage stakeholders, disseminate the latest evidence and stimulate debate.
  - *Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series.*
  - *YAHiR Collaborative Symposium.*

We report the results of objective one in this paper. A linked paper (Oxford consensus study, part 2) describes objectives 2 and 3.

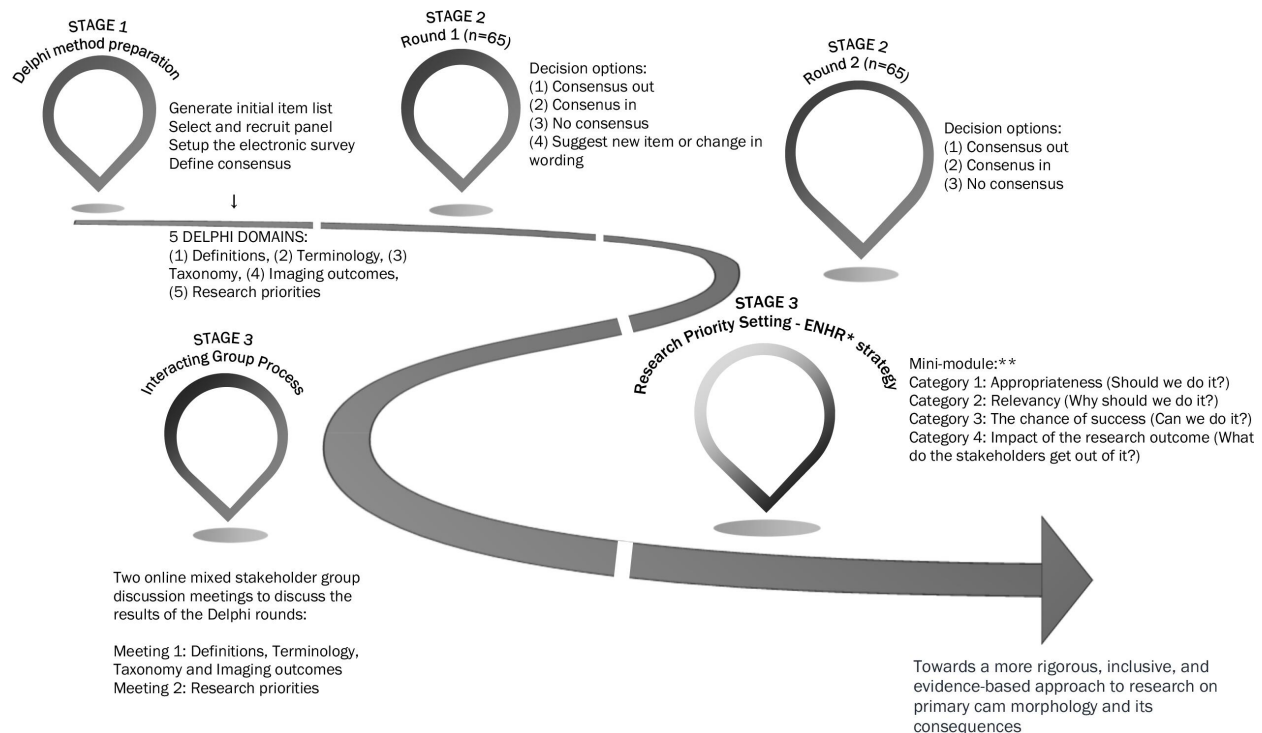
## METHODS

We held a sequential, two-round online Delphi survey and two synchronous online mixed stakeholder group meetings (Interacting Group Process) to explore the level of agreement among a panel of experts, on PCM definitions, terminology, taxonomy and imaging outcome measures for research, and to work towards agreement on a set of research priorities on conditions affecting the young person's hip.

This methods section focuses on objective 1 while the methods section in a linked paper (Oxford consensus study, part 2) describes the research priority setting methods. Online supplemental file 1 describes and elaborates on the combined Methods for Oxford consensus study, parts 1 and 2.

### Methodology

The Delphi method provides a less hierarchical and more ethical approach to conducting research, combined, in our study context, with transformative and knowledge coproduction lenses underpinned by pragmatism as the philosophical paradigm.<sup>8</sup> As a pragmatic tool, the Delphi method is flexible, favouring diversity over statistical representativeness in sampling, relatively low resource and user-friendly.<sup>8,9</sup> Given the focus on (research) transformation and knowledge coproduction, it was important to reflect on our positionality and identities (racial/ethnic, sex/gender). The Oxford Delphi consensus steering committee members, 5 women and 8 men, were English-speaking white academics (11 with PhDs); 4 were physicians, 6 allied healthcare



**Figure 1** Oxford Consensus Study methods flow chart. Stage 1: prepare for Delphi method; stage 2: Delphi method online rounds; stage 3: Interacting Group Process and ENHR strategy for research priority setting. \*Essential National Health Research; \*\*Minimodule adapted from Okello *et al.*<sup>21</sup> ENHR, Essential National Health Research.

practitioners and 3 health researchers. One resided in the Global South.

### Study design: Delphi method and research priority setting process

#### Delphi method

For this three-stage consensus study (figure 1), we modified the classical Delphi method slightly by replacing an open qualitative first round with a pre-selected list of statements based on a review of existing literature and a synthesis of the knowledge of steering group members.<sup>10–13</sup> The Delphi method assesses consensus through an iterative multistage process of controlled online questionnaires, feedback, reflection and discussion, documenting both agreements and the nature and extent of residual disagreement.<sup>14–16</sup> Multiple rounds allow panel members to work towards consensus as members are invited to amend their response in the light of the group average.<sup>17–18</sup> The Delphi method allows panel members to participate anonymously to reduce the influence of dominant individuals.<sup>19</sup> Reporting followed Conducting and REporting DELphi Studies<sup>20</sup> (online supplemental file 2). We report in a linked paper (Oxford consensus study, part 2) how the prioritised research statements were further ranked according to the Council on Health Research for Development's Essential National Health Research (ENHR) ranking method.<sup>21</sup>

### Stage 1: planning

#### Steering committee

The study steering committee included members of the YAHIR Collaborative. Avoiding the 'good old boys sat around a table' approach<sup>22</sup> the steering committee ensured a representative

Delphi panel, and a robust Delphi study process. Interpreting 'diversity' as more than representation of certain demographic groups, the steering committee ensured a diverse and informed Delphi panel, representing six multiprofession stakeholder groups, including previously minoritised groups relevant to this research field (eg, women, athletes, patients and the community, participants from the Global South). This study's online Delphi method, with a specific focus on anonymity and access to adequate topic-specific resources, supported a more equitable and inclusive process. (Online supplemental file 3: steering committee terms of reference).

#### Delphi panel

The concept of 'expert' is contested. We adapted and applied the 'closeness continuum' to purposively recruit 73 experts for this study (figure 2, table 1).<sup>23</sup> The closeness continuum represents an inclusive expert population of individuals with subjective, mandated, and objective closeness to the topic of interest.<sup>23–24</sup>

#### Patient and public involvement

We involved patient and public partners in the planning, delivery and dissemination of the Delphi study through the YAHIR Collaborative's patient and public involvement (PPI) group. The latter group was represented in the Delphi study steering committee. We supplied the PPI group with a glossary, mentored them on definition use and content (during online individual and PPI group meetings), and invited them to weigh in on each Delphi round.<sup>25</sup> A panel information pack facilitated informed assessments. Members of the PPI group co-led and actively participated in the mixed stakeholder group discussions following the Delphi rounds.



provided additional descriptive information ('Help Text') where appropriate and asked stakeholders, including the PPI group, to provide feedback on the draft Delphi survey. Stakeholders examined the survey's face validity and refined language, formatting and layout.

We created an extensive list of statements and a conceptual framework of all the potential definitions, terminology, taxonomy and research imaging outcome measures focused on PCM and its natural history. The initial list of statements was based on our concept analysis of PCM,<sup>5</sup> and informed by the early results of a qualitative study to explore stakeholder perspectives on factors contributing to high-quality research on how PCM develops, and the Lisbon Agreement on Femoroacetabular Imaging.<sup>27–29</sup> Steering committee members independently reviewed the initial statements, followed by an iterative, asynchronous online process to review, discuss, modify and approve the final statements. We

All panel members had access from the outset of the project and throughout the Delphi process, to relevant study material, including recorded presentations of the first 8 webinars of the *Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series* (online supplemental file 4: webinar series agenda). Completion of the webinars and/or reading of the consensus statements was not required.

The steering committee agreed on a consensus definition prior to the Delphi rounds (table 2).

**Table 1** Delphi panel recruitment criteria

Identification of Delphi panel and sample size	Panel members were identified through (1) expert knowledge of the steering committee and colleagues; (2) International Olympic Committee's 11 research centres for the prevention of injury and protection of athlete health; (3) International Hip Pain Research Network Consensus Group; (4) a list of authors (lead/corresponding authors) with a track record of peer-review publications in sports medicine and science, preferably in the field of cam morphology/FAI syndrome over the past 15–20 years (2000–2021). We oversampled to compensate for possible attrition at a rate of 25% per round.
Researchers	Statisticians, methodologists, librarians and sport scientists
Clinicians and clinician researchers	Clinicians who treat patients with hip-related conditions and clinician-researchers with a peer reviewed publication record in the field (cam morphology and/or FAI aetiology, prognosis, treatment), including orthopaedic surgeons, physicians (including sports medicine physicians, physical medicine and rehabilitation physician, rheumatologist, family medicine), radiologists, physical therapists
Patient and public involvement (PPI) representatives	<ul style="list-style-type: none"> <li>▶ Adult patients: a purposive sample of adults diagnosed with FAI syndrome and cam morphology or hip osteoarthritis and cam morphology or hip arthroplasty and cam morphology or any other joint condition (eg, inflammatory arthritis or osteoarthritis), or have a history of recreational or competitive high-load sports participation during adolescence or later,</li> <li>▶ Parents of young adolescents regularly participating in competitive high-load sport, irrespective of a personal history of cam morphology or FAI syndrome,</li> <li>▶ Sports coaches (defined as coaches of early adolescents regularly participating in high-load sports) or athletes (competitive, recreational or retired), irrespective of a personal history of cam morphology or FAI syndrome,</li> <li>▶ Individuals with experience in PPI, or unique perspectives on, health equity, health ethics, racial, ethnic and minority groups in sports medicine (eg, healthcare professionals involved in adolescent sports medicine screening (periodic health assessment) and patient/athlete education).</li> </ul>
Journal editors, representatives of research funding bodies and policymakers	Journal editors (eg, BJSM and JOSPT); Sports organisations/federations for example, FIFA, IOC, IAAF
BJSM, British Journal of Sports Medicine ; FAI, femoroacetabular impingement; FIFA, Fédération Internationale de Football Association; IAAF, International Association of Athletics Federations; IOC, International Olympic Committee; JOSPT, Journal of Orthopaedic & Sports Physical Therapy .	



**Table 2** Definition of consensus

Category	Definition	Action
Consensus in (high agreement)	Scored as very important (7–9) by $\geq 70\%$ of panel members <i>and</i> not important (1–3) by $< 15\%$ of panel members	Item retained for the next survey round/consensus meeting.
Consensus out (low agreement)	Scored as not important (1–3) by $\geq 70\%$ of panel members <i>and</i> very important (7–9) by $< 15\%$ of panel members	Item discarded after round 2 (to be ratified at the face-to-face consensus meeting).
No consensus	Neither criteria above are met	Item retained for the next survey round/consensus meeting.
Suggest rewording	Scored as important but must be reworded.	Provide the opportunity for panel members to suggest rewording. The study steering committee will consider retaining a reworded item for the next survey round.

## Stage 2: online Delphi rounds

### Round 1

Invited participants provided informed consent and registered for the study in one of six stakeholder groups (table 3).

Statements for the Delphi rounds were presented in order of five domains (definitions, terminology, taxonomy, imaging outcomes and research priorities).

Panel members scored each statement using a 9-point Likert scale ranging from 1 ('not important/disagree') to 9 ('critical/agree'), based on the Grading of Recommendations Assessment, Development and Evaluation scale for scoring the importance of including the item in the final list of statements.<sup>30</sup> Round 1 included a free text section allowing participants to propose new or modified statements and provide feedback. The steering committee reviewed, discussed and considered the proposed new statements or statement modifications suggested by participants in round 1, and resolved any uncertainties. All statements were kept unchanged for round 2.

### Round 2

Participants had access to the distribution of round 1 scores for each statement stratified by stakeholder group. Panel members saw their score and then rescored each statement on a scale of 1–9 (or not if they chose to defend their outlying score) based on the average scores of the group. We documented changes in scores from round to round, and panel members could provide reasons when their score boundaries changed between rounds 1 and 2 (online supplemental file 5).

**Table 3** Demographic characteristics of Delphi panel and Essential National Health Research (ENHR) ranking exercise participants

	Delphi exercise	ENHR ranking exercise (Oxford consensus study, part 2)					
	Round 1 and round 2 (n=65)	Survey 1* (n=49)	Survey 2† (n=44)	Survey 3‡ (n=42)			
Sex							
Male	39	No sex data collected for ENHR ranking exercise					
Female	26						
Stakeholder group: n=6							
Orthopaedic surgeons	11	7	4	4			
Patient and public involvement group	10	7	6	6			
Physical therapists	17	17	16	16			
Physicians	13	8	8	7			
Radiologists	6	4	4	4			
Researchers	8	6	6	5			
Country of residence							
Australia	8	No country of residence data collected					
Belgium	1						
Brazil	1						
Canada	5						
Denmark	4						
Germany	1						
Ireland	2						
Netherlands	5						
Norway	2						
Portugal	1						
Qatar	7						
South Africa	3						
Spain	1						
Sweden	1						
Switzerland	2						
Turkey	1						
UK	7						
USA	8						
*Survey 1: Statements 48–54.							
†Survey 2: Statement 55–59.							
‡Survey 3: Statements 64–69.							

The steering committee and Delphi panellists explored and discussed outlying scores, disagreement and dissent (including statements with overall consensus) during the Interacting Group Process (stage 3). Multiple rounds can cause 'group-think' among participants via pressure to comply.<sup>31</sup> We did not wish to force agreement among participants and chose to limit the Delphi process to a maximum of 3 rounds. However, two Delphi rounds resulted in high consensus and surfaced important disagreements and areas of dissent to focus on in online discussions. A third voting round was therefore not required. Following Delphi round 2, we included all statements voted 'consensus in/agree' and 'consensus out/disagree' in the final list of consensus statements.<sup>32 33</sup>

### Stage 3: online Interacting Group Process (and research priority setting exercise discussed in Oxford consensus study, part 2)

#### Interacting Group Process

Delphi panellists discussed discordant items and areas of tension and dissent during two online mixed stakeholder group meetings—the Interacting Group Processes. This process supports sharing and evaluating information,<sup>34</sup> stimulating participants to look at problems and solutions from different perspectives.<sup>34 35</sup> The first meeting discussed the results of the Delphi rounds and ratified the consensus PCM definitions, terminology, taxonomy and imaging outcome measures statements (online supplemental file 8: agenda and discussion topics). The second meeting discussed the priority research statements. To create a safe space for panellists to share their views, the steering committee facilitated discussions in small zoom breakout rooms (6–8 panellists representing different stakeholder groups); the discussions were not recorded. Group leads documented discussions in a field diary, and maintained speaker anonymity.

#### Data analysis

We entered and stored data using the DelphiManager electronic software tool and created Excel spreadsheets.<sup>26</sup> We calculated descriptive statistics for each statement and stakeholder group for example, summary scores, ranges, percentage scoring for each statement 'not important/disagree' (score 1–3), 'important but not critical/neutral' (score 4–6) and 'critical/agree' (score 7–9). Specifically, we reported, per stakeholder group, the median and IQR for each statement between each round (online supplemental file 5). This central tendency and measure of distribution served to estimate the consistency of responses between successive rounds of the Delphi survey. Stability of response is an indication of whether agreement (or continuous dissensus or disagreement) is present throughout and whether it develops between rounds.<sup>36 37</sup> The stability of group response between rounds 1 and 2 was determined using the intraclass correlation coefficient (ICC) type A, and an absolute agreement definition.<sup>38 39</sup> ICC estimates and their 95% CI were calculated using SPSS statistical package V.23 (SPSS) based on two-way mixed-effects model.<sup>40</sup> The lower bound 95% CI of the ICC estimate was used as the basis to evaluate the level of stability using the following general guideline: ICC values <0.5 (poor stability), 0.5–0.75 (moderate stability), 0.75–0.9 (good stability) and >0.9 (excellent stability).<sup>40</sup>

Table 2 represents the prior consensus definition for categorising statements in the five Delphi domains. The Delphi study steering committee retained all statements between rounds 1 and 2 to enable participants to re-score every statement after

considering feedback from round 1. Acknowledging that certain statements might be more relevant to some panel members than others, stakeholders were given the choice not to score a specific statement. We did, however, analyse the data of different stakeholder groups separately in each round.<sup>32</sup>

Dissent analysis: To explore possible dissent, we applied outlier, bipolarity and stakeholder group analysis.<sup>41 42</sup>

- Outlier analysis: We identified low outliers (data points that fall more than 1.5 times the IQR below the first quartile), and high outliers (data points that fall more than 1.5 times the IQR above the third quartile). In addition, we visually inspected histograms of round 2 stakeholder group scoring for outliers. We reanalysed consensus after eliminating outliers for all statements with marginal non-consensus to test if these had an impact on the group's consensus.
- Bipolarity analysis: Opposing groups of experts with an important and insoluble cleft of opinion, might result in non-consensus. Bimodal data distribution is therefore a possible explanation for dissent. To test for bipolarity, we investigated potential bimodal distribution (two or more answer options had the same mode frequency) and visually inspected histograms for round 2 scores of each statement.<sup>41</sup>
- Stakeholder group analysis: To compare the scores from round 2 between the six stakeholder groups, we performed Kruskal-Wallis tests. To account for multiple post hoc comparisons, we adjusted the statistical significance threshold P value to 0.0033 according to Bonferroni method. We are conscious of the limitations of 'statistical significance'<sup>43</sup>; therefore, substantial stakeholder group differences ( $p < 0.0033$ ) prompted us to further scrutinise individual and group opinions for the specific statement.

#### Qualitative analysis

The lead investigator (HPD) immersed himself in the details of participants' comments provided during Delphi rounds, Interacting Group Process and ENHR ranking exercise.<sup>44</sup> After developing a framework based on recurrent and important themes, the free text comments were grouped into categories, iteratively discussed between the lead investigator and second author (SMA). The lead authors (HPD and SMA) then undertook thematic analysis to identify, group and agree on common threads within these categories, further refining themes and subthemes.<sup>45 46</sup> We provided summarised feedback of quantitative and qualitative open responses to panel members during Webinars 10 and 11 of the *Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series*. The two webinars preceded the online synchronous mixed stakeholder group discussions.

#### RESULTS

Of the 73 experts invited to participate in this study, 65 completed rounds 1 and 2 of the Delphi exercise. The Delphi panel from 18 countries represented 6 stakeholder groups—26 were female (table 3). The Delphi panel scored 85 statements (12 definition, 19 terminology, 4 taxonomy, 12 imaging outcome and 38 research statements), and reached consensus on 43 of 85 statements in round 1, and 53 of 85 statements in round 2 (table 4 and online supplemental file 5). Online supplemental file 5 also lists the reasons for score boundary changes between rounds 1 and 2 for each statement; twelve statements did not reach stability (table 4). There were four marginally non-consensus statements after round 2 (figure 3).

**Table 4** Results of two survey rounds showing the level of agreement with primary cam morphology definition, terminology, taxonomy and imaging outcomes statements

Statements		Round 1		Round 2		ICC 95% CI		
		Not important/ disagree	Critical/agree	Not important/ disagree	Critical/agree	ICC*	Lower bound	Upper bound
<b>No</b>	<b>Definitions</b>							
1	Primary cam morphology develops during skeletal maturation as a normal physiological response to load	3.3%	80.3%	1.6%	85.9%	0.69	0.53	0.80
2	Primary cam morphology is not caused by previous disease, injury or an acute event; it represents a normal physiological response of the maturing skeleton to load	3.3%	72.1%	1.6%	81.3%	0.79	0.68	0.87
3	Secondary cam morphology develops due to existing hip disease or acute trauma, including Perthes disease, slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture	0%	73.8%	1.6%	81.0%	0.54	0.34	0.70
4	Primary cam morphology develops in young and active individuals, including athletes, likely due to load (eg, sporting activity) during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	0%	87.1%	0%	96.9%	0.69	0.53	0.80
5	Primary cam morphology is common in young and active males, including athletes, likely due to sporting activity during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	4.9%	73.8%	0%	79.4%	0.80	0.68	0.88
6	Primary cam morphology includes cam morphology of unknown origin	8.8%	49.1%	9.5%	52.4%	0.52	0.30	0.69
7	Cam morphology that develops in young and active individuals without any symptoms (eg, hip-related pain, stiffness) or history of previous/existing hip disease, is primary cam morphology until proven otherwise	3.4%	55.9%	4.7%	53.1%	0.83	0.73	0.90
8	Cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical	1.6%	90.5%	1.5%	92.3%	0.47	0.26	0.64
9	Primary cam morphology often occurs in male athletes in both hips	5.1%	50.8%	3.2%	45.2%	0.89	0.83	0.94
10	The most common outcome measure for cam morphology is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, CT scans or MRI, reported per hip, per person or both	0%	72.6%	0%	74.6%	0.72	0.58	0.82
11	Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors	1.6%	82.3%	0%	93.8%	0.60	0.41	0.74
12	A comprehensive definition for primary cam morphology would be: Primary cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical. It often occurs in male athletes in both hips. The most common outcome measure is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, CT scans or MRI, reported per hip, per person or both. Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors.	0%	93.7%	1.6%	96.9%	0.44	0.21	0.62
<b>Terminology</b>								
13	Cam morphology is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	1.6%	87.5%	1.5%	87.7%	0.56	0.36	0.71
14	Cam lesion is the preferred term to use for a bone/ cartilage bump at any location around the femoral head-neck junction	75.8%	6.5%	83.1%	4.6%	0.84	0.69	0.91
15	Cam deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	71.0%	12.9%	81.5%	7.7%	0.67	0.50	0.79
16	Cam abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	80.6%	4.8%	86.2%	4.6%	0.70	0.54	0.81
17	Cam-type deformity is the preferred term to use for a bone/ cartilage bump at any location around the femoral head-neck junction	79.0%	3.2%	84.6%	4.6%	0.8	0.69	0.87
18	Cam-type abnormality is the preferred term to use for a bone/ cartilage bump at any location around the femoral head-neck junction	79.0%	6.5%	87.7%	3.1%	0.64	0.45	0.77

Continued

Table 4 Continued

Statements		Round 1		Round 2		ICC 95% CI		
		Not important/ disagree	Critical/agree	Not important/ disagree	Critical/agree	ICC*	Lower bound	Upper bound
19	Cam-type lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	77.4%	3.2%	89.2%	1.5%	0.69	0.48	0.82
20	Pistol grip deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	85.2%	1.6%	92.2%	0.0%	0.64	0.40	0.78
21	Pistol grip lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	85.2%	3.3%	92.2%	1.6%	0.59	0.37	0.74
22	Pistol grip abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	85.2%	4.9%	92.2%	1.6%	0.44	0.22	0.63
23	Cam-type impingement is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	56.5%	16.1%	56.3%	10.9%	0.78	0.65	0.86
24	Cam femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	53.2%	27.4%	51.6%	20.3%	0.83	0.74	0.90
25	Cam-type FAI is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	59.7%	19.4%	51.6%	20.3%	0.82	0.72	0.89
26	FAI Syndrome with cam morphology is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	7.9%	69.8%	7.8%	75.0%	0.65	0.47	0.77
27	FAI Syndrome with cam deformity is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	71.0%	6.5%	81.5%	4.6%	0.81	0.66	0.89
28	FAI Syndrome with cam abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	74.2%	4.8%	81.5%	4.6%	0.82	0.70	0.89
29	FAI Syndrome with cam lesion is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	71.0%	4.8%	83.1%	4.6%	0.72	0.52	0.84
30	FAI Syndrome with cam-type abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	74.2%	6.5%	84.6%	1.5%	0.72	0.55	.83
31	FAI Syndrome with cam-type deformity is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	69.4%	9.7%	81.5%	4.6%	0.75	0.56	0.85
<b>Taxonomy</b>								
32	We should distinguish between primary and secondary cam morphology in clinical practice	6.5%	74.2%	6.2%	83.1%	0.87	0.79	0.92
33	We should distinguish between primary and secondary cam morphology in research	4.6%	90.8%	4.6%	92.3%	0.71	0.57	.815
34	We should distinguish between primary and secondary cam morphology in patients with FAI syndrome	6.5%	66.1%	4.7%	68.8%	0.82	0.72	0.89
35	We should distinguish between primary and secondary cam morphology in research participants with FAI syndrome	4.7%	84.4%	4.6%	90.8%	0.69	0.53	0.80
<b>Imaging outcomes</b>								
36	The main imaging modality for research on how primary cam morphology develops should be MR with radial imaging (1.5T or 3T)	1.9%	75.9%	1.8%	89.3%	0.81	0.59	0.90
37	The minimum acceptable number of radial sequence MRI slices for research on how primary cam morphology develops should be 12 slices (30° intervals in all 12 clock face positions from 12 o'clock to 11 o'clock positions)	0%	60.0%	0%	81.6%	0.7	0.49	0.83
38	Referring to precisely quantifying the asphericity of the femoral head-neck junction on radial sequence MRI: use either radial sequences along the axis of the femoral neck (providing higher resolution images) or radial reconstructions from 3-dimensional acquisitions	0%	75.0%	0%	87.0%	0.84	0.70	0.92
39	The MRI protocol for research on how primary cam morphology develops should include: (1) unilateral small field-of-view sequences and radial images of a randomly selected or both hips; as well as (2) femoral torsion assessment (fast axial sequences of the distal knee—femoral condyles—and proximal femoral neck); and (3) a fluid sensitive sequence covering the whole pelvis (in axial or coronal planes; to screen for soft-tissue and bone marrow oedema beyond the hip)	5.9%	64.7%	0%	78.4%	0.71	0.47	0.85

Continued



Table 4 Continued

Statements	Round 1		Round 2		ICC 95% CI		
	Not important/ disagree	Critical/agree	Not important/ disagree	Critical/agree	ICC*	Lower bound	Upper bound
40 The MRI for prospective research on how primary cam morphology develops should be repeated every 18 to 24 months	11.3%	56.6%	7.3%	56.4%	0.86	0.78	0.92
41 In primary cam morphology epidemiological research (eg, when regression is being used in aetiology or prognosis research) continuous imaging outcome measures (variables) like the alpha angle should be kept continuous	3.6%	72.7%	0%	89.3%	0.77	0.58	0.87
42 The cam morphology MRI outcome measure for research on how primary cam morphology develops (aetiology) should be the alpha angle for bone and cartilage as a continuous variable reported for all the o'clock locations around the femoral head-neck junction regardless of the symptomatic state of the research participant.	5.4%	66.1%	0%	80.7%	0.81	0.68	0.89
43 For research on how primary cam morphology develops it is important to quantify the epiphysal morphology MRI outcome measure using epiphysal extension	4.8%	57.1%	0%	65.9%	0.83	0.68	0.91
44 For research on how primary cam morphology develops the epiphysal morphology MRI outcome measure should also be quantified using epiphysal tilt	5.1%	43.6%	0%	44.2%	0.81	0.67	0.90
45 The main imaging modality for longitudinal primary cam morphology prognosis research should be anteroposterior (AP) pelvis and Dunn 45° view radiographs repeated at least every 5 years	20.4%	44.9%	15.4%	42.3%	0.91	0.84	0.95
46 The radiographic imaging outcome measure for research on primary cam morphology prognosis should be the alpha angle as a continuous variable reported for AP pelvis and Dunn 45° view radiographs	15.7%	56.9%	11.3%	67.9%	0.90	0.83	0.94
47 In addition to reporting alpha angles as continuous in studies on aetiology or prognosis the following quantitative and qualitative imaging outcome measures to categorise cam morphology can be useful in research or clinical practice: (1) Alpha angle $\geq 60^\circ$ (preferred) (2) Head-neck offset $< 8$ mm and head-neck offset ratio $\leq 0.15$ usually at the anterior (3 o'clock) location around the femoral head-neck junction (in addition to (1)); Osseous or cartilage convexity of the femoral head neck junction at any location (in addition to (1) and (2))	2.1%	52.1%	0%	72.5%	0.81	0.68	0.89

**Green** (high agreement on 'consensus in'): Statement scored as critical (7–9) by  $\geq 70\%$  of panel members and not important (1–3) by  $< 15\%$  of panel members.

**Red** (high agreement on 'consensus out'): Scored as not important (1–3) by  $\geq 70\%$  of panel members and critical (7–9) by  $< 15\%$  of panel members.

**Yellow** (non-consensus): Neither of the 'consensus in' or 'consensus out' criteria were met.

ICC is an indication of the level of agreement (within-subject variation and between-subject variance of individual statement scores between round 1 and round 2.) We used the lower bound 95% CI of the ICC estimate as the basis to evaluate the level of reliability using the following general guideline: values  $< 0.5$  were classified as poor reliability ICC values  $0.5-0.75$  moderate reliability and  $0.75-0.9$  indicated good reliability and ICC values  $> 0.9$  indicated excellent reliability.

\*Type A ICC coefficients using an absolute agreement definition; two-way mixed effects model where people effects are random and measures effects are fixed.

ICC, intraclass correlation coefficient.

Here, we report the quantitative results, analysis of qualitative feedback and dissent analysis of the Delphi rounds for definition, terminology, taxonomy and imaging outcomes statements. An online Interacting Group Process followed the Delphi exercise; six mixed stakeholder groups of 5–8 panellists ( $n=43$ ), discussed the Delphi exercise results on 22 September 2021. We summarise the discussions in [boxes 1–4](#) and online supplemental file 8.

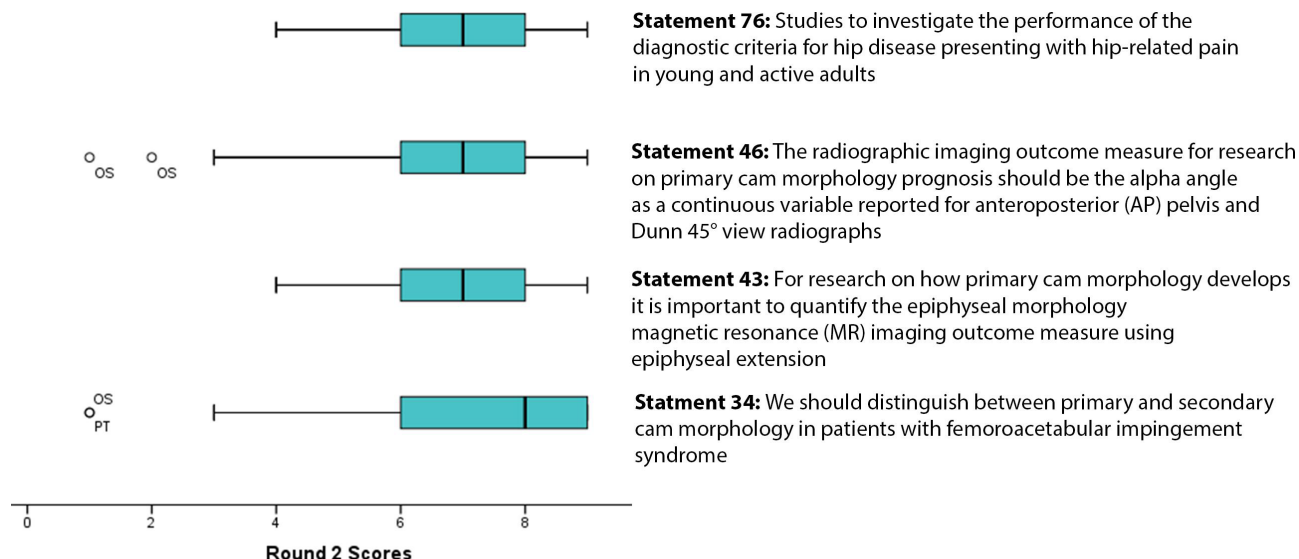
### Definitions: Delphi domain 1

The Delphi panel reached consensus on 9 of 12 definition statements in rounds 1 and 2 ([table 4](#); online supplemental file 5). The panel agreed on a comprehensive definition for PCM, based on its five proposed conceptual attributes ([figure 4](#); statements 1, 2, 4, 5, 8, 10–12). The panel also agreed that secondary cam morphology develops due to existing and/or pre-existing hip disease (statement 3).

Qualitative analysis identified 12 themes (online supplemental files 5 and 6). The first four themes illuminated tension and dissent related to three non-consensus definition statements (statements 6, 7 and 9).

First, some Delphi panel members commented that PCM's origin is not 'entirely "unknown" [but] likely due to variable loading demands' (statement 6). However, 'at an individual level not all PCM has [a] clear cause.' Second, the Delphi panel did not agree that 'all cam morphology in young and active adults without any symptoms or history of previous hip disease is PCM until proven otherwise' (statement 7). Some found the 'concept of primary and secondary cam morphology' challenging. Third, the statement 'PCM is more common in male athletes in both hips' (statement 9) created the impression that this morphology was a 'male-only problem' while the reality is 'females [are] often left out of research.' Last, while the Delphi panel agreed that PCM usually occurs bilaterally, representing 'a defining element for primary vs secondary cam morphology and important for patients', some athletes might have unilateral PCM.

Dissent analysis (online supplemental file 7). Outlier analysis: Although outliers were identified for ten of twelve definition statements in round 2, they did not influence group consensus or non-consensus. None of the outliers provided qualitative comments. One physical therapist 'did not agree that the concept of primary and secondary CAM is commonly agreed



**Figure 3** Marginally non-consensus statements 34, 43 and 46 (and statement 76 relevant to Delphi exercise domain 5; Oxford consensus study, part 2). Recalculating consensus after removing the four outliers for statements 34 and 46 resulted in consensus. OS, orthopaedic surgeon; PT, physical therapist.

and established', choosing 'Unable to score' for most of the definition statements in rounds 1 and 2. Bipolarity analysis: There was no bimodal distribution in the overall scoring of definition statements. Stakeholder group analysis: There was no significant difference in how stakeholder groups scored definition statements in rounds 1 and 2.

### Terminology: Delphi domain 2

The Delphi panel reached consensus on 14 of 19 terminology statements in round 1 and 16 in round 2—consensus on two statements to include ('consensus in/agree'), and consensus on 14 statements to exclude ('consensus out/disagree') certain terms. The panel agreed that 'cam morphology' is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction (statement 13), and 'FAI syndrome with cam morphology' (statement 26) for hip-related pain due to a bony bump at any location around the femoral head-neck junction. The Delphi panel agreed to avoid ('consensus out') terms 'lesion', 'deformity' and 'abnormality' (statements 14–22 and 27–31).

Three statements related to the terms proposed for hip-related pain due to a bony bump at any location around the femoral head-neck junction, did not reach consensus: 'cam-type impingement' (statement 23), 'cam FAI' (statement 24) and 'cam-type FAI' (statement 25).

Qualitative analysis identified four themes (online supplemental files 5 and 6). First, warning that 'abnormality is not a very optimistic term', panellists preferred the term 'morphology': 'We've agreed it is a "normal physiological response" and therefore shouldn't be called a lesion/ deformity with their connotations of abnormality.' Second, a panellist suggested replacing 'bump' with 'prominence' as 'not every cam morphology has a "bump". It might only be decreased offset and that certainly does not constitute a "bump".' Third, although 'FAI syndrome' is the agreed term for hip-related pain due to a bony bump at any location around the femoral head-neck junction, one panellist warned that other causes for hip-related pain exist, and '(FAI syndrome) is one type of pathology' in the hip. Last, one

panellist disagreed with the term 'any location', as 'an inferior bony bump may not lead to FAI.'

Dissent analysis (online supplemental file 7). Outlier analysis: Outliers (present in 16 of the 19 terminology statements) in round 2, did not influence group consensus or non-consensus. The orthopaedic surgeon outlier for statements 13 and 26 did not agree that PCM refers to a bump 'at any location' around the femoral head-neck junction. One physician chose 'unable to score' for most of the terminology statements in round 1 as they misinterpreted the statement wording. Feedback after round 1 clarified the misunderstanding. Bipolarity analysis: There was no bimodal distribution in the overall scoring of terminology statements. Stakeholder group analysis: The average terminology statement scores were significantly different for the physical therapist stakeholder group compared with the researcher stakeholder group (statement 23, round 1; statement 24, rounds 1 and 2), and for the radiologist stakeholder group compared with the researcher stakeholder group (statement 24, round 2).

### Taxonomy: Delphi domain 3

The Delphi panel reached consensus in rounds 1 and 2 on three of four statements in the taxonomy domain. There is consensus that we should distinguish between primary and secondary cam morphology in clinical practice and in research (statements 32 and 33), and in research participants with FAI syndrome (statement 35). However, there was marginal non-consensus on the importance of distinguishing between primary and secondary cam morphology in patients (clinical practice) with FAI syndrome (statement 34).

Qualitative analysis of individual panellist feedback identified six themes (online supplemental files 5 and 6). First, although not agreed as critical by the panel, distinguishing between primary and secondary cam morphology in patients with FAI syndrome (statement 34) is important as 'secondary CAM morphology has a poorer prognosis and therefore should be distinguished to improve treatment planning.' Second, the taxonomy is important for diagnosis. Third, the taxonomy is important for treatment. Fourth, the taxonomy is important for

**Box 1 Interacting Group Process: mixed stakeholder group discussion summary—definition domain**

Mixed stakeholder groups agreed on the importance of primary cam morphology (PCM) as a concept. This taxonomy, differentiating between primary and secondary cam morphology (SCM), offers several advantages that offset its drawbacks—'their origins are important to distinguish', and 'it has utility in research, prognosis and treatment.' In research the taxonomy is 'important for classification', while the prognosis is often worse for SCM. Treatment maybe distinctly different as most individuals with PCM will never present with any symptoms. The panel contended more work is needed to authentically engage a small group that is not yet convinced that PCM is an important concept.

Although there is agreement, albeit 'based on the (limited) available literature', that PCM is more common in males and mostly asymptomatic, female athletes also develop this morphology and 'longer-term consequences of PCM seem to affect women as much as men.' More inclusive research is needed involving minoritised female cohorts.

Although there is agreement that PCM, unlike SCM, often occurs bilaterally, and this distinction 'is the defining element for PCM versus SCM, and important for patients', this is not always the case. Some patients might have unilateral PCM while others might present with a combination of primary and SCM.

The mixed stakeholder groups agreed that PCM also include the group where no clear aetiology 'at an individual level' exists. It is likely that a 'complex relationship' between PCM and 'a genetic susceptibility' exists. Genetics as risk factor, and 'the interplay between genetic risk and load relationship' should therefore be considered and researched.

Despite strong consensus that PCM develops during skeletal maturation 'as a normal physiological response to load' (statement 1) further qualified as 'high-load sporting activity' (statement 11), some panellists, during the online discussions, felt 'normal' is 'potentially problematic.' However, the high prevalence of PCM in largely asymptomatic professional athletes—'several studies showed >80% prevalence'—begs the question: 'when does it [physiological response] become abnormal? ...when it's very painful?' Furthermore, high-load sporting activity for one athlete might be normal-load sporting activity for another; load type ('torsion, varus/valgus') and skeletal maturation status are both important variables to consider in clinical practice and research.

prognosis. Fifth, distinguishing between primary and secondary cam morphology is age dependent and perhaps 'less relevant if someone is 30 years old.' Last, panellists commented on the challenge 'where a patient has a mix of both' primary and secondary cam morphology.

Dissent analysis (online supplemental file 7). Outlier analysis: Although strong consensus was achieved for statements 32, 33 and 35, few outliers (mainly orthopaedic surgeons and a physical therapist) were not convinced. After removing two outliers for statement 34, the Delphi panel reached consensus on the importance of distinguishing between primary and secondary cam morphology in patients with FAI syndrome (figure 3 and online supplemental files 5 and 7). Bipolarity analysis: There was no bimodal distribution in the overall scoring of taxonomy statements. Stakeholder group analysis: The average scores for taxonomy statement 32 were significantly different for PPI

**Box 2 Interacting Group Process: mixed stakeholder group discussion summary—terminology domain**

The Delphi panel achieved strong consensus on using the term 'morphology' and to abandon 'lesion', 'deformity' and 'abnormality': 'large foreign words set the tone for fear, unknown, not in control, especially about [the] outcome.' Although the majority agreed, some felt that 'language didn't necessarily change things for patients', and that the consequences ('the pathology part') of primary cam morphology 'is the bigger problem and needs to be part of the file, but the patient doesn't necessarily need to know about this [wording].' Others thought that 'morphology should be avoided in patient consultations as it's unfriendly, not well understood and likely medical "jargon".' A further problem is that 'morphology' doesn't always translate well into other languages.

Although 'bump' is easy for patients to understand and visualise ('I use "bump" to make it easy for patients'), some felt primary cam morphology is 'likely more complex than "bump".' 'Morphology and syndrome sound more scientific. Bump totally not.' Another group warned about the possible 'nociceptive response in patients' caused by associating the term 'bump' with 'bumping bones', or of 'things hitting.' 'Therefore we may need to take care with using this term [bump] too.' One mixed stakeholder group concluded that the 'language we use in patient-facing consultations should be tailored to the person' and mentioned alternatives like 'bumpy-shape' and 'egg-shape.' There was agreement to use 'less threatening' language supported by visual aids 'images/figures.' While it might be appropriate to 'tailor terms to three different target audiences: researchers, clinicians and patients and public', stakeholder groups suggested that patient and public involvement group should inform further research on this.

Validating the Warwick Agreement, the Delphi panel achieved strong consensus on using the 'much preferred scientifically' term, 'femoroacetabular impingement (FAI) Syndrome' for FAI in patients with symptoms (pain/stiffness etc). However, some felt that 'syndrome' sounds 'too serious.' Arguing that 'words matter' panellists discussed the importance to 'tailor language to the individual', and distinguish between a 'research discussion vs talking with patients.' Commenting on the 2016 Warwick Agreement, a member of that panel mentioned 'we considered whether "syndrome" might apply a negative label to patients, but the expert patient member of the panel did not feel this would be the case, but could be good to bounce this off more patients too.' We therefore need 'further patient-orientated research to assess whether it [syndrome] has negative consequences and whether FAI used in isolation may be a better term when communicating with patients.'

group compared with the: (1) orthopaedic surgeon stakeholder group (round 2); (2) physical therapist stakeholder group (rounds 1 and 2); (3) radiologist stakeholder group (rounds 1 and 2) and (4) researcher stakeholder group (round 2). PPI stakeholder group compared with the physical therapist stakeholder group scored statement 34 significantly different (rounds 1 and 2).

**Imaging outcomes: Delphi domain 4**

The Delphi panel reached consensus on 3 of 12 imaging outcomes statements in round 1 and 7 of 12 in round 2. Radial sequence 1.5 T or 3 T MRI should be used for research on how

## Consensus statement

## Box 3 Interacting Group Process: mixed stakeholder group discussion summary—taxonomy domain

The general agreement was that it is important (and not necessarily difficult) to distinguish between primary and secondary cam morphology in clinical practice and in research: 'Where we can, we should make the differential diagnosis as it affects the prognosis and therefore the management of the problem.' A librarian panellist emphasised the benefit of 'consistent terminology' when reviewing the literature: 'using primary versus secondary allowed searching the literature more clear.' Although most panellists felt that 'history is key' to distinguish between primary and secondary cam morphology, others felt that 'obtaining a detailed history and discussion with patient is more important than a label of primary and secondary.'

It can be clinically challenging when a combination of primary and secondary cam morphology exists in the same patient as 'there are some cases where primary cam morphology exists prior to a secondary injury (eg, SCFE), and these cases can be a little more difficult to diagnose but are less commonly observed.'

SCFE, Slipped capital femoral epiphysis

PCM develops (statements 36–38), with continuous bone and/or cartilage alpha angles as the agreed outcome measure reported for all the o'clock locations around the femoral head-neck junction regardless of the symptomatic state of the research participant (statements 41 and 42). MRI protocols for research on how PCM develops should include: (1) unilateral small field-of-view sequences and radial images of a randomly selected or both hips, as well as (2) femoral torsion assessment (fast axial sequences of the distal knee—femoral condyles—and proximal femoral neck), and (3) a fluid sensitive sequence covering the whole pelvis (in axial or coronal planes to screen for soft-tissue and bone marrow oedema beyond the hip) (statement 39).

In addition to reporting alpha angles as continuous in studies on aetiology or prognosis, other quantitative and qualitative imaging outcome measures to categorise cam morphology can be useful in research or clinical practice (statement 47).

The Delphi panel did not reach consensus on five imaging outcomes statements. First, panellists did not agree that 'every 18–24 months' is the preferred time interval for serial MRI in prospective research on how PCM develops. Some commented 'it really depends on the research question', while others suggested it should be 'more often', acknowledging that 'it will be difficult but if there is a critical window that we want to identify, 2-year intervals would not be frequent enough' (statement 40). Second, although it is 'probably critical', panellists felt 'insufficient data' exist to support using epiphysal extension or epiphysal tilt to quantify epiphysal morphology on MRI (statements 43 and 44). Third, questioning the evidence for a 5-year imaging interval, panellists did not agree on the main imaging modality for longitudinal PCM prognosis research nor how often to repeat the imaging. While some suggested frog-leg lateral or Dunn view radiographs, and others 'any lateral head-neck view depending on the particular centre', a few panellists preferred MRI with all clock positions (statement 45). Last, the panel failed to agree that, for prognosis studies, radiographs (anteroposterior, AP pelvis and Dunn 45° views) should be used to calculate the alpha angle. Some preferred MRI with all clock positions and others felt AP pelvis alpha angles are 'too imprecise.' Panellists reminded that, to date, 'there is no consensus on optimum threshold for dichotomising this [alpha angle] variable.'

## Box 4 Interacting Group Process: mixed stakeholder group discussion summary—imaging outcomes domain

Commenting on the 'obvious ethical consideration for the amount or frequency of imaging', a radiologist in one of the mixed stakeholder groups felt 'the more the better in terms of insight', and raised the possible benefit of radial vs block imaging—'block images may allow you to evaluate the images later through the use of novel techniques such as artificial intelligence.' While one group felt that yearly MRI is appropriate when investigating how primary cam morphology develops in boys (from 11 to 16 years) and girls (from 9 to 14 years), another commented that 'the time interval should be much shorter if it is to be truly "ideal" (eg, every 3 months). This would capture periods of considerably faster growth or considerable changes in load', while 'more frequent imaging will help in periods of rapid growth but it is also important to have frequent serial imaging even in periods without rapid growth to assess the influence of growth spurts.' However, the value of serial imaging was questioned, as, for example, 'positions [of primary cam morphology] might vary making it impossible to use them to track changes over time.' One group warned that the use of serial radiographs to investigate primary cam morphology aetiology constitutes research waste: 'if you can't do serial MRIs at short enough intervals, don't waste time and money; don't do the study.'

Discussing long-term prognosis studies, groups agreed MRI trumps radiography and 'should be the investigation of choice where at all possible in adolescent populations.' The quality of imaging is better, it better quantifies cartilaginous progression in adolescents where 'the use of alpha-angle on X-ray can be misleading and therefore inaccurate', and, as it does not pose a (cumulative) radiation risk 'ethics committees are more likely to accept MRI based studies.' However, there are at least three issues with MRI: cost, availability (equipment and expert radiologists), and the burden of procedure (time, claustrophobia, etc). MRI is challenging in young adolescents 'due to difficulty remaining still, that is, movement artefact.'

The group agreed that further work is needed to develop and refine consensus on the specific and standardised imaging protocol: 'If X-rays are used then it has to be reinforced on the views that are valuable and this message should be repeated in order to support this becoming routine practice; not all facilities are skilled with specific radiograph images for example, Dunn.'

It is further important to consider dissemination of findings: 'Do athletes want to know the results? How, what, and when do we communicate imaging results to participants or parents? Do we consider positive/negative response by athletes/parents, and provide them with the 'opt in' opportunity not to be informed of their individual imaging results?' Group members raised four important points from the athlete/parent's perspective. First, parents 'were not comfortable' with cumulative radiation exposure associated with serial radiographs. Radiation exposure is an 'ethical dilemma in this area' with 'a need to be up front and transparent with information so parents are aware.' Second, sharing of imaging results is a 'hugely important area' and research teams should carefully consider the possibility that 'parents may pick up the information or interpret it differently than healthcare practitioners.' Third, research teams should consider 'an "opt-in" option for participants and parents where, except if there is an issue with an imaging finding, they will not be informed of the results.' Last, research teams should carefully

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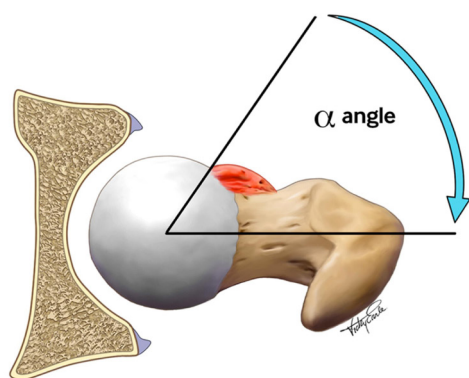
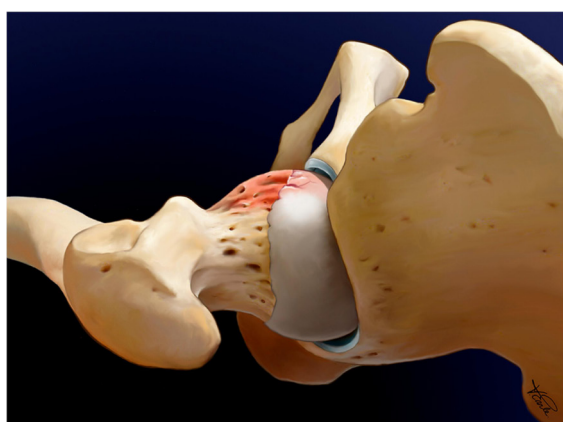


## Box 4 Continued

consider how they communicate periodic imaging results and suggested a 'common approach to dissemination of results/imaging is needed.'

It makes comparing across studies very difficult when different thresholds are used.' Despite this, a diagnostic threshold might be important for clinicians (statement 46).

In addition to the above, qualitative analysis of individual panellist feedback identified nine more themes (online supplemental files 5 and 6): (1) the 'huge cost aspect' of MRI is an important consideration, especially for minoritised and marginalised research populations; (2) disagreement on PCM as a concept; (3) the importance of qualifying 'type of radial MRI'; (4) 'fluid sensitive pelvis images' are unnecessary when studying



**Figure 4** Primary cam morphology definition. Primary cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction of the hip, which changes the shape of the femoral head from spherical to aspherical. It occurs most often in asymptomatic male athletes in both hips. The preferred outcome measure for research on primary cam morphology aetiology is a cartilage or bone alpha angle as a continuous variable on radial MRI along the axis of the femoral neck, using 30° intervals from 12 o'clock to 11 o'clock positions, reported per hip, per person or both. In addition to a continuous alpha angle, a dichotomous alpha angle (using a threshold of  $\geq 60^\circ$ ) can be useful in clinical practice or research. Primary cam morphology develops during skeletal maturation in young adolescents (with no current or previous hip disease), as a normal physiological response to high-load sporting activity and other unconfirmed risk factors. Illustrations from Dijkstra et al. (2021)<sup>5</sup>

PCM development because 'the rationale for this is to find pathological processes elsewhere'; (5) research question will determine the preferred imaging; (6) confusion created by alternative PCM imaging outcome measures; (7) importance of standardising imaging across research; (8) concern about radiation exposure of serial radiographs. While radiographs are 'cheap' with 'little time costs', the concerns are 'radiation and less detail'; (9) lack of knowledge to score imaging statements.

Dissent analysis (online supplemental file 7). Outlier analysis: Six of 12 imaging outcomes statements (statements 36, 39, 42, 44, 45 and 46) had outliers. After eliminating the two orthopaedic surgeon outliers for marginally non-consensus statement 46, the Delphi panel reached consensus that alpha angle as a continuous variable, reported for AP pelvis and Dunn 45° view radiographs, should be the radiographic imaging outcome measure for research on PCM prognosis (figure 3). Bipolarity analysis: There was no bimodal distribution in the overall scoring of imaging outcomes statements. Stakeholder group analysis: There was no statistically significant difference in how stakeholder groups scored the imaging outcomes statements in rounds 1 and 2.

## DISCUSSION

An international Delphi panel of expert clinicians, athletes, patients and their representatives, and researchers—representing the YAHIR collaborative—agreed on four key PCM elements (definition, terminology, taxonomy and imaging outcome measures). In what follows, we discuss the Delphi panel's opinions on these key elements and summarise how agreement and areas of tension and dissent inform a more rigorous, inclusive and evidence-based approach to research on PCM and its natural history.

### Definitions: Delphi domain 1

The Delphi panel agreed on a comprehensive conceptual and operational definition for PCM (figure 4).

The conceptual definition equips all stakeholders, especially athletes and patients, with meaningful language to describe an abstract concept in their hip. It is a bony or cartilage prominence (or 'bump'), with shape (aspherical), size (most are small; some are large), location (anywhere around the head-neck junction of the hip but predominantly antero-lateral) and ownership (it is more prevalent in male athletes compared with females and non-athletes, and more common in both hips).<sup>5</sup> Ownership also implies 'lived with'—opening the door for conversations and qualitative research with athletes and patients on their experiences.

While celebrating consensus, tension and dissent spotlighted three areas for future research. First, although this morphology is more prevalent in male versus female athletes, very little research involves female athletes, and no research has been done in para-athlete cohorts—researchers must cast a much broader net to involve minoritised and marginalised groups. Second, although the vast majority of athletes with PCM will never develop symptoms or hip disease, some do. Yet, we cannot predict with confidence who these athletes are. While important to investigate the morphology's prognosis, we should take care not to medicalise a common, mostly benign morphology. The key messages are: (1) this largely benign morphology develops as a 'normal physiological response' to 'high-load' physical activity, and (2) childhood physical activity and sport are important. Third, we should investigate the tension between 'normal and abnormal' as it

relates to the capital femoral growth plate's physiological response to load. Bone is a dynamic tissue; how mechanical loading influences the epiphyseal growth plate is physiologically complex depending, for example, on the load type, and physical and physiological maturity. What might be a normal load for one athlete is abnormal or high-load for another.

### Terminology: Delphi domain 2

Confirming the Warwick Agreement's recommendations,<sup>7</sup> this much larger, more inclusive and diverse panel agreed that PCM is a 'morphology' and not a 'lesion', 'abnormality' or 'deformity'; in athlete-patients presenting with symptoms the agreed term is 'FAI syndrome.' However, while these are acceptable scientific terms, 'morphology' and 'syndrome' do not resonate with everyone. These terms are not necessarily patient-friendly and 'morphology' does not translate well into at least some other languages (of expert panel members). With patient and public partners, more work is needed to further refine preferred patient-friendly terms.

### Taxonomy: Delphi domain 3

PCM, in contrast with secondary cam morphology, is a predominantly benign hip morphology that develops during maturation in many athletes. The Delphi panel agreed with this cam morphology taxonomy.<sup>5</sup> Distinguishing between primary and secondary cam morphology offers advantages. First, a cam morphology taxonomy provides clarity and consistent terminology with utility in research; researchers describe their populations better with more specific inclusion and exclusion criteria. Second, primary and secondary cam morphology have distinctly different aetiology and prognosis. Contrary to secondary cam morphology, PCM develops during maturation due to load and is largely benign—an important distinction that empowers athletes and patients to embrace normality and their 'happy hips'. Third, the clinical approach to an athlete with FAI syndrome and PCM is different to a patient with FAI syndrome and secondary cam morphology. The general agreement was that 'it is not difficult to distinguish between primary and secondary cam morphology.' However, some patients might have both types while in others, a clear distinction might only be possible later in the disease process.

### Imaging outcomes: Delphi domain 4

Acknowledging that operationalising PCM remains challenging, the panel agreed to report a continuous alpha angle—the primary imaging outcome variable for aetiology and prognosis research (figure 4). In agreement with a recent systematic review,<sup>47</sup> and the Lisbon Agreement,<sup>27–29</sup> and mainly for clinical research, a 60° alpha angle cut-off value can be used to classify PCM. However, alpha angle should be reported as a specific number (continuous variable).

Although the panel agreed that serial MRI (radial imaging) is needed in studies to investigate how PCM develops during maturation, opinions on how often this should be done varied. Some experts suggested MRI every 3 months during the growth spurt, while others opined that every 6–24 months would suffice. MRI, however, is expensive and access to it limited. Not everyone agreed to use AP pelvis and lateral radiographs in long term prognosis studies of PCM or FAI syndrome; however, anything but radiographs will exclude the vast majority of minoritised populations with limited access to expensive three-dimensional imaging (MRI or CT scans) and expert radiologists.

Imaging findings could confuse and worry patients. Researchers should therefore consider how potentially sensitive imaging findings are communicated to athletes, patients and other stakeholders (eg, parents, coaches, club managers). A discussion paper on athlete data in professional sport by the Australian Academy of Sport describes some of the important aspects.<sup>48</sup>

### How this consensus informs research on PCM and its natural history

Having standard PCM conceptual and operational definitions, taxonomy and terminology, empowers researchers, including patient and public partners, to do more rigorous research—research that is more credible, consistent, replicable, and valid, and of a higher quality.<sup>49–51</sup> Although the panel reached strong consensus on key elements, this consensus study illuminates challenges relevant to the minoritised, including athletes and patients. It invites authentic collaboration on a level playing field, setting the scene for a more inclusive approach to clinical decision-making and research.

Inclusive PCM research should address issues that matter to patients and improve their lives, 'access and represent' the patient's views and experiences, and treat them with respect.<sup>52</sup> To date, research on PCM and its natural history, continue to minoritise important patient-athlete populations—women, children and parents, para-athletes, and athletes from the Global South. Patient partners are to a large extent absent from the research process. While emphasising the importance of meaningful inclusion of patients, giving them an active voice in research, Frankena *et al* emphasised partnerships that value each other's skills.<sup>53</sup> This consensus study served the inclusive agreement-seeking agenda well—not only did the pragmatic online approach limit travel, it also invited the minoritised and marginalised into the room. PPI colleagues voiced their opinions on improving conceptual and operational elements of the morphology's definition, using more patient-friendly terminology, and applying a taxonomy that reflects their needs. This inclusive partnership strengthens evidence-based research.

Evidence-based research uses 'prior research in a systematic and transparent way to inform a new study so that it is answering questions that matter in a valid, efficient and accessible manner', minimising clinical health research that is unnecessary, irrelevant, unscientific, wasteful and unethical.<sup>54–56</sup> While this consensus on the key elements of PCM will help researchers to produce research that is more 'searchable' in a systematic and transparent way, it is also a catalyst for a fresh look at evidence—a strong foundation for higher research value and less research waste.

### Strengths and limitations

External validity of the Delphi method is often contested. Delphi panel judgements might differ from another equally diverse expert panel. However, many authors have argued that the Delphi method provides evidence of content and face validity—group opinion is more valid than that of a single person, and 'real-world' expertise provides confirmative judgement(s) on the subject/phenomenon/concept. Although we applied the 'closeness continuum' to purposively recruit a large and diverse expert panel (in terms of sex, geographical representation and profession/stakeholder group), this study's panel and steering committee could have been more representative of communities that are not widely represented in this field. While making explicit progress on diversity, equity and inclusion, including

actively involving a PPI stakeholder group (also as coauthors), we acknowledge that more could be done. This study, and the hip-and-groin research field in general, would benefit from actively involving researchers and participants from minoritised communities (diversity) ‘...including Black, Indigenous, and people of colour, people from the LGBTQIA2S+ Community, people with disabilities, people with complex/chronic illnesses, people from the Global South or Far North, people from low-income or middle-income nations, people from stateless communities’ (BJSM Equity, Diversity and Inclusion Guiding Document: <https://bjsm.bmj.com/pages/bj-sm-key-publishing-resources>). However, diversity in isolation is not enough. Clinicians and researchers should work to level the playing field (equity), and actively practice inclusivity (by creating, eg, a welcoming atmosphere, including a positive and supportive experience) to a diverse group of research participants. We used a modified (close ended) Delphi method—the classic open first round may create unambiguous, broad statements leading to bias from the outset. An open first round might also compromise assessment of reliability.<sup>57</sup>

Although anonymity of the Delphi method and large panels have many advantages, we acknowledge that it has limitations too. These include low compliance, lack of responsibility for the end result and loss of flexibility and richness of non-verbal communication—important elements of unstructured, direct group interaction.<sup>31</sup> This study benefited from a closed first round and group interactions that were both anonymous for the Delphi surveys and direct, although online, for the Interactive Group Process. Larger panels, however, might introduce more variation of opinion and false ‘consensus’ as panellists are ‘forced’ to reach consensus without any opportunity to debate the issues or areas of tension and dissent.<sup>10,38</sup>

The increase in consensus between rounds 1 and 2 can be ascribed to iteration of judgement and partly to an artificial by-product of the pressure to conformity caused by feedback; we provided stakeholder group-specific histograms to all participants between rounds 1 and 2. In addition to anonymous feedback during the Delphi rounds, online mixed stakeholder group discussion meetings were opportunities to deliberate. Here it was possible for certain voices in the online room to dominate; however, group leads were carefully selected to guide conversations, guard against dominance and to give minoritised groups a voice.

Because the aim of this study was not to pursue consensus at all cost, but rather to obtain reasonable consensus while mapping the level of agreement, the panel did not vote again on non-consensus statements during online meetings. Statistical consensus or non-consensus was therefore unchanged but enriched by including deliberations from multiple perspectives.

Although the Delphi panel reached consensus on many statements, we acknowledge that consensus relies on ‘expert judgement’ with possible group pressure to conform. Consensus in a Delphi could therefore be seen as suspect.<sup>31</sup>

A third Delphi round might have resulted in an even higher overall consensus, although limited to a small number of statements. After removing outliers and reanalysing panellists’ scores, the panel reached consensus on two statements (statements 34 and 46) with marginal non-consensus after round 2.

## CONCLUSION

A diverse and inclusive Delphi panel agreed on four key issues essential to moving clinical practice and research forward in the area of PCM and its natural history: (1) definition, confirming its

proposed conceptual attributes (tissue type, size, location, shape and ownership); (2) terminology—use ‘morphology’ and not doom-and-gloom terms ‘lesion’, ‘abnormality’ or ‘deformity’; (3) taxonomy, distinguishing between primary and secondary cam morphology, and (4) imaging outcomes, continuous bone and/or cartilage alpha angles on radial femoral head-neck MRI for research on how PCM develops.

This broad consensus provides athletes, patients, clinicians and researchers with a strong foundation for more precise communication, better clinical decision-making and higher value research on PCM and its natural history.

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**Contributors** HPD proposed the idea of a Delphi consensus study on the topic, planned and coordinated the study as part of his DPhil Evidence-Based Health Care studies. TG, MC, JLO, KMK and SG-J supervise the lead author’s DPhil studies and provided oversight to the study with other members of the Delphi Study Steering Committee (SMA, CLA, JK, ABM, AP, PB and AS). All steering committee members contributed to, revised and refined the list of Delphi statements. AP co-led the Patient and Public Involvement Group with HPD and, with DR and RWW, facilitated an authentic patient’s voice throughout. AF, with oversight by JLO, contributed to the statistical analysis of the study. Although EM and VM contributed to all stages



of the Delphi study, their focus was the imaging- and research priorities domains. CLA and KMK co-chaired with HPD the Interactive Group Process while ABM, AP, JLO, SG-J, DR, SMA, EM, PB, RWW, AS and MC acted as group leads for the 6 small multistakeholder groups. HPD wrote the first draft of the manuscript; all listed authors contributed to reviewing, editing and revising the manuscript, and have read and agreed to the submitted version of the manuscript. The Young Athlete's Hip Research (YAHIR) Collaborative listed as 'collaborators' were all Delphi panel members and contributed to the online Interactive Group Process and the ENHR ranking exercise.

**Competing interests** HPD is a BJSM Associate Editor; CLA is Editor-in-Chief of Journal of Orthopaedic & Sports Physical Therapy (JOSPT); SM, PB, DR, AF, AS, EM, VM, RWW, KMK, JLO, SG-J, MC and TG—none to declare; JK is an editor of BJSM; ABM is BJSM Deputy Editor; AP is an editor at BMJ; KMK was Editor-in-Chief of BJSM from 2008 to 2020 but holds no position with BJSM or BMJ Group at present (June 2022). Collaborator group: JT and NM are editors of BJSM; KT and FW are BJSM Deputy Editors; LE is BJSM IPHP Editor; SB, CJvR, JoT, AW, SK and FW are BJSM Associate Editors.

**Patient and public involvement statement** We involved patient and public partners in the planning, delivery, and dissemination phases of the Delphi study through the YAHIR Collaborative's patient and public involvement (PPI) group. The latter group was represented in the Delphi study steering committee. We supplied all members of the PPI group with a glossary, mentored them on definition use and content (during online individual and PPI group meetings), and invited them to weigh in on each Delphi round. They had access to the recordings of the *Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series*, providing a good knowledge base including the current evidence, and issues, allowing an informed assessment. Members of the PPI group led and actively participated in the mixed stakeholder group discussions following the Delphi rounds (Delphi study, Stage 3).

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**Ethics approval** This study involves human participants and was approved by The University of Oxford's Medical Sciences Interdivisional Research Ethics Committee (MS IDREC) provided ethics approval for the study—R73576/RE001. Participants gave informed consent to participate in the study before taking part.

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**Author note** Equity, diversity and inclusion: The Oxford consensus steering committee (HPD, SMA, CLA, JK, ABM, AP, PB, AS, JLO, KMK, SG-J, MK and TG), 5 women and 8 men, were English-speaking (as a first- or second language) white academics (11 with PhDs); 4 were physicians, 6 allied healthcare practitioners, and 3 health researchers. AP represented the Young Athlete's Hip Research (YAHIR) Collaborative's Patient and Public Involvement Group. One resided in the Global South. Interpreting 'diversity' as more than representation of certain demographic groups, the steering committee ensured a diverse and informed Delphi panel, representing six multi-profession stakeholder groups, including previously minoritised groups relevant to this research field (eg, women, athletes, patients and the community, participants from the Global South). This study's online Delphi method, with a specific focus on anonymity and access to adequate topic-specific resources, supported a more equitable and inclusive process. First, the study's online Delphi method was more equitable (as opposed to an in-person meeting) as traditionally underrepresented groups had similar opportunities to participate—levelling the playing field (they didn't need to travel and could share their opinion in a 'safe space'). Second, the study's online Delphi method was more inclusive (referring to a positive and supportive experience) as our efforts included online meetings to share and discuss study resources and topic-specific information, and giving patient and public involvement partners leading roles in all aspects of the study (including steering committee membership, active involvement in study design, leading roles in online discussions, and co-authorship of study reports, including peer reviewed papers). Finally, in addition to the steering committee members, the main authors included a biostatistician (AF), two radiologists (EMcN and VM), and two additional members of the YAHIR Collaborative's Patient and Public Involvement Group (DR and RWW). The 18 main authors include six women (including the senior author, TG).

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## SUPPLEMENTARY FILE 1

## Oxford consensus on primary cam morphology and femoroacetabular impingement syndrome. Part 1 and 2 methods

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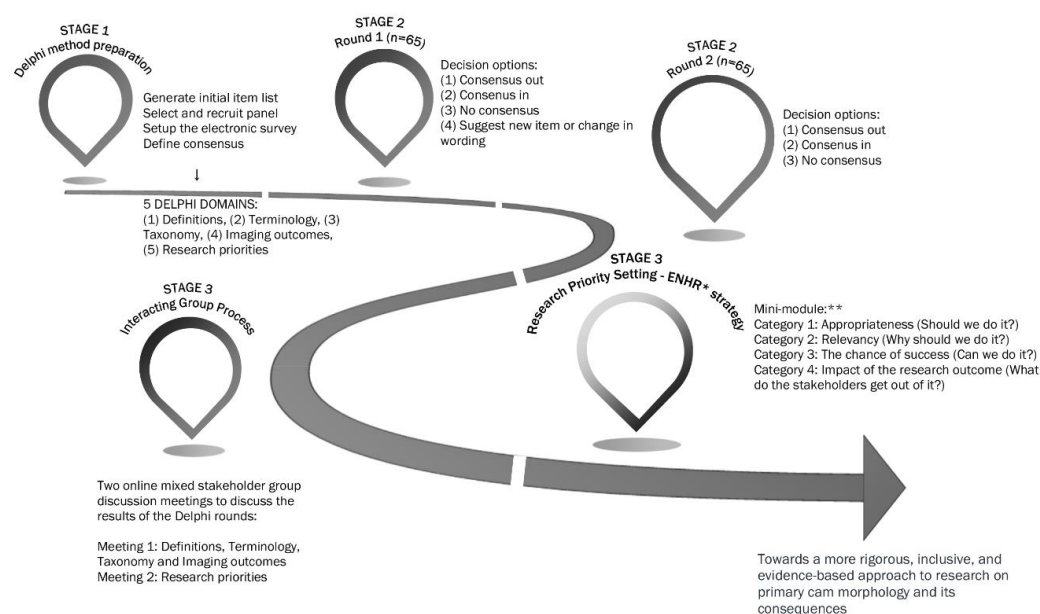
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## METHODS

We held a sequential, two-round online Delphi survey and two synchronous online mixed stakeholder group meetings (Interacting Group Process) to explore the level of agreement amongst a panel of experts, on primary cam morphology definitions, terminology, taxonomy, and imaging outcome measures for research, and work towards agreement on a set of research priorities on conditions affecting the young person's hip. The prioritised research statements were further ranked according to the Council on Health Research for Development's Essential National Health Research (ENHR) ranking method. The Delphi and ENHR exercises allowed panel members to participate anonymously to reduce the influence of dominant individuals. [1] Reporting followed the 31-item REporting guideline for PRiority Setting of health (REPRISE) [2], and the Conducting and REporting DELphi Studies (CREDES) [3].

This comprehensive Methods document combines and extend the methods sections of the two Oxford Delphi consensus papers (Part 1 and 2).



**Figure SF1-1** Oxford Consensus Study flow chart. Stage 1: prepare for Delphi method; Stage 2: Delphi method online rounds; Stage 3: virtual discussion meetings and ENHR strategy for research priority setting. \*Essential National Health Research; \*\*Mini-module adapted from [4]

## Methodology

The Delphi method, especially its qualitative elements, has roots in the philosophical traditions that emphasise the importance of opinions and perceptions of groups of people. [5] This is important, alongside other sources of empirical data, when exploring the nature of reality or informing decision making. [6] This study applied the Delphi method as a pragmatic tool for working towards consensus



and for mapping the level of, and reasons for, any residual disagreement. Many studies applying the Delphi method suffice with statistical consensus or non-consensus. We went further.

By embracing the pragmatic qualities of the Delphi method, this study dealt with tension and dissent in a meaningful way. While some argued that the Delphi method “rises above the paradigmatic divide”—it includes elements of qualitative and quantitative approaches, and of constructivism and positivism—others, including Brady (2015), have argued its alignment with a pragmatic philosophy. [6] We agree with Brady (2015) and Skulmoski and Hartman (2007): The Delphi method is flexible, favouring diversity over statistical representativeness in sampling, relatively low-resource, and user-friendly. [6,7] It is therefore a good tool for community-based and community engaged research, working towards consensus and surfacing tension and dissent in a meaningful way.

“...methods are the tools of the trade. Methodology is the philosophy that guides how and when you deploy those tools.” [8]

Relevant to the primary cam morphology research field, community-engaged research empowers the potentially marginalised and minoritised voices of patients, children, parents, women, citizens of the global south, para-athletes and non-physicians. Community-engaged research, characterised by inclusion, collaboration, and participation, builds upon the principles of reciprocity, relationship building, and translational learning between communities and professional researchers. [9] It provides a less hierarchical and more ethical approach to conducting research, combining, in our study context, transformative and knowledge co-production lenses underpinned by pragmatism as the philosophical paradigm. [6]

Given the focus on (research) transformation and knowledge co-production, it is important to reflect on our positionality and identities (racial/ethnic, sex/gender). The steering committee members (HPD, SMA, CLA, JLK, ABM, AP, PB, AS, JO, KMK, SGJ, MK, TG), 5 women and 8 men, were English-speaking (as a first- or second language) white academics (11 with PhDs); 4 were physicians, 6 allied healthcare practitioners, and 3 health researchers. AP represented the Young Athlete’s Hip Research Collaborative’s Patient and Public Involvement Group. One resided in the Global South.

Not only did we combine multiple methodologies to accomplish this study’s aim, but also multiple research methods, and reflexive quantitative and qualitative analyses. Combining multiple methodologies and methods is not new; qualitative scholars use the term “methodological bricolage”—“an eclectic critical, multi-perspectival, multi-theoretical and multi-methodological approach to enquiry”. [10,11] Here we combined the online Delphi method, Interacting Group Process for mixed stakeholder group discussions [12], Essential National Health Research (ENHR) research strategy to rank the prioritised research statements, and revised Bloom’s Taxonomy, a tool to

create education that encourages critical thinking, to develop two education events aimed at early dissemination and implementation.

### Study design – Delphi method and Research Priority Setting process

**Delphi method:** For this 3-stage Oxford Consensus Study (Figure SF1-1), we modified the classical Delphi method slightly by replacing an open qualitative first round with a pre-selected list of statements based on a review of existing literature and a synthesis of the knowledge of steering group members. [13–15] The Delphi method assesses consensus through an iterative multistage process of controlled online questionnaires, feedback, reflection, and discussion, documenting both agreements and the nature and extent of residual disagreement. [16–18] Multiple rounds allow panel members to work towards consensus as members are invited to amend their response in the light of the group average. [19,20] The Delphi method allows panel members to participate anonymously to reduce the influence of dominant individuals.[1] Reporting followed CREDES (‘Conducting and REporting DELphi Studies’) [3]. We report in a linked paper (Oxford Delphi consensus, Part 2) how the prioritised research statements were further ranked according to the Council on Health Research for Development’s Essential National Health Research (ENHR) ranking method.[4]

The essence of the Delphi method, initially developed by the Rand Corporation for technological forecasting and named after the famous oracle at Delphi, is to generate discussion on a topic of interest amongst experts. [21,16] The Delphi method has four important methodological features: (1) a panel made up of various kinds of expert, (2) an anonymous process, (3) iterative rounds of enquiry, (4) subsequent rounds informed by a summary of the group response of the previous round. [3,13,22] While celebrating the Delphi method’s strengths, it is important to acknowledge and deal with its challenges.

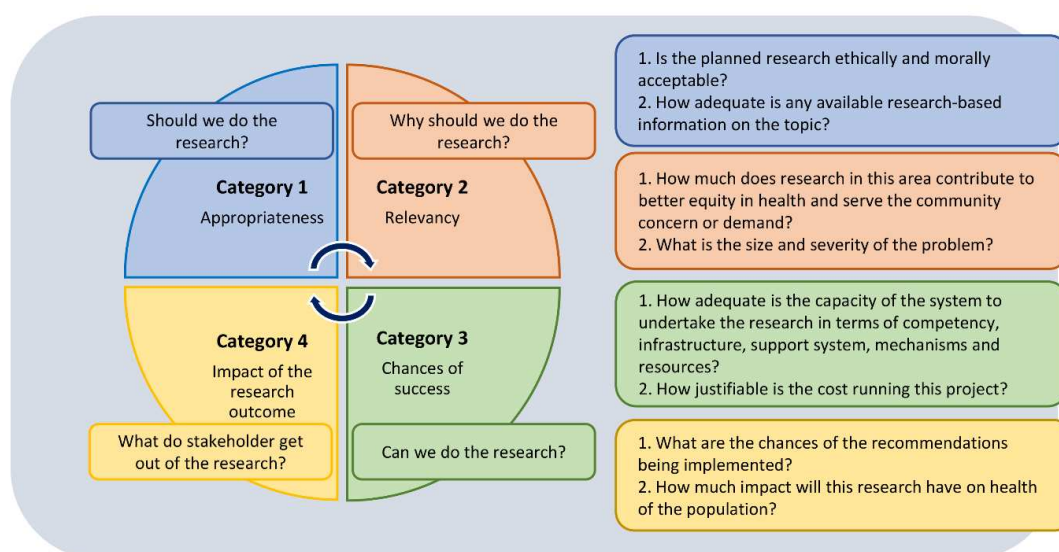
Although challenging, an *online* consensus development process is more likely to improve than jeopardise the process and outcome, especially during covid-19-related restrictions on travel and indoor face-to-face meetings. There are many empirical examples of successful online Delphi studies in health care involving geographically dispersed panel members. [23–25] The online consensus development process is reliable [26] while asynchronous online communication has well-established benefits in promoting reflection and knowledge construction. [27] Therefore, the quality of any Delphi study depends on the underlying design and rigour, and not the medium of the research process. [15] However, ensuring a high-quality Delphi study is easier said than done as no standard quality parameters exist to evaluate Delphi studies in healthcare. [28]

Many Delphi method quality criteria have been proposed. Nine criteria were used to assess the quality of 52 Delphi studies on coronavirus disease 2019 (covid-19). [28] In sum, this study assessed how Delphi studies (1) documented the process followed to identify the problem area; (2) selected panel members based on objective and predefined criteria; (3) maintained strict anonymity of panel

members and their responses; (4) provided controlled feedback between rounds; (5) managed iterative rounds of discussions and feedback; (6) defined consensus criteria a priori; (7) analysed consensus in a transparent way; (8) identified criteria for stopping the Delphi rounds; (9) analysed stability of responses. Although comprehensive, this list is arguably not complete. For example, how Delphi researchers performed and reported qualitative analysis of panellists' responses, and treated dissent and ambiguity are equally important 'quality criteria'. [17,29,30]

**Research Priority Setting – ENHR strategy:** The problem of largely investigator-driven health research agendas, marginalising the voices of key stakeholders including patients, caregivers and the community, has fuelled a mismatch between the interests of patients and researchers, and a possible misdirected allocation of limited resources. [2,31,32] This spotlighted the need for transparent research priority setting with stakeholders. [2,33–40] Research priority setting—a range of “interpersonal” activities amongst stakeholders to identify, prioritise and achieve consensus on the key questions or research topics—can be small or broad. Small research priority setting projects, often the scope of a specific group or organization, focus on a health condition, while broader priority setting projects inform national or international health research strategies. [2,41–43] Ensuring transparency of the research priority setting process, and to “strengthen legitimacy and credibility for influencing the research agenda”, we applied the 31-item REporting guideline for PRIority SETting of health (REPRISE). [2] To add rigour and transparency, we plan to register this research priority setting project on the Ludwig Biltzmann Gesellschaft Open Innovation in Science Center's worldwide Priority Setting Database of research priority setting projects. This database inspires future priority setting projects serves as a research tool “for unanswered research questions and under-researched topics”. [44] The *Early Hip and Knee Osteoarthritis Priority Setting Partnership* and *Too Fit To Fracture: a consensus on future research priorities in osteoporosis and exercise*, are examples of priority setting projects registered on this database. [45,46]

We adapted the ENHR “mini-module” [4], asking the Delphi Panel to apply a 0 to 3 Likert Scale score to category 1 criteria, and 1 to 3 Likert Scale for the remaining 6 criteria. A maximum 3 points per criterium resulted in an equal weighting of 6 points for each of the four categories (Figure SF1-2). We shared and discussed the ENHR ranking strategy results with Delphi panel members during optional online meetings.



**Figure SF1-2** Four categories (and 2 criteria for each) of the Essential National Health Research ranking strategy [4]

### Stage 1: Planning

**Steering committee:** The study steering committee included members of the YAHiR Collaborative.

Avoiding the “GOBSAT” (good old boys sat around a table) approach [47] the steering committee ensured a representative Delphi panel, and a robust Delphi method and ENHR ranking process. Interpreting ‘diversity’ as more than representation of certain demographic groups, the steering committee ensured a diverse and informed Delphi panel, representing six multi-profession stakeholder groups, including previously minoritised groups relevant to this research field (e.g., women, athletes, patients and the community, participants from the Global South). This study’s online Delphi method, with a specific focus on anonymity and access to adequate topic-specific resources, supported a more equitable and inclusive process.

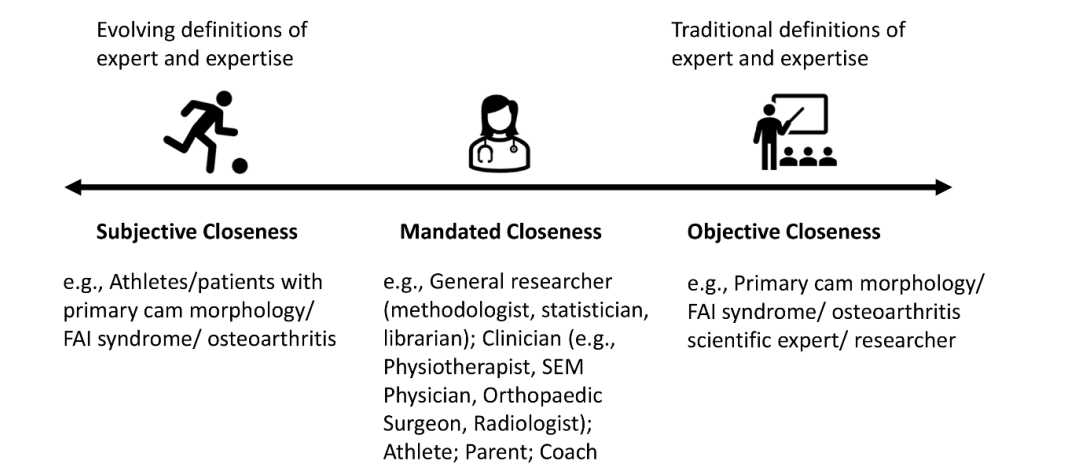
More equitable (as opposed to an in-person meeting) as traditionally underrepresented groups had similar opportunities to participate—levelling the playing field (they didn’t need to travel and could share their opinion in a ‘safe space’). Our efforts to promote a more inclusive Delphi study (referring to a positive and supportive experience) included online meetings to share and discuss study resources and topic-specific information, and giving patient and public involvement partners leading roles in all aspects of the study (including steering committee membership, active involvement in study design, leading roles in online discussions, and co-authorship of study reports, including peer reviewed papers). (We provided the Primary Cam Morphology Delphi Study Steering Committee Terms of Reference as a Supplementary File).



**Delphi and ENHR ranking panel:** The concept of ‘expert’ is contested. According to Christiansen-Ruffman and Stuart (1978), cited by Needham and de Loë (1990:136) expertise is restricted “to people with specialized training, such as architects, academics, medical doctors and scientists.” [48] Cantril et al (1996:69) argued that an ‘expert’ is “any individual with relevant knowledge and experience of a particular topic”. [49] However, the narrow definition of expertise is unfortunate and “excludes individuals who derive expertise, not from specialised training, but real or first-hand experience, or familiarity”, and “more recognition must be given to a variety of experts who exist along a closeness continuum”. [48]

The closeness continuum represents an inclusive expert population of individuals with subjective, mandated, and objective closeness to the topic of interest. Experts with subjective closeness have deep experiential knowledge or real-life experiences. Experts with mandated closeness are those with professional and/or legal (ethical) responsibility while experts with objective closeness are those who study the topic, exploring and inquiring without preconceived bias. [48,50]

We adapted and applied the “closeness continuum” to purposively recruit 73 experts for this study representing multiple stakeholder groups with relevant experience and expertise (Figure SF1-3 and Table SF1-1). Participants were not reimbursed.



**Figure SF1-3** Adapted closeness continuum of experts applied to the Oxford Consensus Study [48]

**Table SF1-1** Delphi panel recruitment criteria

Identification of Delphi panel	Panel members were identified through (1) expert knowledge of the steering committee and colleagues; (2) International Olympic Committee’s 11 research centres for the prevention of injury and protection of athlete health; (3) International Hip Pain Research Network Consensus Group; (4) a list of authors (lead/corresponding authors) with a track record of peer-review publications in sports medicine and science, preferably in the field of cam morphology/FAI syndrome over the past 15-20 years (2000 to 2021).
--------------------------------	--

	We oversampled to compensate for possible attrition at a rate of 25% per round.
Researchers	Statisticians, methodologists, librarians, and sport scientists
Clinicians and clinician-researchers	Clinicians who treat patients with hip-related conditions and clinician-researchers with a peer reviewed publication record in the field (cam morphology and/or femoroacetabular impingement aetiology, prognosis, treatment), including orthopaedic surgeons, physicians (including sports medicine physicians, physical medicine and rehabilitation physician, rheumatologist, family medicine), radiologists, physical therapists
Patient and Public Involvement (PPI) representatives	<ul style="list-style-type: none"> <li>➤ adult patients: a purposive sample of adults diagnosed with femoroacetabular impingement and cam morphology or hip osteoarthritis and cam morphology or hip arthroplasty and cam morphology or any other joint condition (e.g., inflammatory arthritis or osteoarthritis), or have a history of recreational or competitive high-load sports participation during adolescence or later</li> <li>➤ parents of young adolescents regularly participating in competitive high-load sport, irrespective of a personal history of cam morphology or FAI syndrome</li> <li>➤ sports coaches (defined as coaches of early adolescents regularly participating in high-load sports) or athletes (competitive, recreational, or retired), irrespective of a personal history of cam morphology or FAI syndrome</li> <li>➤ individuals with experience in patient and public involvement, or unique perspectives on, health equity, health ethics, racial, ethnic, and minority groups in sports medicine (e.g., healthcare professionals involved in adolescent sports medicine screening (periodic health assessment) and patient / athlete education)</li> </ul>
Journal editors, representatives of research funding bodies and policymakers	Journal editors (e.g., BJSM and JOSPT); Sports organisations/federations e.g. FIFA, IOC, IAAF

**Sample size:** We oversampled to compensate for possible attrition over rounds (at a rate of 25% per round). Consensus is normally achieved in an average of three rounds [51]; the steering committee, therefore, aimed to recruit a starting sample of 50 to 100 panel members. The study was fully anonymised and panel members did not know who the other panel members were during the Delphi survey rounds.

**Patient and public involvement (PPI):** We involved patient and public partners in the planning, delivery, and dissemination phases of the Delphi study through the YAHIR Collaborative's PPI group. The latter group was represented in the Delphi study steering committee. We supplied all members of the PPI group with a glossary, mentored them on definition use and content (during online individual and PPI Group meetings), and invited them to weigh in on each Delphi round. [52] They had access to the recordings of the *Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series*, providing a good knowledge base including the current evidence, and issues, allowing an informed assessment. Members of the PPI Group lead and actively participated in the mixed stakeholder group discussions following the Delphi rounds (Stage 3 below).

**Delphi software:** We used DelphiManager®, “a web-based system designed to facilitate the building and management of Delphi surveys” for the Delphi rounds and Microsoft Forms for the ENHR research ranking exercise. [53]

**Ethical considerations:** Research participants provided informed online consent for the study as part of the DelphiManager® surveys. Participants did not meet face-to-face during the online Delphi rounds. The University of Oxford’s Medical Sciences Interdivisional Research Ethics Committee (MS IDREC) provided ethics approval for the study - R73576/RE001.

**Statement preparation:** The Delphi study steering committee created an extensive list of statements and conceptual framework of all the potential definitions, terminology, taxonomy, and a set of research priorities on conditions affecting the young person’s hip focussing on primary cam morphology and its natural history. We based the initial statement list on a concept analysis of primary cam morphology [54], the early results of a qualitative study to explore stakeholder perspectives on factors contributing to high-quality research on how primary cam morphology develops, and the Lisbon Agreement on Femoroacetabular Imaging. [55–57]. In addition, the list of possible research recommendations was informed by recent (since January 2016) consensus recommendations on research in the field. [55–62] Members of the Delphi study steering committee independently reviewed the statements, followed by an iterative, asynchronous online process to review, discuss, modify and approve the final statements. The steering committee provided additional descriptive information (“Help Text”) where appropriate, and asked stakeholders, including members of the Patient and Public Involvement group, to provide feedback on the draft Delphi survey. Stakeholders examined the survey’s face validity (e.g., comprehensibility and acceptability) and refined language, formatting, and layout.

**Panel information pack:** All panel members had access from the outset of the project and throughout the Delphi process, to the course material, including recorded presentations, of the first 9 Webinars of the *Oxford-Aspetar-La Trobe Young Athlete’s Hip Webinar Series* (Appendix 2). (Webinar 1: *What is primary cam morphology? Taxonomy, terminology, and definitions*, and Webinar 2: *Imaging strategies for primary cam morphology and FAI syndrome*, were particularly relevant to this Delphi study). Panel members had full-text access to 5 recent consensus statements [58–62], and a summary of their research recommendations, to support scoring Domain 5 of the Delphi study on research priorities. We refer the reader to the relevant Supplementary Files (Oxford Delphi consensus study Part 1 and Part 2). Completion of the webinars and/or reading of the consensus statements was not required.

**Consensus definition:** The steering committee agreed on a consensus definition prior to the Delphi rounds (Table SF1-2).

**Table SF1-2** Definition of consensus

Category	Definition	Action
Consensus in (high agreement)	Scored as very important (7 to 9) by $\geq 70\%$ of panel members <i>and</i> not important (1 to 3) by $< 15\%$ of panel members	Item retained for the next survey round/consensus meeting
Consensus out (low agreement)	Scored as not important (1 to 3) by $\geq 70\%$ of panel members <i>and</i> very important (7 to 9) by $< 15\%$ of panel members	Item discarded after round 2 (to be ratified at the face-to-face consensus meeting)
No consensus	Neither criteria above are met	Item retained for the next survey round/consensus meeting
Suggest rewording	Scored as important but must be reworded.	Provide the opportunity for panel members to suggest rewording. The study steering committee will consider retaining a reworded item for the next survey round.

## Stage 2: Online Delphi Rounds

The consensus process involved a sequential, two-round Delphi survey and synchronous online consensus meetings to establish multi-stakeholder agreement and surface disagreement.

**Round 1:** Participants provided informed consent and registered for the Delphi study in one of 6 stakeholder groups. The statements were presented in a sensible and logical order in 5 questionnaire domains (definitions, terminology, taxonomy, imaging outcomes, and research priorities).

Panel members scored each statement using a 9-point Likert scale ranging from 1 (“not important/disagree”) to 9 (“critical/ agree”), based on the Grading of Recommendations Assessment, Development and Evaluation scale for scoring the importance of including the item in the final list of statements. [63] Round 1 survey included free text sections to allow participants to propose new or modified statements and provide general study feedback. The Delphi study steering committee reviewed the proposed new statements or statement modifications suggested by participants in round 1, discussed and considered all the agreed new or modified survey statements for a subsequent round(s), and resolved any uncertainties.

**Round 2:** Participants had access to the distribution of round 1 scores for each statement stratified by stakeholder group. Judgements after feedback, including aggregated group feedback, are less exposed to cognitive and personal biases, and panellists are more confident in their decisions. [64–66] Panel members saw their score and then re-scored each statement on a scale of 1 to 9 (or not if they chose to defend their outlying score) based on the average scores of the group. We documented changes in score from round to round, and panel members could provide reasons when their score boundaries changed between rounds 1 and 2, defending their outlying score(s).

The steering committee and Delphi panellists explored and discussed reasons for outlying scores, disagreement and dissent (including statements with overall consensus) during the online Interacting Group Process (stage 3 of the Delphi study). Multiple rounds can cause ‘group-think’ amongst



participants via pressure to comply.[67] We did not wish to force agreement amongst participants and chose to limit the Delphi process to a maximum of 3 rounds. However, two Delphi rounds resulted in high consensus and surfaced important disagreements and areas of dissent to focus on in online discussions. A third voting round was therefore not required. Following Delphi round 2, we included all statements voted ‘consensus in/ agree’ and ‘consensus out/disagree’ in the final list of consensus statements.[68,69].

### **Stage 3: Online Interacting Group Process and Research Priority Setting using the ENHR ranking exercise**

**Interacting Group Process - online mixed stakeholder group discussion meetings:** Delphi panellists discussed all discordant items as well as areas of tension and dissent, during two online mixed stakeholder group meetings, based on the Interacting Group Process. Interacting Group Processes stimulate participants to look at problems and solutions from different perspectives. [12,70] While Nominal Group Processes are better for generating ideas or solutions, interacting groups are better for sharing and evaluating information. [12] Acknowledging the importance of areas of dissensus or disagreement substantial time and effort were allocated to exploring these. To create a safe space for panellists to share their views, the steering committee facilitated discussions in small zoom breakout rooms (6-8 panellists representing different stakeholder groups); the discussions were not recorded. Group leads documented discussions in a field diary, and maintained speaker anonymity.

The first meeting discussed the results of the Delphi rounds, including ongoing areas of disagreement and dissent, and ratified the primary cam morphology definitions, terminology, taxonomy, and imaging outcome measures. The second meeting discussed the prioritised list YAHIR Collaborative research statements on conditions affecting the young person’s hip, focussing on primary cam morphology and its consequences in athletes.

**Research Priority Setting – ENHR strategy:** An online Microsoft Forms survey process followed to further rank the prioritised statements according to the ENHR strategy for research priority setting as described earlier. [4]

**Feedback:** Following the ENHR ranking exercise, panellists were able to attend one of six optional, time-zone friendly online feedback-and-discuss-meetings. Although these were not recorded, the lead investigator took field notes that provided an additional context for analysis. Field notes aided in constructing thick, rich descriptions of the context and discussions of these (and other) encounters. [71]

## Data analysis

We entered and stored all data using the DelphiManager® electronic software tool and created Excel spreadsheets. [53] We calculated descriptive statistics for each statement and stakeholder group e.g., summary scores, ranges, percentage scoring for each statement “not important/ disagree” (score 1 to 3), “important but not critical/ neutral” (score 4 to 6) and “critical/ agree” (score 7 to 9). Specifically, we reported, per stakeholder group, the median and interquartile range (IQR) for each statement between each round. This central tendency and measure of distribution served to estimate the consistency of responses between successive rounds of the Delphi study. Stability of response is an indication of whether agreement (or continuous dissensus or disagreement) is present throughout and whether it develops between rounds. [72,73] The stability of group response between rounds 1 and 2 was calculated using the Intraclass Correlation Coefficient (ICC) type A, and an absolute agreement definition. [74,75] ICC estimates and their 95% confidence intervals were calculated using SPSS statistical package version 23 (SPSS Inc, Chicago, IL) based on 2-way mixed-effects model. [76] The lower bound 95% confidence interval of the ICC estimate was used as the basis to evaluate the level of reliability using the following general guideline: ICC values <0.5 (poor stability), ICC values 0.5 to 0.75 (moderate stability), 0.75 to 0.9 indicated (good stability) and ICC values >0.9 (excellent stability). [76]

Table SF1-2 represents the prior consensus definition for categorising the statements in all five Delphi domains. The Delphi study steering committee retained all statements between rounds 1 and 2 to enable participants to re-score every statement after considering feedback from round 1. This likely reduced participant burden in potential subsequent rounds and at the consensus discussion meetings. [1] Acknowledging that certain statements might be more relevant to some panel members than others, stakeholders were given the choice not to score a specific statement. We did, however, analyse the data of different stakeholder groups separately in each round. [68]

In addition to the quantitative consensus definition in table 2, the Delphi study steering committee reflected carefully on the findings, drawing on clinical wisdom and experience, encouraging, facilitating and documenting further deliberation during two synchronous online discussion meetings.

**Dissent analysis:** Although the main aim of the Delphi method is to structure a group communication process that might lead to consensus, we were also interested in panel dissent. To explore possible dissent, we applied *dissent analysis* including outlier analysis, bipolarity analysis, and stakeholder group analysis. [77,78]

- Outlier analysis: Outliers can have a substantial effect on variables (e.g., Interquartile range), and statistical consensus. The existence of outliers is therefore an important potential explanation for dissent. We identified low outliers (data points that fall more than 1.5 times the Interquartile range below the first quartile) and high outliers (data points that fall more

than 1.5 times the Interquartile range above the third quartile). In addition, we visually inspected histograms of round 2 stakeholder group scoring for outliers. We re-analysed consensus after eliminating outliers for all statements with marginal non-consensus to test if these had an impact on the group's consensus.

- **Bipolarity analysis:** Opposing groups of experts with an important and insoluble cleft of opinion, might result in non-consensus. Bimodal data distribution is therefore a possible explanation for dissent. To test for bipolarity, we investigated potential bimodal distribution (two or more answer options had the same mode frequency) and visually inspected histograms for round 2 scores of each statement. [77]
- **Stakeholder group analysis:** Stakeholder group analysis, a classical dissent analysis, is important to identify opposing views. To compare the scores from round 2 between the six stakeholder groups, we performed Kruskal-Wallis tests. To account for multiple post hoc comparisons, we adjusted the statistical significance threshold p-value to 0.0033 according to Bonferroni method. We are conscious of the limitations of 'statistical significance' [79]; therefore, substantial stakeholder group differences ( $p < 0.0033$ ) prompted us to further scrutinise individual- and group opinions for the specific statement.

**Qualitative analysis:** The lead investigator (HPD) immersed himself in the details of participants' comments provided during Delphi rounds, Interacting Group Process, and ENHR ranking exercise.[80] After developing a framework based on recurrent and important themes, the free text comments were grouped into categories, iteratively discussed between the lead investigator and second author (SM). The lead authors (HPD and SM) then undertook thematic analysis to identify, group and agree on common threads within these categories, further refining themes and subthemes.[81,82] We provided summarised feedback of quantitative and qualitative open responses to panel members during Webinars 10 and 11 of the *Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series*. The webinars preceded the online synchronous mixed stakeholder group discussions on 22 and 23 September 2021 (Stage 3).

## Dissemination

Considerable time lags—up to an average of 17 years—exist in the health research (knowledge) translation process. [83–85] On the other hand, rapid knowledge translation and implementation into policy and practice, as evident in the early covid-19 pandemic days, served and savaged communities—scientific-, health and care-, and patient communities. [86–88] We created opportunities for the community of researchers, clinicians, athletes and athlete-patients, to responsibly disseminate and effectively implement the findings of this study, not only to amplify the ethical conduct of future research, but also to foster authentic co-production of new knowledge. [89] Dissemination of new knowledge, an active process of spreading or sharing evidence to a target population, is most effective “when it starts early, galvanizes support, uses champions and brokers,

considers contextual factors, is timely, relevant, and accessible, and knows the players and process.” [90,91]

To fulfil objective 3 of the Oxford consensus, we applied the revised Bloom’s taxonomy (Figure SF 1-4). [92], a tool to create education that encourages critical thinking, to develop two education events aimed at early dissemination and implementation: *Oxford-Aspetar-La Trobe Young Athlete’s Hip Webinar Series* (Supplementary File 4), and *YAHiR Collaborative’s Young Athlete’s Hip Symposium and Research Meeting* (22-23 September 2022, Worcester College, Oxford).

Bloom and co-workers developed a taxonomy of learning domains, which was divided into cognitive (knowledge and mental skills), psychomotor (physical movement, coordination, and use of motor skills), and affective (how individuals deal with things emotionally – feelings, values, attitudes). While the original Taxonomy provided a hierarchy of six different levels of objectives in the cognitive domain, each entailing more intricate thinking than the previous one, the revised Bloom’s taxonomy emphasised verbs— the basis of the cognitive process: “what is to be done with or to the subject matter content.” (Figure 4) [92]

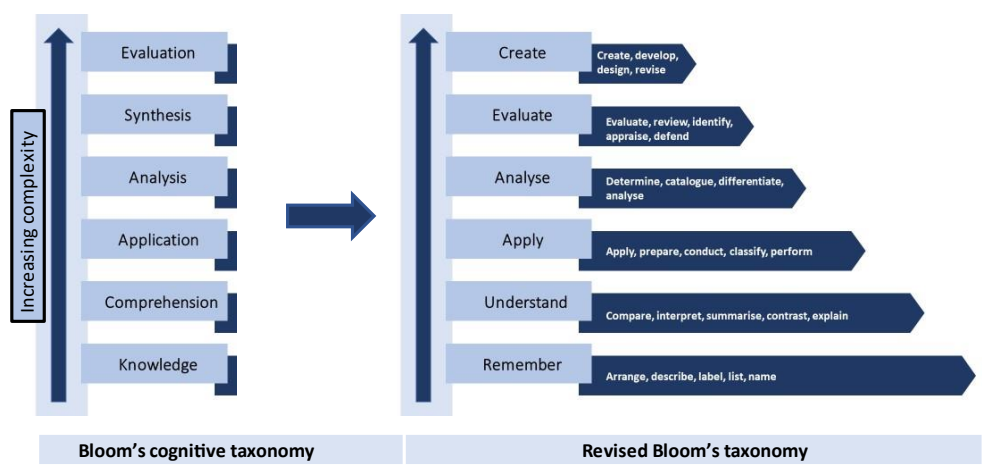


Figure SF1-4 Bloom’s revised taxonomy of cognitive process action verbs



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## SUPPLEMENTARY FILE 2

### Recommendations for the Conducting and REporting of DElphi Studies (CREDES) and how these will inform the primary cam morphology (PCM) Delphi Study

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## Recommendations for the Conducting and REporting of DELphi Studies (CREDES) and how these will inform the primary cam morphology (PCM) Delphi Study

### Recommendation

#### Rationale for choosing the Delphi technique

1. Justification.  
“It is important to justify the choice of the Delphi technique as a method of systematically collating expert consultation and building consensus. It is also important to keep its constructivist nature in mind.”

*PCM Delphi Study:* we justified the choice of the Delphi technique in the study protocol document.

#### Planning and design

2. Planning and process.  
“The Delphi technique is a flexible method. It can be adjusted to the respective research aims and purposes. Any modifications should be justified and be applied systematically and rigorously.”

*PCM Delphi Study:* we explain the three stages of the PCM Delphi Study in the study protocol document.

3. Definition of consensus.  
“Define an a priori criterion for consensus (unless not reasonable due to the explorative nature of the study). This includes a clear and transparent guide for action on (a) how to proceed with certain items or topics in the next survey round, (b) the required threshold to terminate the Delphi process and, (c) procedures to be followed when consensus is (not) reached after one or more iterations.”

*PCM Delphi study:* we define an a-priori criterion for consensus (Table 4 and data analysis section of the study protocol document), including how to proceed with certain items in the next survey round, and facilitate discussion (stage 3) relevant to areas of tension and dissent.

#### Study conduct

4. Informational input.  
“Carefully review all material provided to the expert panel at the outset of the project and throughout the Delphi process; pilot the process in advance in order to examine the effect on experts’ judgements and to prevent bias.”

*PCM Delphi Study:* we provide information on all material provided to the expert Delphi panel (recruitment section of the study protocol document).

5. Prevention of bias.  
“Researchers need to take measures to avoid directly or indirectly influencing the experts’ judgements. Consider to entrust an independent researcher with the main coordination of the Delphi study if one or more members of the research team have a conflict of interest.”



*PCM Delphi Study:* the Delphi Study Steering Committee will provide oversight to this Delphi study. 'The study steering committee included members of the YAHIR Collaborative. Avoiding the "GOBSAT" ("good old boys sat around a table") approach[22] the steering committee ensured a representative Delphi panel, and a robust Delphi study process. Interpreting 'diversity' as more than representation of certain demographic groups, the steering committee ensured a diverse and informed Delphi panel, representing six multi-profession stakeholder groups, including previously minoritised groups relevant to this research field (e.g., women, athletes, patients and the community, participants from the Global South). This study's online Delphi method, with a specific focus on anonymity and access to adequate topic-specific resources, supported a more equitable and inclusive process.' (Supplementary File 3: Steering Committee Terms of Reference).

6. Interpretation and processing of results.  
"Consensus does not necessarily imply the 'correct' answer or judgement; (non)consensus and stable disagreement provide informative insights and highlight differences in perspectives concerning the topic in question."

*PCM Delphi Study:* the Delphi Study Steering Committee provide oversight to the planning and conduct of the Delphi exercise, including the final synchronous (online) discussion of the Delphi Rounds' results with careful attention to dissent and ambiguity. We also performed and reported: (1) a thematic analysis of individual and group feedback; (2) Intraclass Correlation Coefficient and its 95% Confidence Interval for each statement as an indication of stability; (3) dissent analysis (bipolarity of group opinion, outlier analysis, and stakeholder group analysis)

7. External validation.  
"Consider an external board or authority to review and approve the final Delphi study results (e.g., draft of the resulting guidance) before it is published and disseminated."

*PCM Delphi Study:* we state in the dissemination section of the study protocol document that "we will ask international professional bodies (e.g. International Society for Hip Arthroscopy; British Association of Sport and Exercise Medicine; International Federation of Sports Physical Therapy) to participate in and endorse the consensus". Furthermore, the Young Athlete's Hip Research Collaborative's members are from many international organisations.

## Reporting

8. Purpose and rationale.  
"Define the purpose of the study and demonstrate the appropriateness of the use of the Delphi technique as a method to achieve the research aim. Provide a rationale for the choice of the Delphi technique as the most suitable method."

*PCM Delphi Study:* we discuss the aim and objectives of this Delphi Study and the appropriateness of the use of the Delphi technique in the study protocol document.




9. Expert panel.  
"Report the selection criteria for expert panellists and provide transparent information on recruitment of the expert panel, sociodemographic details, including information on

expertise regarding the topic in question, (non)response and response rates over the ongoing iterations.”

*PCM Delphi Study:* we report the selection criteria of expert panellists in the study protocol document. We report and provide transparent information on recruitment of the expert panel, sociodemographic details, including information on expertise regarding the topic in question, (non)response and response rates over the ongoing iterations.

10. Description of the methods.  
“The methods employed need to be comprehensible; this includes information on preparatory steps (How was available evidence on the topic in question synthesised?), piloting of material and survey instruments, design of the survey instrument(s), the number and design of survey rounds, methods of data analysis, processing and synthesis of experts’ responses to inform the subsequent survey round and methodological decisions taken by the research team throughout the process.”  
  
*PCM Delphi Study:* we describe the Delphi Study methods in detail in the study methods (Supplementary File 1)
11. Procedure.  
“Provide a flow chart to illustrate the stages of the Delphi process, including a preparatory phase, the actual ‘Delphi rounds’, interim steps of data processing and analysis, and concluding steps”  
  
*PCM Delphi Study:* Figure 1 illustrates the stages of the Delphi process, including a preparatory phase, the actual Delphi rounds, interim steps of data processing and analysis, and concluding steps
12. Definition and attainment of consensus.  
“It needs to be comprehensible to the reader how consensus was achieved throughout the process, including strategies to deal with non-consensus”  
  
*PCM Delphi Study:* we report how consensus was achieved: a priori consensus definition (Table 2), consensus results (Table 4 and Supplementary File 5). We describe our strategies to deal with non-consensus/dissent in the Methods section and report in the Results section (Qualitative analysis of panellists’ comments and feedback, and dissent analysis)
13. Results.  
“Reporting of results for each round separately is highly advisable in order to make the evolving of consensus over the rounds transparent. This includes figures showing the average group response, changes between rounds, as well as any modifications of the survey instrument such as deletion, addition or modification of survey items based on previous rounds.”  
  
*PCM Delphi Study:* we report the results of each round separately to make the evolving of consensus (or not) over the rounds transparent (Table 4 and Supplementary File 5). We provided all panellists, using the DelphiManager® software, with figures (Histograms) showing the average stakeholder group response between round 1 and round 2. We did not modify the survey instrument after round 1 (no deletion, addition or modification of survey items based on previous rounds).




14. Discussion of limitations.  
“Reporting should include a critical reflection of potential limitations and their impact on the resulting guidance.”  
  
*PCM Delphi Study:* we reflect in the discussion section on potential limitations and their impact on the final results
15. Adequacy of conclusions.  
“The conclusions should adequately reflect the outcomes of the Delphi study with a view to the scope and applicability of the resulting practice guidance.”  
  
*PCM Delphi Study:* the Delphi Study Steering Committee provided oversight to the rigorous reporting of results (to avoid “spinning” when reporting and discussing results) and ensured that conclusions adequately reflect the outcome of the Delphi Study.
16. Publication and dissemination.  
The resulting guidance (e.g., on good practice in palliative care) should be clearly identifiable from the publication, including recommendations for transfer into practice and implementation. If the publication does not allow for a detailed presentation of either the resulting practice guidance or the methodological features of the applied Delphi technique, or both, reference to a more detailed presentation elsewhere should be made (e.g. availability of the full guideline from the authors or online; publication of a separate paper reporting on methodological details and particularities of the process (e.g. persistent disagreement and controversy on certain issues)). A dissemination plan should include endorsement of the guidance by professional associations and health care authorities to facilitate implementation”  
  
*PCM Delphi Study:* we discuss the extensive dissemination of this Delphi Study’s results (involving the YAHIR Collaborative’s Patient and Public Involvement Group) in the Discussion section of this protocol paper: Webinar 9 to 11 of the *Oxford-Aspetar-La Trobe Young Athlete’s Hip Webinar Series* and the *YAHIR Collaborative’s Symposium and Research Meeting* planned for 22-23 September 2022 in Oxford.

Nuffield Department of Primary Care Health Sciences University of Oxford Radcliffe Primary Care Building Woodstock Rd Oxford OX2 6GG	  
<b>Principal Investigator:</b> Prof Trisha Greenhalgh	<b>Primary researcher:</b> Dr Paul Dijkstra (DPhil Evidence-Based Health Care student) Oxford University telephone number: 01865 617835 Oxford University e-mail: hendrik.dijkstra@conted.ox.ac.uk

## Primary Cam Morphology Delphi Study Steering Committee

### Terms of Reference

<b>Title</b>	An international Delphi study on a more rigorous, inclusive, and evidence-based approach to research on primary cam morphology
<b>Aim</b>	To inform a more rigorous, inclusive, and evidence-based approach to research on primary cam morphology in athletes
<b>Objectives</b>	The study objectives; to: <ol style="list-style-type: none"> <li>(1) ascertain level of agreement between experts on primary cam morphology taxonomy, terminology, and definitions, (including imaging outcome measures),</li> <li>(2) work towards agreement on a set of research priorities on conditions affecting the young person's hip (focussing on primary cam morphology and its consequences in athletes), and</li> <li>(3) inform the design of a webinar and symposium to engage stakeholders, disseminate latest evidence, and stimulate debate</li> </ol>
<b>Steering Committee Chairperson</b>	Professor Trisha Greenhalgh
<b>Steering Committee Members &amp; Affiliations</b>	<p>H Paul Dijkstra<sup>1 2</sup>, Sean Mc Auliffe<sup>3</sup>, Andreas Serner<sup>4</sup>, Andrea Mosler<sup>5</sup>, Joanne Kemp<sup>5</sup>, Clare L Arden<sup>5 6</sup>, Amy Price<sup>7</sup>, Sally Hopewell<sup>8</sup>, Jason Oke<sup>9</sup>, Karim M Khan<sup>10</sup>, Sion Glyn-Jones<sup>11</sup>, Mike Clarke<sup>12</sup>, Trisha Greenhalgh<sup>13</sup></p> <p><b>Steering Committee Affiliations</b></p> <p><sup>1</sup> Department of Medical Education, Aspetar, Qatar Orthopaedic and Sports Medicine Hospital, Doha, Qatar</p> <p><sup>2</sup> Department for Continuing Education, University of Oxford, Oxford, UK</p> <p><sup>3</sup> Department of Physical Therapy &amp; Rehabilitation Science, College of Health Sciences, Qatar University, Doha, Qatar</p> <p><sup>4</sup> Aspetar Sports Groin Pain Centre, Aspetar Orthopaedic and Sports Medicine Hospital, Doha, Qatar</p> <p><sup>5</sup> La Trobe Sport and Exercise Medicine Research Centre, School of Allied Health, Human Services and Sport, La Trobe University, Melbourne, Victoria, Australia</p> <p><sup>6</sup> Musculoskeletal and Sports Injury Epidemiology Centre, Department of Health Promotion Science, Sophiahemmen University, Stockholm, Sweden</p>

Nuffield Department of Primary Care Health Sciences University of Oxford Radcliffe Primary Care Building Woodstock Rd Oxford OX2 6GG	 	
<b>Principal Investigator:</b> Prof Trisha Greenhalgh	<b>Primary researcher:</b> Dr Paul Dijkstra (DPhil Evidence-Based Health Care student) Oxford University telephone number: 01865 617835 Oxford University e-mail: <a href="mailto:hendrik.dijkstra@conted.ox.ac.uk">hendrik.dijkstra@conted.ox.ac.uk</a>	

	<sup>7</sup> Stanford Anesthesia, Informatics and Media Lab, Stanford School of Medicine, Department of Anesthesia, Stanford University <sup>8</sup> Centre for Statistics in Medicine, Oxford Clinical Trials Research Unit, Medical Sciences Division, University of Oxford <sup>9</sup> NIHR Oxford Biomedical Research Centre, Oxford University Hospitals NHS Foundation Trust <sup>10</sup> Department of Family Practice and School of Kinesiology, University of British Columbia, Vancouver, Canada <sup>11</sup> Nuffield Department of Orthopaedics, Rheumatology and Musculoskeletal Sciences, University of Oxford <sup>12</sup> Northern Ireland Methodology Hub, Centre for Public Health, Queen's University Belfast, UK <sup>13</sup> Nuffield Department of Primary Care Health Sciences, University of Oxford, Oxford, UK;
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### Terms of Reference

The Primary Cam Morphology Delphi Study Steering Committee will:

1. approve and publish the study protocol
2. deliver expertise to the study group
3. provide oversight to all elements of the study towards its overall objectives
4. review study progress at regular intervals
5. ensure compliance with ethical research standards
6. provide oversight to the planning and conduct of the final synchronous (online/in-person) discussion of the Delphi results with careful attention to dissent and ambiguity
7. assist in disseminating findings from the study across their wider networks

Approved: 14<sup>th</sup> April 2021

Mr Paul Blazey (Centre for Hip Health and Mobility, University of British Columbia, Vancouver, Canada; Department of Physical Therapy, Faculty of Medicine, University of British Columbia, Vancouver, Canada) replaced Professor Sally Hopewell.





## The Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series

### The Young Athlete's Hip Research (YAHir) Collaboration

Protecting the young athlete's hip: the frontline of clinical practice and research on primary cam morphology and femoroacetabular impingement (FAI) syndrome

### #OxfordHip2021

Date	Title and faculty	CPD 17.5
20 <sup>th</sup> Nov 2020, 5pm GMT	<b>1. What is primary cam morphology? Taxonomy, terminology and definitions</b> Clare Ardern, Paul Dijkstra, Siôn Glyn-Jones, Karim Khan	1
11 <sup>th</sup> Dec 2020, 6pm GMT	<b>2. Imaging strategies for primary cam morphology and FAI syndrome</b> Paul Dijkstra, Ara Kassarian, Joanne Kemp, Andrea Mosler, Eugene McNally, Antony Palmer with Bruce Forster and Scott Fernquest	1.5
15 <sup>th</sup> Jan 2021, 7pm GMT	<b>3. What causes primary cam morphology and FAI syndrome?</b> Clare Ardern, Joanne Kemp, Paul Dijkstra, Rintje Agricola, Siôn Glyn-Jones, Josh Heerey, Pim van Klij	1.5
5 <sup>th</sup> Feb 2021, 7pm GMT	<b>4. Screening and prevention of primary cam morphology and its consequences in athletes</b> Clare Ardern, Joanne Kemp, Paul Dijkstra, Rintje Agricola, Andrea Mosler, Jason Oke	1.5
26 <sup>th</sup> Feb 2021, 7pm GMT	<b>5. Hip dysplasia, cam morphology and FAI syndrome – is there a link?</b> Julie Jacobsen, Inger Mechlenburg, Siôn Glyn-Jones, Clare Ardern, Joanne Kemp, Paul Dijkstra	1.5
26 <sup>th</sup> March 2021, 7pm GMT	<b>6. What are the consequences of primary cam morphology?</b> Andrea Mosler, Josh Heerey, Siôn Glyn-Jones, Rintje Agricola, Clare Ardern, Joanne Kemp, Paul Dijkstra	1.5
30 <sup>th</sup> April 2021, 7pm BST	<b>7. Treatment and prognosis of primary cam morphology and FAI syndrome in young athletes</b> Joanne Kemp, Mo Gimpel, Per Hölmich, Siôn Glyn-Jones, Marc Philippon, Clare Ardern, Paul Dijkstra	2
Saturday 29 <sup>th</sup> May 2021, 12.00 BST	<b>8. Young Athlete's Hip Research (YAHir) collaboration</b> Sean Mc Auliffe, Paul Dijkstra, Femi Ayeni, Scott Fernquest, Antony Palmer, Sheree Bekker, Lauren Pierpoint, Clare Ardern	2
23 <sup>rd</sup> June 2021, 8pm BST	<b>9. Involving patients and the public in developing, performing, and reporting research and education on FAI syndrome and primary cam morphology</b> Amy Price, Dawn Richards, Lindsey Plass, Rich Willy, Andrea Mosler, Clare Ardern, Joanne Kemp, Paul Dijkstra	1.5
22 <sup>nd</sup> Sept 2021, 12pm BST	<b>10. Sharing results of the YAHir Collaboration's Delphi exercise on primary cam morphology terminology, definitions and imaging outcome measures</b> Clare Ardern, Paul Dijkstra, Eugene McNally, Siôn Glyn-Jones, Joanne Kemp	1.5
23 <sup>rd</sup> Sept 2021, 12pm BST	<b>11. Young Athlete's Hip Research Collaboration: Prioritising rigorous, inclusive, and evidence-based research on conditions affecting the young person's hip (focussing on primary cam morphology and its consequences in athletes)</b> Mike Clarke, Andrea Mosler, Stephanie Kliethermes, Trish Greenhalgh, Siôn Glyn-Jones, Karim Khan, Joanne Kemp, Clare Ardern, Paul Dijkstra	2.5

Version: 30 August 2020 (14)



<b>Scientific Planning &amp; Organising Committee</b>	Paul Dijkstra (Chair), Siôn Glyn-Jones (Co-Chair), Mike Clarke (Co-Chair), Joanne Kemp (Co-Chair), Karim Khan, Trisha Greenhalgh, Jason Oke, Clare Arden, Andrea Mosler, Louise Strickland, Sofie Nelis, Faten Smiley, Sue King, Tiya Muluzi, Matt Brock, Ruth Davis
<b>Scientific Faculty</b>	Rintje Agricola, Clare Arden, Femi Ayeni, Sheree Bekker, Paul Dijkstra, Scott Fernquest, Bruce Forster, Mo Gimpel, Siôn Glyn-Jones, Trisha Greenhalgh, Josh Heerey, Per Hölmich, Julie Jacobsen, Ara Kassarian, Joanne Kemp, Stephanie Kliethermes, Sean Mc Auliffe, Eugene McNally, Inger Mechlenburg, Andrea Mosler, Jason Oke, Antony Palmer, Marc Philippon, Lauren Pierpoint, Lindsey Plass, Amy Price, Dawn Richards, Pim van Klij, Rich Willy
<b>Cost</b>	<b>£75 for all 11 webinars</b>
<b>CPD Accreditation</b>	The Royal College of Surgeons of England (17.5 CPD credits) <a href="http://accreditation.rcseng.ac.uk/Home/InfoAccredited">http://accreditation.rcseng.ac.uk/Home/InfoAccredited</a>
<b>Collaborating Institutions</b>	A <b>collaborative event</b> between the University of Oxford, Aspetar, Qatar Orthopaedic and Sports Medicine Hospital, and La Trobe University. <b>Approved by</b> British Journal of Sports Medicine (BJSM) as “Quality International Education” <b>Endorsed by:</b> CIHR Institute of Musculoskeletal Health and Arthritis (CIHR) <b>Faculty from:</b> Aarhus University, University of Bath, Copenhagen University, Erasmus University Medical Centre, McMaster University, Philippon Steadman Clinic, Southampton Football Club, Stanford University, Qatar University



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## Overall Objectives

### Following this webinar series participants will be able to:

1. Discuss terminology and definitions for primary cam morphology and femoroacetabular impingement (FAI) syndrome
2. Compare imaging outcome measures in research studies on how primary cam morphology develops, and in clinical practice when treating patients with FAI syndrome
3. List the risk factors for primary cam morphology in athletes, and discuss the definition, measurement and reporting of these
4. Describe potential benefits and harms of screening for primary cam morphology in athletes, including wise treatment strategies, overdiagnosis and overtreatment
5. Describe hip dysplasia and its role in FAI
6. Discuss primary cam morphology prognosis, including who is likely to develop FAI syndrome and hip osteoarthritis
7. Discuss wise clinical management of asymptomatic athletes with primary cam morphology, and those with FAI syndrome
8. Develop a research plan for prospective research on aetiology and prognosis of hip conditions in the young athlete
9. Develop a plan for Patient and Public Involvement (PPI) in hip research
10. Discuss the role of prospective individual participant data meta-analyses in research on primary cam morphology formation and prognosis



## The Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series

### WEBINAR 1: What is primary cam morphology? Taxonomy, terminology and definitions (1 hour)

**Faculty:** Clare Ardern, Siôn Glyn-Jones, Paul Dijkstra, Karim Khan

#### Objectives

Following this webinar participants will be able to:

1. Discuss the current inconsistent use of terminology and definitions for primary cam morphology
2. Describe 3 key elements of concept analysis method
3. Discuss why primary cam morphology in the athlete matters

#### How do we talk about and define primary cam morphology?

8 min	Introduction	Paul Dijkstra, Clare Ardern & Karim Khan
12 min	Confusing terminology, definitions and outcome measures make it difficult to protect athletes' health	Clare Ardern
12 min	What is primary cam morphology? A concept analysis	Paul Dijkstra
12 min	Why is primary cam morphology important?	Siôn Glyn-Jones
16 min	Discussion: implications for clinical practice and research	All



## WEBINAR 2: Imaging strategies for primary cam morphology and FAI syndrome (1.5 hours)

**Faculty:** Clare Ardern, Paul Dijkstra, Ara Kassarian, Joanne Kemp, Andrea Mosler, Eugene McNally, Antony Palmer with Bruce Forster and Scott Fernquest

### Objectives

Following this webinar participants will be able to:

1. Choose wisely the appropriate imaging for studies on how primary cam morphology develops, and for managing femoracetabular impingement syndrome in clinical practice
2. Describe the factors to consider when planning serial scanning for research in adolescent athletes

### How do we diagnose cam morphology and FAI syndrome?

5 min	Introduction	Clare Ardern, Joanne Kemp & Paul Dijkstra
20 min	What are the imaging modalities and standards for primary cam morphology and its complications in research and clinical practice?	Eugene McNally
20 min	This is how I would do serial hip MRI-scans in research on how primary cam morphology develops	Ara Kassarian
20 min	Should the imaging core outcomes for primary cam morphology <b>research</b> be different to that used when managing FAI syndrome in <b>clinical practice</b> ?	Antony Palmer
10 min	A parent's perspective: "Will I allow my athlete-child to participate in a research project involving regular scanning?"	Andrea Mosler
15 min	Discussion: implications for primary cam morphology research	With Bruce Forster and Scott Fernquest





### WEBINAR 3: What causes primary cam morphology and FAI syndrome? (1.5 hours)

**Faculty:** Clare Ardern, Joanne Kemp, Paul Dijkstra, Rintje Agricola, Siôn Glyn-Jones, Josh Heerey, Pim van Klij

#### Objectives

Following this session participants will be able to:

1. Describe the possible causes of primary cam morphology
2. List the risk factors for primary cam morphology
3. Discuss the causes of FAI syndrome

#### What causes primary cam morphology & femoroacetabular impingement (FAI) syndrome?

5 min	Introduction	Clare Ardern, Joanne Kemp & Paul Dijkstra
20 min	Do we know yet what causes primary cam morphology in athletes? The role of the femoral capital growth plate	Siôn Glyn-Jones
15 min	Modelling load—what is it about load in sport that might cause primary cam morphology?	Rintje Agricola
15 min	What are the possible risk factors for primary cam morphology?	Pim van Klij
20 min	What causes FAI syndrome?	Josh Heerey
15 min	Panel discussion	All



#### WEBINAR 4: Screening and prevention of primary cam morphology and its consequences in athletes (1.5 hours)

**Faculty:** Clare Ardern, Joanne Kemp, Paul Dijkstra, Rintje Agricola, Andrea Mosler, Jason Oke

##### Objectives

Following this session participants will be able to

1. Implement wise decisions on screening for primary cam morphology in athletes
2. Explain overdiagnosis and overtreatment in the context of primary cam morphology
3. Summarise the current evidence for primary cam morphology prevention

##### Should we screen for cam morphology to prevent FAI syndrome?

5 min	Introduction	Clare Ardern, Joanne Kemp & Paul Dijkstra
20 min	Screening the young and older athlete for cam morphology – why, how, who and when?	Andrea Mosler
20 min	Is overdiagnosis and overtreatment a reasonable concern when screening young athletes for primary cam morphology?	Jason Oke
20 min	Is it possible (yet) to prevent primary cam morphology in young athletes?	Rintje Agricola
25 min	Panel discussion	All



## WEBINAR 5: Hip dysplasia, cam morphology and femoroacetabular impingement (FAI) syndrome – is there a link? (1.5 hours)

**Faculty:** Julie Jacobsen, Inger Mechlenburg, Siôn Glyn-Jones, Clare Ardern, Joanne Kemp, Paul Dijkstra

### Objectives

Following this session participants will be able to:

1. Define hip dysplasia
2. Explain the role for physiotherapy training in managing hip dysplasia
3. Describe the current evidence for dysplasia in femoroacetabular impingement and primary cam morphology
4. Develop a management plan for an athlete with hip dysplasia

### Is hip dysplasia associated with primary cam morphology and FAI syndrome?

5 min	Introduction	Clare Ardern, Joanne Kemp & Paul Dijkstra
20 min	What is hip dysplasia and is there a role for physiotherapy training in managing the condition?	Julie Jacobsen
20 min	Hip dysplasia, cam morphology and FAI syndrome – is there a link?	Inger Mechlenburg
20 min	How do we manage hip dysplasia in the athlete? When is surgery indicated and what types of surgery should we consider?	Siôn Glyn-Jones
25 min	Panel discussion	All



## WEBINAR 6: What are the consequences of primary cam morphology? (1.5 hours)

**Faculty: Andrea Mosler, Josh Heerey, Siôn Glyn-Jones, Rintje Agricola, Clare Ardern, Joanne Kemp, Paul Dijkstra**

### Objectives

Following this session participants will be able to:

1. Explain the possible consequences of primary cam morphology
2. Describe the relationship between primary cam morphology, hip pain, and early osteoarthritis
3. Discuss primary cam morphology in athletes as a risk factor for hip osteoarthritis
4. Design a patient information leaflet to help patients/athletes to understand their risk of developing osteoarthritis associated with different sizes of primary cam morphology

### Consequences of primary cam morphology in the athlete

5 min	Introduction	Clare Ardern, Joanne Kemp & Paul Dijkstra
15 min	Will athletes with primary cam morphology develop groin pain?	Andrea Mosler
15 min	What is the relationship between primary cam morphology, hip pain and early OA?	Josh Heerey
15 min	Who will develop osteoarthritis?	Siôn Glyn-Jones
15 min	Can we prevent athletes with large primary cam morphologies from developing osteoarthritis?	Rintje Agricola
25 min	Panel discussion	All



## WEBINAR 7: Treatment and prognosis of primary cam morphology and femoroacetabular impingement in young athletes (2 hours)

**Faculty:** Joanne Kemp, Mo Gimpel, Per Hölmich, Siôn Glyn-Jones, Marc Philippon, Clare Ardern, Paul Dijkstra

### Objectives

Following this session participants will be able to:

1. Construct an effective physiotherapy program for athletes with FAI syndrome and primary cam morphology
2. Explain the indications for surgery in athletes with FAI syndrome and primary cam morphology
3. Create a wise treatment plan for the athlete with asymptomatic primary cam morphology or FAI syndrome and primary cam morphology
4. Summarise the current evidence for physiotherapy vs hip arthroscopy when managing athletes with FAI syndrome

### Treatment and Prognosis of primary cam morphology and FAI syndrome in athletes

5 min	Introduction	Clare Ardern & Paul Dijkstra
20 min	What is best practice physiotherapy for the athlete with primary cam morphology and early FAI syndrome?	Joanne Kemp
20 min	Clinical pearls in managing early primary cam morphology – the Southampton Football Club experience	Mo Gimpel
20 min	What are the indications for surgery for the athlete with primary cam morphology and early FAI syndrome?	Per Hölmich
20 min	Physiotherapy vs hip arthroscopy for athletes with FAI syndrome – current evidence	Siôn Glyn-Jones
20 min	What are the best surgical options for the athlete with debilitating FAI syndrome?	Marc Philippon
15 min	Panel Discussion	All





### WEBINAR 8: Young Athlete's Hip Research (YAHIR) Collaboration (2 hours)

**Faculty: Sean Mc Auliffe, Paul Dijkstra, Femi Ayeni, Antony Palmer, Scott Fernquest, Sheree Bekker, Lauren Pierpoint, Clare Ardern**

#### Objectives

Following this session participants will be able to:

1. Apply a framework for high quality clinical research
2. List the factors contributing to complexity in research
3. Discuss the importance of hip research collaboration

High quality research and collaboration		
10 min	Introduction	Clare Ardern & Paul Dijkstra
15 min	What is high quality research? Stakeholder perspectives on factors contributing to high quality research on how primary cam morphology develops in athletes - a qualitative interview study	Sean Mc Auliffe & Paul Dijkstra
15 min	Planning collaborative research on primary cam morphology formation – top tips.	Femi Ayeni
20 min	Lessons from the FAIM study	Antony Palmer & Scott Fernquest
15 min	Why is clinical research so complex?	Sheree Bekker
15 min	Why is it important to collaborate and share data in hip research?	Lauren Pierpoint
30 min	Panel Discussion	All



**WEBINAR 9: Involving patients and the public in developing, performing, and reporting research and education on FAI syndrome and primary cam morphology (1.5 hours)**

**Faculty: Amy Price, Dawn Richards, Lindsey Plass, Rich Willy, Andrea Mosler, Clare Ardern, Joanne Kemp, Paul Dijkstra**

**Objectives**

Following this session participants will be able to:

1. Describe patient and public involvement (PPI) in planning, performing, and reporting research
2. Develop a PPI plan for research on primary cam morphology and FAI syndrome
3. Summarise a parent's perspective on the risk of their child developing primary cam morphology in adolescent sport
4. Consider the importance of the patient's voice when discussing FAI syndrome treatment options

**Patient and public involvement in research and education**

5 min	Introduction	Clare Ardern, Jo Kemp & Paul Dijkstra
20 min	Patient and public involvement (PPI) in research – what is it and why is this so important? Essential components of a plan for PPI in research	Amy Price and Dawn Richards
15 min	Thriving with FAI syndrome	Lindsey Plass
15 min	Involving patients in developing patient reported outcome measures in hip research/How can we make research more inclusive?	Rich Willy
5 min	A parent's perspective: my child is a young competitive football player at risk of developing primary cam morphology - should I worry?	Andrea Mosler
30 min	Research and Collaboration Panel Discussion	All with Dawn Richards



## WEBINAR 10: Sharing results of the YAHIR Collaboration's Delphi exercise on primary cam morphology terminology, definitions, and imaging outcome measures (1.5 hours)

**Faculty:** Clare Ardern, Paul Dijkstra, Eugene McNally, Siôn Glyn-Jones, Joanne Kemp

### Objectives

Following this session participants will be able to:

1. Apply a standard taxonomy, terminology, and definition for primary cam morphology and femoroacetabular syndrome
2. Discuss the consensus on imaging outcomes for studies on how primary cam morphology develops
3. Consider the benefits to stakeholders of applying consistent terminology and definitions for primary cam morphology

10 min	Introduction – Delphi study on primary cam morphology	Joanne Kemp, Clare Ardern and Paul Dijkstra
15 min	Consensus definition for primary cam morphology – results of the Delphi study	Paul Dijkstra
15 min	Consensus taxonomy and terminology for primary cam morphology and femoroacetabular impingement syndrome	Clare Ardern
20 min	Consensus on imaging outcomes for studies on how primary cam morphology develops	Eugene McNally
30 min	Research and Collaboration Panel Discussion	All with Siôn Glyn-Jones



**WEBINAR 11: Young Athlete's Hip Research Collaboration: Prioritising rigorous, inclusive, and evidence-based research on conditions affecting the young person's hip (focussing on primary cam morphology and its consequences in athletes) (2.5 hours)**

**Faculty: Mike Clarke, Andrea Mosler, Stephanie Kliethermes, Trisha Greenhalgh, Karim Khan, Siôn Glyn-Jones, Clare Ardern, Joanne Kemp, Paul Dijkstra**

**Objectives**

Following this session participants will be able to:

1. Summarise the key elements of study design to investigate how primary cam morphology develops
2. Review measures to avoid selection bias in research on how primary cam morphology develops
3. Discuss examples of high-quality research on how primary cam morphology develops (focussing on how to define, measure and report risk factors)
4. Discuss some of the important questions only qualitative research can answer

10 min	Introduction	Clare Ardern, Joanne Kemp and Paul Dijkstra
15 min	What are the best populations to investigate how primary cam morphology develops? (Including top 5 tips to avoid selection bias)	Andrea Mosler
15 min	What is an Individual Participant Data (IPD) Meta-analysis?	Mike Clarke
20 min	Cohort study planning, conducting and data sharing for future IPD meta-analyses – is it possible?	Stephanie Kliethermes
25 min	We should go beyond numbers and meta-analyses; there are important questions that only qualitative research can answer	Trisha Greenhalgh
5 min	Short break	
20 min	Summary of the Delphi exercise to agree on a prioritised research agenda for conditions affecting the young person's hip	Paul Dijkstra
40 min	Research and Collaboration Panel Discussion	All with Karim Khan and Siôn Glyn-Jones

## SUPPLEMENTARY FILE 5

## Primary Cam Morphology Delphi – Round 1 and 2

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- Statement 39:** The magnetic resonance (MR) imaging protocol for research on how primary cam morphology develops should include: (i) unilateral small field-of-view (FOV) sequences and radial images of a randomly selected or both hips, as well as (ii) femoral torsion assessment (fast axial sequences of the distal knee—femoral condyles—and proximal femoral neck), and (iii) a fluid sensitive sequence covering the whole pelvis (in axial or coronal planes, to screen for soft-tissue and bone marrow edema beyond the hip)..... 128
- Statement 40:** The magnetic resonance (MR) imaging for prospective research on how primary cam morphology develops should be repeated every 18 to 24 months..... 131
- Statement 41:** In primary cam morphology epidemiological research (e.g., when regression is being used in aetiology or prognosis research), continuous imaging outcome measures (variables), like the alpha angle, should be kept continuous..... 134
- Statement 42:** The cam morphology magnetic resonance (MR) imaging outcome measure for research on how primary cam morphology develops (aetiology), should be the alpha angle for bone and cartilage as a continuous variable, reported for all the o'clock locations around the femoral head-neck junction, regardless of the symptomatic state of the research participant. .... 137
- Statement 43:** For research on how primary cam morphology develops it is important to quantify the epiphyseal morphology magnetic resonance (MR) imaging outcome measure using epiphyseal extension..... 140
- Statement 44:** For research on how primary cam morphology develops the epiphyseal morphology magnetic resonance (MR) imaging outcome measure should also be quantified using epiphyseal tilt ..... 143
- Statement 45:** The main imaging modality for longitudinal primary cam morphology prognosis research should be anteroposterior (AP) pelvis and Dunn 45° view radiographs repeated at least every 5 years ..... 146
- Statement 46:** The radiographic imaging outcome measure for research on primary cam morphology prognosis should be the alpha angle as a continuous variable reported for anteroposterior (AP) pelvis and Dunn 45° view radiographs. .... 149
- Statement 47:** In addition to reporting alpha angles as continuous in studies on aetiology or prognosis, the following quantitative and qualitative imaging outcome measures, to categorise cam morphology, can be useful in research or clinical practice: (i) Alpha angle  $\geq 60^\circ$  (preferred) (ii) Head-neck offset  $< 8\text{mm}$  AND head-neck offset ratio  $\leq 0.15$  usually at the anterior (3 o'clock) location around the femoral head-neck junction (in addition to (i)); Osseous or cartilage convexity of the femoral head neck junction at any location (in addition to (i) and (ii)) ..... 152

## Definition of consensus

Table 4 Definition of consensus		
Category	Definition	Action
Consensus in (high agreement)	Statement scored as critical (7 to 9) by $\geq 70\%$ of panel members <i>and</i> not important (1 to 3) by $<15\%$ of panel members	Item retained for the next survey round/consensus meeting
Consensus out (low agreement)	Scored as not important (1 to 3) by $\geq 70\%$ of panel members <i>and</i> critical (7 to 9) by $<15\%$ of panel members	Item discarded after round 2 (to be ratified at the face-to-face consensus meeting)
No consensus	Neither criteria above are met	Item retained for the next survey round/consensus meeting
Unable to score or provide feedback	Panel member unable to score the statement or provide a score and qualitative feedback	Provide the opportunity for panel members to indicate that they are unable to score the statement and/or to provide feedback (including statement rewording). Steering committee will consider retaining a reworded item for the next survey round.

## General Comments after Round 1

- I have no special training in this area (eg medical; physiotherapy; radiology etc) and therefore feel somewhat unqualified to answer some of these questions. I have just done my best as a lay person; using the knowledge from my career as a former elite athlete and now coach; and from webinars 1 and 2.
- Thanks for doing such a thorough job of curating the vast number of research questions that could be answered. I hadn't dreamed that there might be so many.
- Fantastic and important work.----I did not answer some of the technical radiography questions as I feel even with the help text it would be biased of me to answer them without a great depth of knowledge on the techniques involved.
- VERY comprehensive; congratulations!; MB
- I don't think the categorization of the 1-9 as critical; important; but not critical;... were appropriate in terms of agreeing to statements; only for priorities.
- Well designed; good luck.
- Great work!!!!----Really amazing effort
- I think it is really important to come up with a consensus on the terminology and how the health care providers tell patients they have this condition. It is also really important to come up with a consensus on how radiologists should document the findings in the MRI so that this does not cause unnecessary catastrophizing--like it did in my own personal hip journey.----For interventions; it will be helpful to better identify subgroups that will benefit from mobility vs stabilization vs combined interventions to help make PT treatments more targeted. ----It will be helpful to know what the recommendations are for younger people involved in high level sports who are at risk of developing FAI syndrome later in life. Can we do a certain screen once the

athlete stops playing or retires---and what information from this screen would indicate someone is at risk for developing symptomatic FAIs?----

- Instructive questioning. Thanks
- many questions very close to each other; difficult to distinguish...
- I noted a research priority regarding physiotherapy vs surgical outcomes - it would be interesting to look at physical activity interventions and/or non-surgical treatments (eg injections) alongside these;
- Overall it is a very good first round. I found it somewhat difficult to answer some research section statements; specifically when using the term 'studies'; which is quite generic.
- Great work; looking forward to the next steps!----Greetings

#### General comments after Round 2 (additional to Round 1)

- Fantastic work.
- Excellent presentation of round1 results among stakeholders
- Comments:
  - **Question 1:** I think the statement should remove the word abnormal. It seems that specific types of loading influence the development of a cam morphology. As we do not know details of which loads are key in this regard; the use of normal response to load may not be accurate. I would agree with the statement: "Primary cam morphology develops during skeletal maturation as a physiological response to load" or "Primary cam morphology develops during skeletal maturation as a physiological response to specific types of load"
  - **Question 2:** Same as question 1. I think the statement should remove the word "abnormal". It seems that specific types of loading influence the development of a cam morphology. As we do not know details of which loads are key in this regard; the use of normal response to load may not be accurate. --as the second part of the question is covered in question one; the statement could be shortened to: "Primary cam morphology is not caused by previous disease; injury or an acute event". I would agree with this.
  - **Question 3:** I think the word "existing" should be changed to "pre-existing". I do not think a healed proximal femoral fracture; as in the example; classify as an existing disease; rather a disease existing prior to the cam development therefore "pre-existing" or "prior" or "preceding". (disclaimer: English is not my first language).
  - **Question 7:** Could the statement possibly be modified to add "known" before history? If there is no history of disease it cannot be proven otherwise, correct? so the statement would be: "Cam morphology that develops in young and active individuals without any symptoms (e.g.; hip-related pain; stiffness) or known history of previous/existing hip disease; is primary cam morphology until proven otherwise.
  - **Questions 12:** I suggest changing "possibly" to "probably" before "due to high-load sporting activity and other unconfirmed risk factors"
  - **Questions 13-31:** Regarding preferred terms; there is probably a difference between preferences for communication between medical professionals (who may need specific terminology) and between

patients (who may benefit from more general terms to understand it better - e.g. "non-rounded" etc). This should be investigated.

- **Question 40:** I think the imaging should be repeated with even shorter intervals between (around 12 months).
- Thanks for the invite to participate!
- CONGRATS!----Important study!!
- The initial set of questions were not clear to me. None of the statements seemed to describe the terminology adequately; apart from the last one; which is why I initially scored them so low. However; on reviewing the other participants' answers; I realized I misunderstood. My understanding now is that each of these statements are important (in as far as they contain an element of the final definition; which is why I scored them much higher); even if they do not contain the full definition. The only statement to my mind which is less important is that it develops in both hips - whilst this is often the case; it is not always true.----Happy to explain more in person if this is not clear!
- Interesting and well conducted
- On this round I could not find the comment button by the statements.
- Eek. I was trying to enter reasons for the others and hit "enter" instead of tabbing to the next one. --The only big change was from 4 to 7... which now I can't really remember why. Most other changes were 1 point; and where more likely my "regression toward a mean" than anything else.
- Great process! Thanks again for including me.
- I just wonder how the patients can interpret so many technical terms. Regarding the studies; I also considered feasibility and whether there is strong conceptual background knowledge on which to build a reasonable hypothesis. So it is not just a rate on the importance.
- Thank you. It was an interesting exercise to measure my votes against that of colleagues and other disciplines.
- Great work; looking forward to the next round!

**Additional Statements proposed by panel**

1. Determine which type of study (Prospective cohort; RCT) will best answer a specific research question (as it is listed currently it is very difficult to get you head around the options listed on p.5) regarding aetiology, diagnosis, prognosis and management

Steering committee response:

**This can be part of the discussion(s) following the Delphi online rounds**

2. (unsure of how to word this but....) a research priority related to how diagnosis, rehab, return to sport impacted the mental health of young athletes (and others)

Steering committee response:

**Studies exploring how diagnosis, rehabilitation and return to sport potentially impact the mental health of young athletes (and others) – consider this as part of the online stakeholder group discussions**

3. In athletes with cam morphology, which movement patterns (prognostic screening) contribute to or reduce the incidence of FAIS?

Steering committee response:

**Studies to investigate which movement patterns (prognostic screening) contribute to or reduce the incidence of FAI syndrome in athletes with primary cam morphology – consider this as part of the online stakeholder group discussions (part of studies on primary cam morphology prognosis studies)**



## Summary: consensus and tension points / areas of dissent

- Consensus on 35 of 47 statements in Domains 1 to 4
- Consensus to further prioritise (using the ENHR method) 18 of 38 Research Statements (Domain 5)

Domain	Statements and expert panel opinions	Areas of tension and dissent	Proposed Action & topics for discussion
<b>Definitions</b>	Consensus on 9/12 statements  No consensus on 3/12 statements: statements 6,7,9	“unknown origin”  Primary cam morphology often occurs in <b>male athletes in both hips</b>  “I do not agree that the concept of Primary and secondary CAM is commonly agreed and established”	Statement 6: Primary cam morphology <b>ALSO</b> includes cam morphology of unknown origin  Higher prevalence in males due to lack of research in female cohorts
<b>Terminology</b>	Consensus on 16/19 statements  No consensus on 3/19 statements: statements 23,24,25	No consensus:  “ <b>Cam-type impingement</b> is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction”  “ <b>Cam femoroacetabular impingement (FAI)</b> is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction”  “ <b>Cam-type femoroacetabular impingement (FAI)</b> is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction”	Consensus to use: “Cam morphology is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction”  “Femoroacetabular impingement (FAI) Syndrome with cam morphology is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction”  Consensus to avoid: “lesion”; “deformity”; “abnormality”; “pistol grip deformity”
<b>Taxonomy</b>	Consensus on 3/4 statements	<b>Statement 34:</b> We should distinguish between primary and secondary cam morphology in <b>patients</b> with femoroacetabular impingement syndrome	Discuss: differences in opinion on importance /

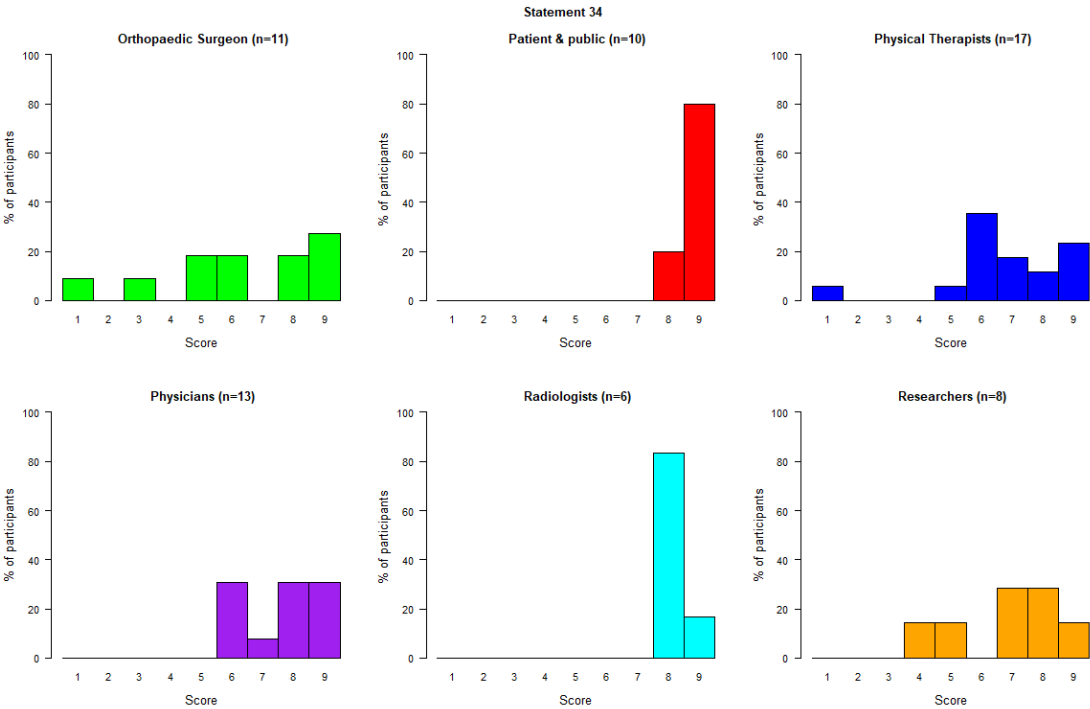
	No consensus on 1 statement: statement 34	Very close to achieving consensus: Percentage panelists that scored the statement as critical: 66.1% (R1) and 68.8% (R2) Percentage panelists that scored the statement as not important: 6.5% (R1) and 4.7% (R2)	difficulty to distinguish between primary and secondary cam morphology in clinical practice when treating patients with femoroacetabular impingement syndrome  Consider Round 3 for statement 34
<b>Imaging Outcomes</b>	Consensus on 7/12 statements  No consensus on 5/12 statements: statements 40,43, 44,45,46	No consensus (consider Round 3 for 3 statements in bold approaching consensus): Statement 40: "The magnetic resonance (MR) imaging for prospective research on how primary cam morphology develops should be repeated every 18 to 24 months"  <b>Statement 43:</b> "For research on how primary cam morphology develops it is important to quantify the epiphyseal morphology magnetic resonance (MR) imaging outcome measure using epiphyseal extension"  <b>Statement 44:</b> "For research on how primary cam morphology develops the epiphyseal morphology magnetic resonance (MR) imaging outcome measure should also be quantified using epiphyseal tilt"  <b>Statement 45:</b> "The main imaging modality for longitudinal primary cam morphology prognosis research should be anteroposterior (AP) pelvis and Dunn 45° view radiographs repeated at least every 5 years"  <b>Statement 46:</b> "The radiographic imaging outcome measure for research on primary cam morphology prognosis should be the alpha angle as a continuous variable reported for anteroposterior (AP) pelvis and Dunn 45° view radiographs."	"I just wonder how the patients can interpret so many technical terms"  Consider Round 3 for statements 43, 44, 45,46

Statements to consider for Round 3 (4 statements are close to ALL PANELIST or RADIOLOGIST STAKEHOLDER GROUP consensus)

- 1. TAXONOMY: Statement 34** We should distinguish between primary and secondary cam morphology in patients with femoroacetabular impingement syndrome

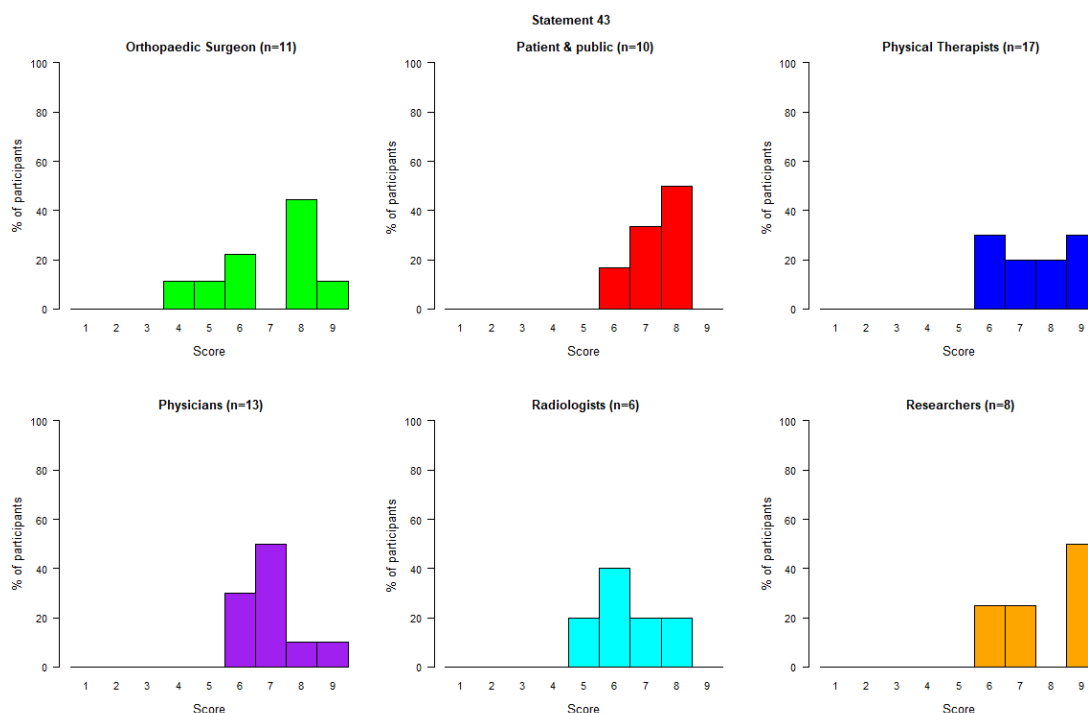
	Round 1	Round 2
Percentage panelists that scored the statement as critical	66.1%	68.8%
Percentage panelists that scored the statement as not important	6.5%	4.7%

RESULT	NO CONSENSUS	NO CONSENSUS
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2. IMAGING OUTCOME: Statement 43 For research on how primary cam morphology develops it is important to quantify the epiphyseal morphology magnetic resonance (MR) imaging outcome measure using epiphyseal extension

	Round 1	Round 2
Percentage panelists that scored the statement as critical	57.1%	65.9%
Percentage panelists that scored the statement as not important	4.8%	0%
RESULT	NO CONSENSUS	NO CONSENSUS



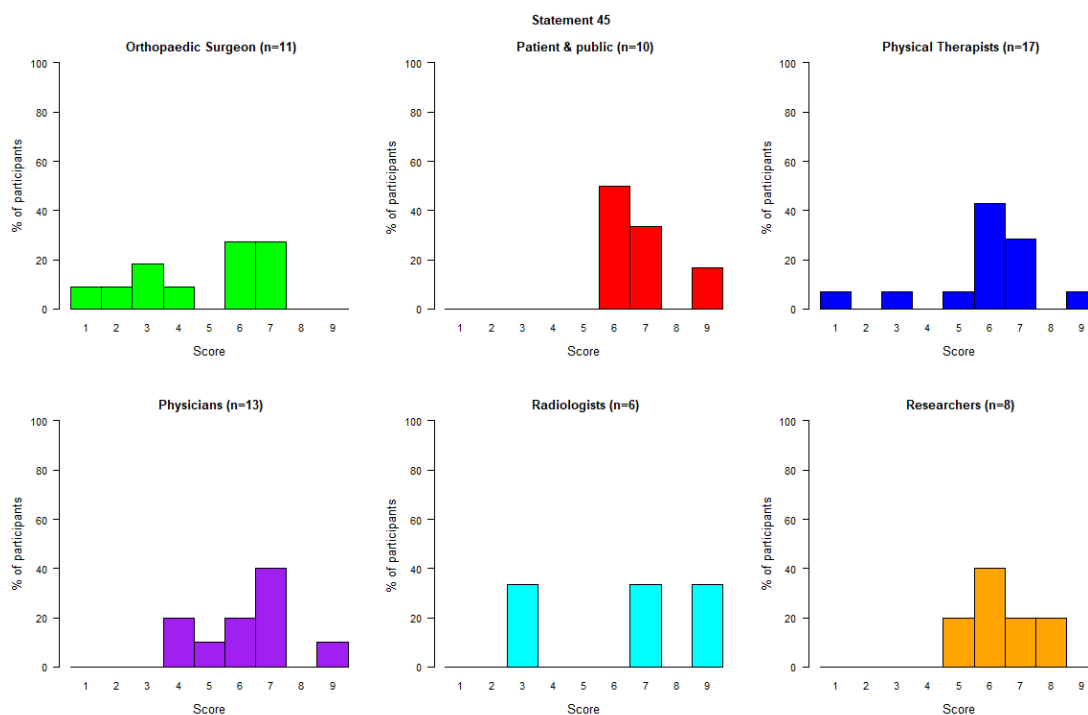
3. **IMAGING OUTCOMES: Statement 45** The main imaging modality for longitudinal primary cam morphology prognosis research should be anteroposterior (AP) pelvis and Dunn 45° view radiographs repeated at least every 5 years

#### ALL PANELISTS:

	Round 1	Round 2
Percentage panelists that scored the statement as critical	44.9%	42.3%
Percentage panelists that scored the statement as not important	20.4%	15.4%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

#### RADIOLOGISTS:

	Round 1	Round 2
Percentage panelists that scored the statement as critical	66.7%	66.7%
Percentage panelists that scored the statement as not important	33.3%	33.3%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>



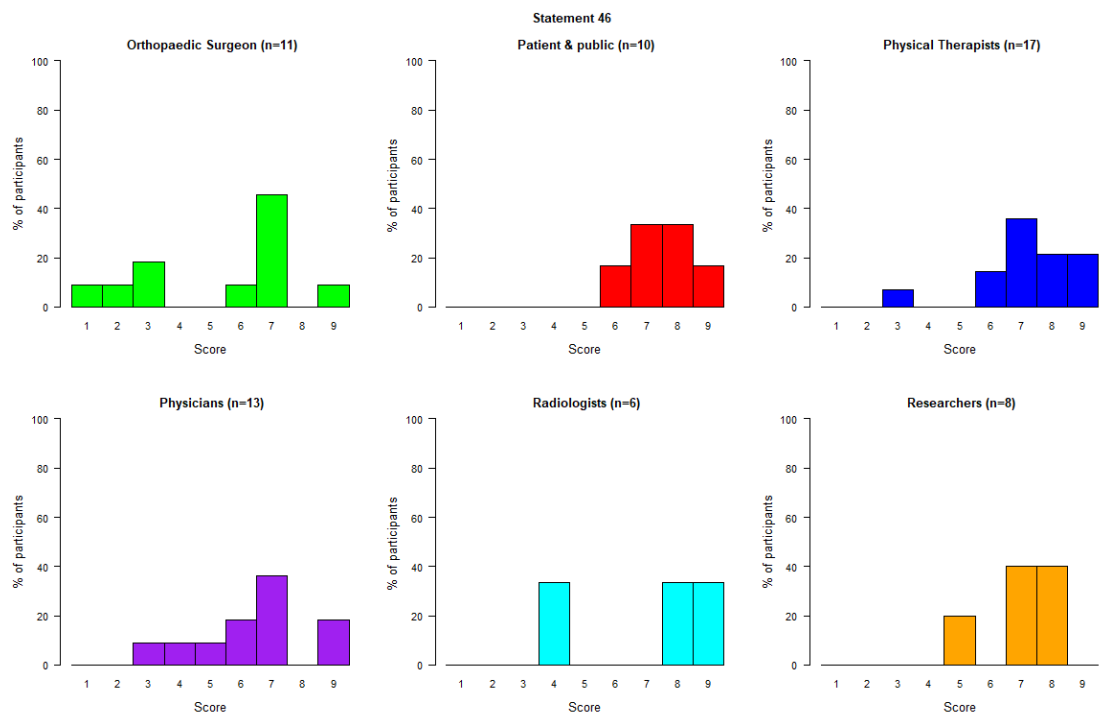
**4. IMAGING OUTCOME: Statement 46** The radiographic imaging outcome measure for research on primary cam morphology prognosis should be the alpha angle as a continuous variable reported for anteroposterior (AP) pelvis and Dunn 45° view radiographs.

#### ALL PANELISTS:

	Round 1	Round 2
Percentage panelists that scored the statement as critical	56.9%	67.9%
Percentage panelists that scored the statement as not important	15.7%	11.3%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

#### RADIOLOGISTS:

	Round 1	Round 2
Percentage panelists that scored the statement as critical	66.7%	66.7%
Percentage panelists that scored the statement as not important	0%	0%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>





## DEFINITIONS

**Statement 1:** Primary cam morphology develops during skeletal maturation as a normal physiological response to load

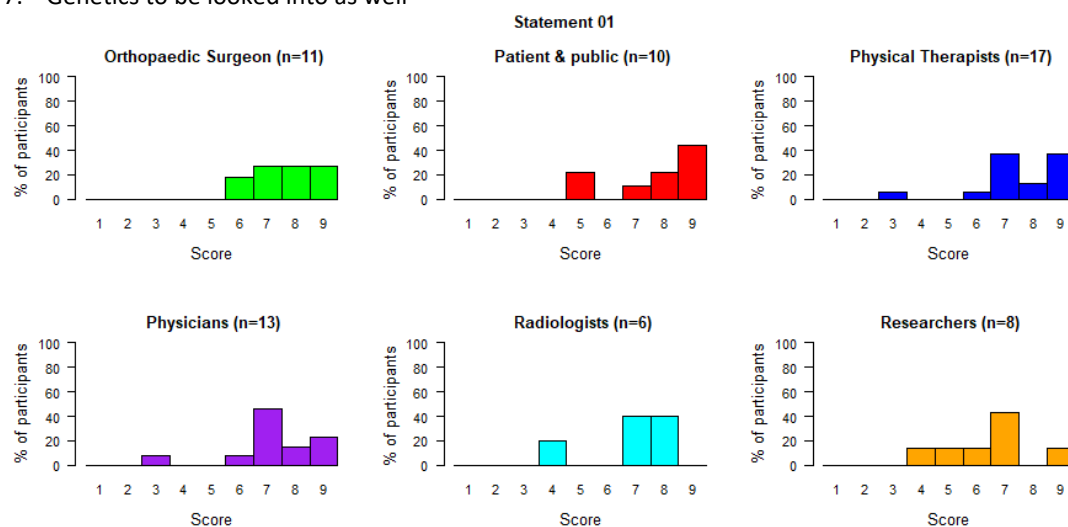
**R1: CONSENSUS IN**

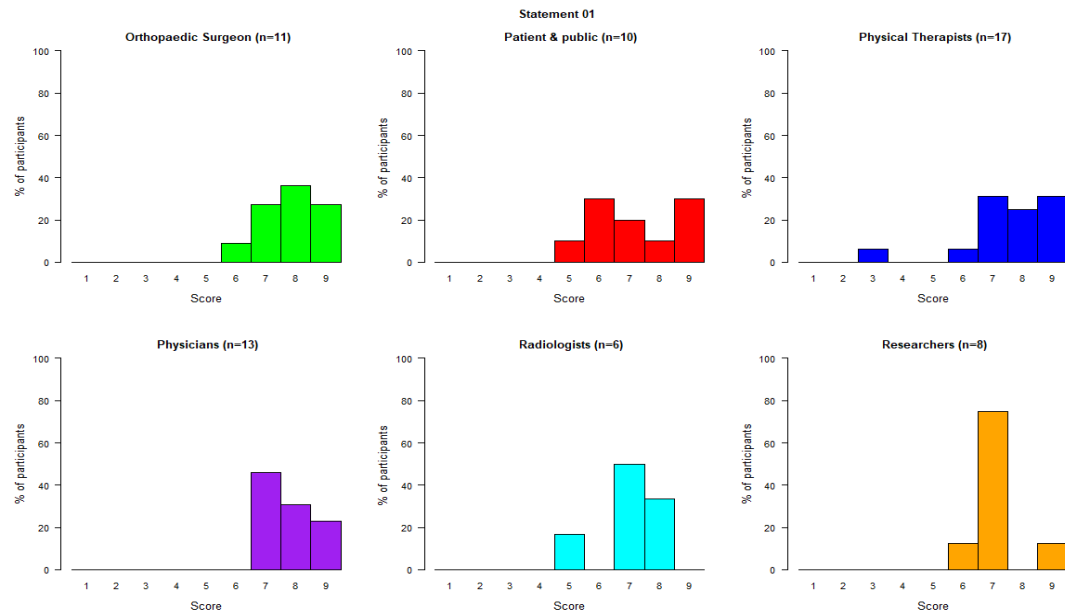
**R2: CONSENSUS IN**

HELPTXT from the Delphi repeated here for your convenience: A primary medical condition is one that arises spontaneously and is not associated with or caused by a previous disease, injury, or acute event while a secondary medical condition develops due to a pre-existing medical condition. For example, primary osteoporosis, bone loss due to aging or the loss of sex steroids at menopause, differs from secondary osteoporosis which is due to conditions such as thyroid hormone imbalance or renal disease. Thus, primary cam morphology is cam morphology that is not caused by previous disease, injury or an acute event. Secondary cam morphology develops due to pre-existing hip disease or acute trauma including Perthes disease, slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture.

## RESULTS: ROUND 1

1. I am in doubt whether to buy this concept?
2. My replies are made accepting the concept; but I feel it is twisting the idea of cam as the bony reaction during growth to include all kinds of malformations. Not sure how this concept will help us or be useful.
3. I would debate the term 'normal'; it's a physiological reaction but normal is questionable.
4. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
5. while I agree that CAM appears to occur during maturation as a response to load; whether this can be considered a normal response to load is more unclear.
6. not sure importance it the correct term to grade these statements; they are all important considerations
7. Genetics to be looked into as well



**RESULTS ROUND 2:****Reasons for score boundary changes from R1 to R2**

R1	R2	
3	7	I misunderstood the question - will elaborate in person
4	7	Actually very important to investigate further
5	7	I understand the group's feeling that this is an important component of defining primary cam morphology
4	7	Initial misunderstanding of the purpose of the statement

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	7	9	8	7	9
Patient & Public In	8	7	9	7	6	9
Physical Therapists	8	7	9	8	7	9
Physicians	7	7	8	8	7	8
Radiologists	7	7	8	7	7	8
Researchers	7	5	7	7	7	7

	Round 1	Round 2
Percentage panelists that scored the statement as critical	80.3%	85.9%
Percentage panelists that scored the statement as not important	3.3%	1.6%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>

**Statement 2:** Primary cam morphology is not caused by previous disease, injury or an acute event; it represents a normal physiological response of the maturing skeleton to load

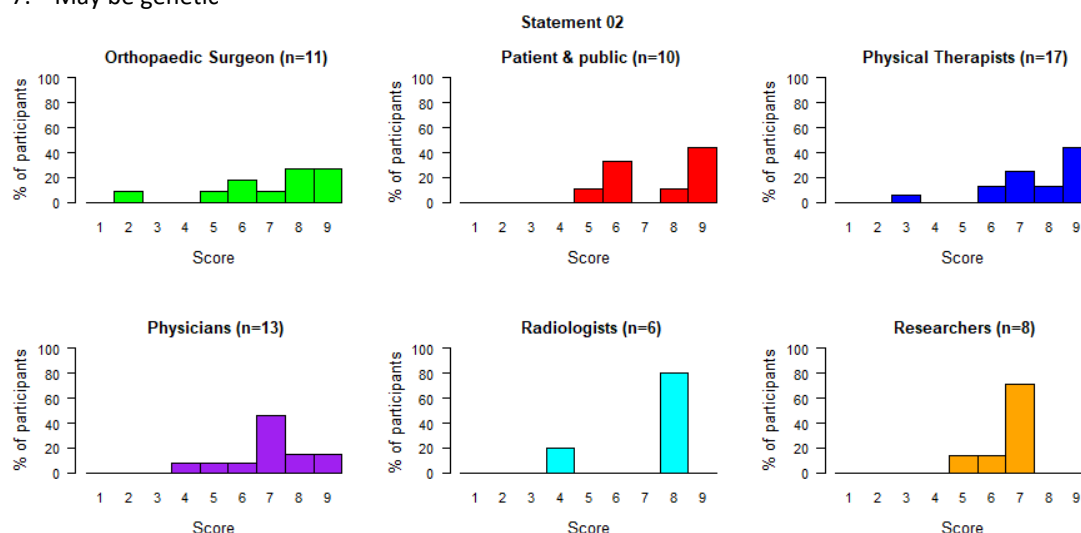
**R1: CONSENSUS IN**

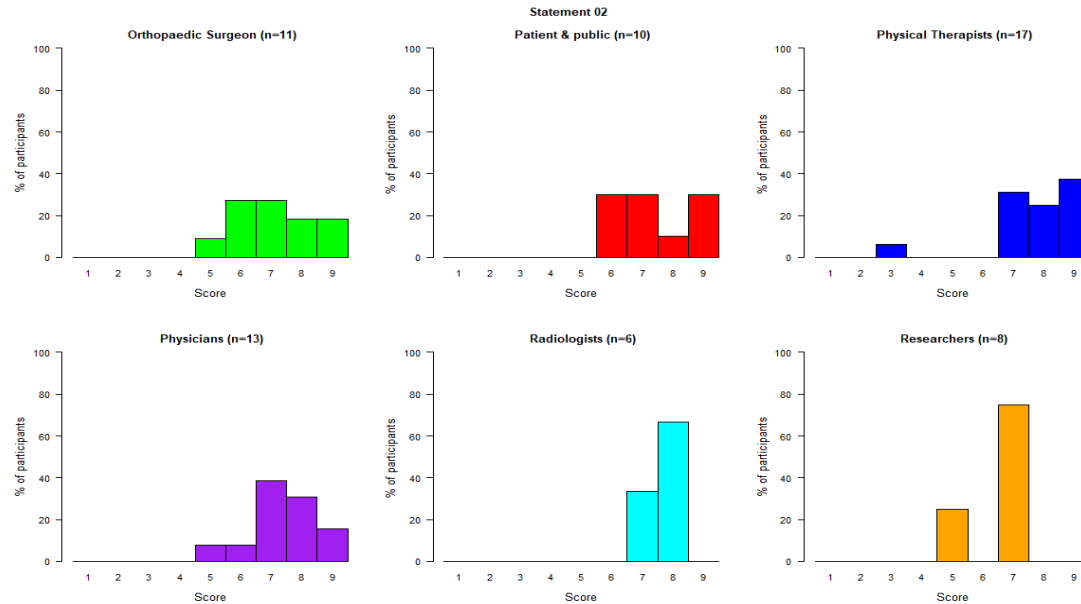
**R2: CONSENSUS IN**

HELPTXT: A primary medical condition is one that arises spontaneously and is not associated with or caused by a previous disease, injury, or acute event while a secondary medical condition develops due to a pre-existing medical condition. For example, primary osteoporosis, bone loss due to aging or the loss of sex steroids at menopause, differs from secondary osteoporosis which is due to conditions such as thyroid hormone imbalance or renal disease. Thus, primary cam morphology is cam morphology that is not caused by previous disease, injury or an acute event. Secondary cam morphology develops due to pre-existing hip disease or acute trauma including Perthes disease, slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture.

## RESULTS: ROUND 1

1. I feel this supersedes statement one.
2. I don't agree with a normal physiological response to 'load'. Isn't it overload? And can we then still call it a physiological response?
3. Not caused by previous disease seems to be a critical distinction of primary cam morphology
4. The same. I would debate the term 'normal'; it's a physiological reaction but normal is questionable.
5. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
6. again the use of "normal" response to load; reduces my agreement
7. May be genetic



**RESULTS: ROUND 2****Reasons for score boundary changes from R1 to R2**

R1	R2	
6	7	Relevant that cam morphology is normal.
6	7	It is important for patients to know this.
2	5	Can occur due to SCFE or other etiologies
4	7	As above
4	7	Initial misunderstanding of the purpose of the statement
10	5	Felt more confident in being able to answer question

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	6	9	7	6	8
Patient & Public In	8	6	9	7	6	9
Physical Therapists	8	7	9	8	7	9
Physicians	7	7	8	7	7	8
Radiologists	8	8	8	8	7	8
Researchers	7	6	7	7	6	7

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	72.1%	81.3%
Percentage panelists that scored the statement as not important	3.3%	1.6%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>

**Statement 3:** Secondary cam morphology develops due to existing hip disease or acute trauma, including Perthes disease, slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture

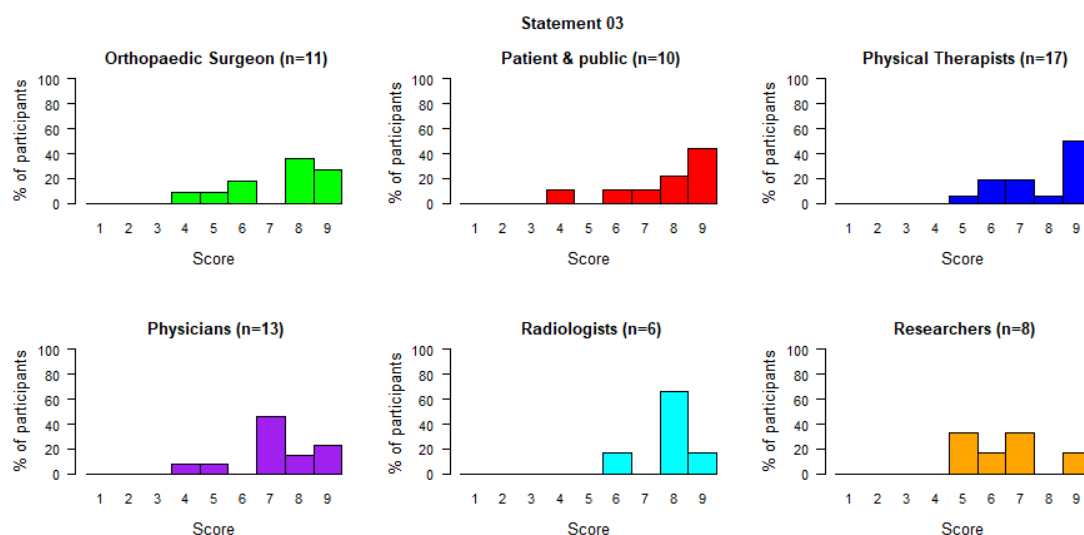
**R1: CONSENSUS IN**

**R2: CONSENSUS IN**

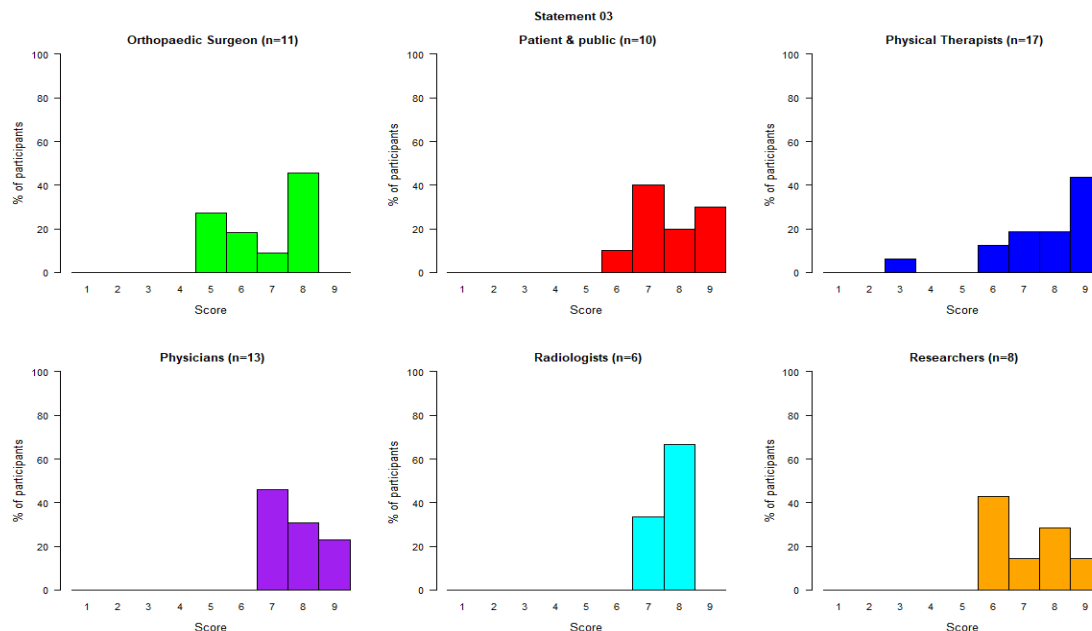
HELPTXT: A primary medical condition is one that arises spontaneously and is not associated with or caused by a previous disease, injury, or acute event while a secondary medical condition develops due to a pre-existing medical condition. For example, primary osteoporosis, bone loss due to aging or the loss of sex steroids at menopause, differs from secondary osteoporosis which is due to conditions such as thyroid hormone imbalance or renal disease. Thus, primary cam morphology is cam morphology that is not caused by previous disease, injury or an acute event. Secondary cam morphology develops due to pre-existing hip disease or acute trauma including Perthes disease, slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture.

## RESULTS: ROUND 1

I do not agree that the concept of Primary and secondary CAM is commonly agreed and established





**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
6	7	Reflecting on it; understanding how secondary is different from primary is important.
5	7	First round I thought it was common knowledge. I now followed the lead of orthopedics and physicians
6	7	reviewed other responses
4	7	As above
6	7	At first I thought that secondary cam morphology is that rare that's not really important; but it can ben be some individuals.
9	3	I think the statement should remove the word "normal". It seems that specific types of loading influence the development of a cam morphology. As we do not know details of which loads are key in this regard; the use of normal response to load may not be accurate. I would agree with the statement: "Primary cam morphology develops during skeletal maturation as a physiological response to load" or "Primary cam morphology develops during skeletal maturation as a physiological response to specific types of load".

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75

<b>Orthopaedic Surgeon</b>	8	6	9	7	5	8
<b>Patient &amp; Public In</b>	8	7	9	8	7	9
<b>Physical Therapists</b>	9	7	9	8	7	9
<b>Physicians</b>	7	7	8	8	7	8
<b>Radiologists</b>	8	8	8	8	7	8
<b>Researchers</b>	7	5	7	7	6	8

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	73.8%	81%
Percentage panelists that scored the statement as not important	0%	1.6%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>

**Statement 4:** Primary cam morphology develops in young and active individuals, including athletes, likely due to load (e.g., sporting activity) during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate

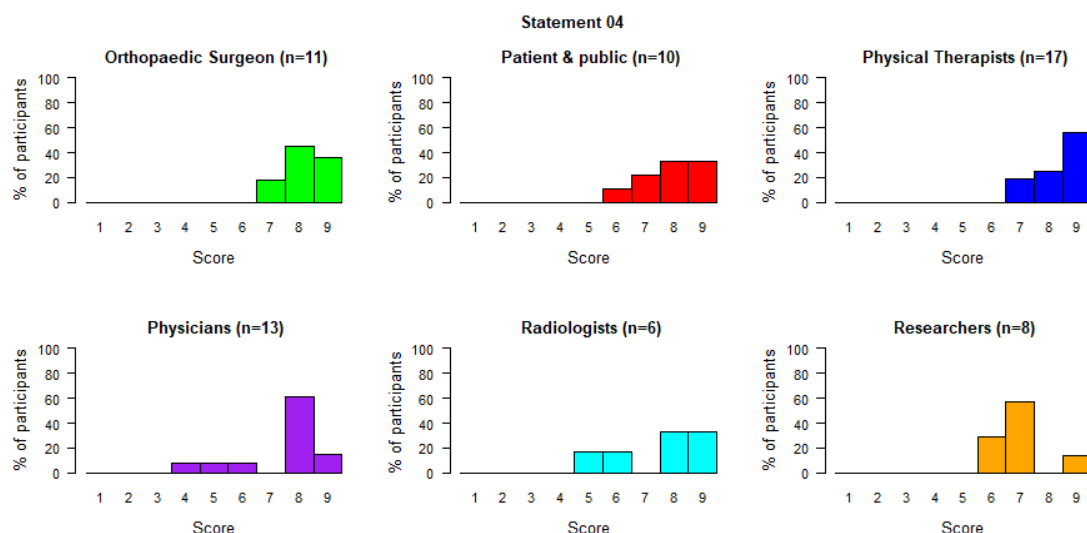
**R1: CONSENSUS IN**

**R2: CONSENSUS IN**

HELPTXT: Skeletal maturation is the process of tissue change from the embryonic beginning of bone to the adult form. Puberty is the period during which growing boys or girls undergo the process of sexual maturation. A primary medical condition is one that arises spontaneously and is not associated with or caused by a previous disease, injury, or acute event while a secondary medical condition develops due to a pre-existing medical condition. For example, primary osteoporosis, bone loss due to aging or the loss of sex steroids at menopause, differs from secondary osteoporosis which is due to conditions such as thyroid hormone imbalance or renal disease. Thus, primary cam morphology is cam morphology that is not caused by previous disease, injury or an acute event. Secondary cam morphology develops due to pre-existing hip disease or acute trauma including Perthes disease, slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture.

#### RESULTS: ROUND 1

1. And this supersedes statement two.
2. This statement seems more appropriate than the one beneath it
3. Specify more common in males so the next statement can be removed
4. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established

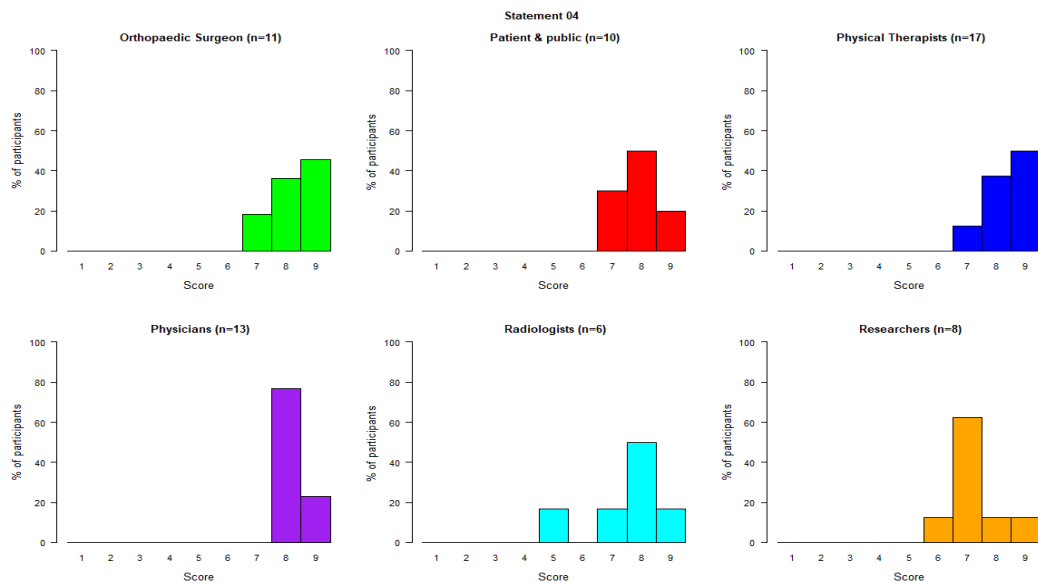


	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	8	9
Patient & Public In	8	7	9
Physical Therapists	9	8	9
Physicians	8	8	8
Radiologists	8	6	9

Researchers | 7 | 6 | 7 |

Percentage panelists that scored the statement as critical	87.1%
Percentage panelists that scored the statement as not important	0%
<b>RESULT</b>	<b>CONSENSUS IN</b>

## RESULTS: ROUND 2



## Reasons for score boundary changes

R1	R2	
4	8	I misunderstood the question - will elaborate in person
6	7	This is a stronger statement than some of the others focusing on males.
6	8	calibration from the other disciplines
6	7	Initial misunderstanding of the purpose of the statement

## Median, IQR

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	8	9	8	8	9
Patient & Public In	8	7	9	8	7	8
Physical Therapists	9	8	9	9	8	9
Physicians	8	8	8	8	8	8
Radiologists	8	6	9	8	7	8
Researchers	7	6	7	7	7	8

	Round 1	Round 2
Percentage panelists that scored the statement as critical	87.1%	96.9%
Percentage panelists that scored the statement as not important	0%	0%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>

**Statement 5:** Primary cam morphology is common in young and active males, including athletes, likely due to sporting activity during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate

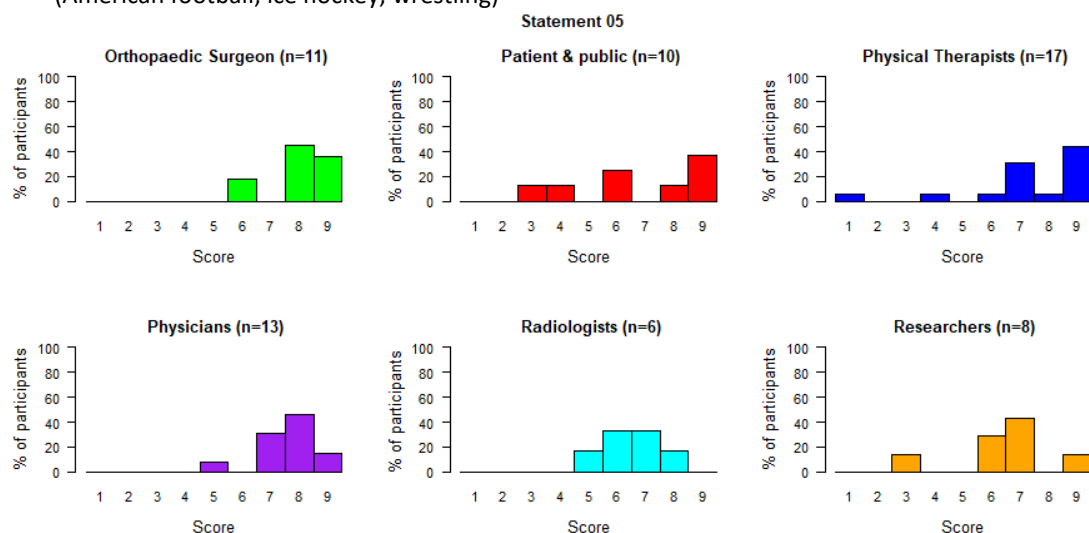
**R1: CONSENSUS IN**

**R2: CONSENSUS IN**

HELPTXT: Skeletal maturation is the process of tissue change from the embryonic beginning of bone to the adult form. Puberty is the period during which growing boys or girls undergo the process of sexual maturation. A primary medical condition is one that arises spontaneously and is not associated with or caused by a previous disease, injury, or acute event. For example, primary osteoporosis, bone loss due to aging or the loss of sex steroids at menopause, differs from secondary osteoporosis which is due to conditions such as thyroid hormone imbalance or renal disease. Thus, primary cam morphology is cam morphology that is not caused by previous disease, injury or an acute event. Secondary cam morphology develops due to pre-existing hip disease or acute trauma including Perthes disease, slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture.

## RESULTS: ROUND 1

1. I don't think we know enough about females to make it categorical that it more frequently occurs in males and therefore would make this differentiation a lower priority i.e. not critical
2. is this because more males are playing sports with higher loading?
3. Is it proportionally just as prevalent in females?
4. This statement suggests PCM occurs only/mostly in males but I am not sure if that is the case. I thought it occurs in both sexes.
5. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
6. It is common in males; but I would argue that it's mainly bc we've looked at historically male sports (American football; ice hockey; wrestling)



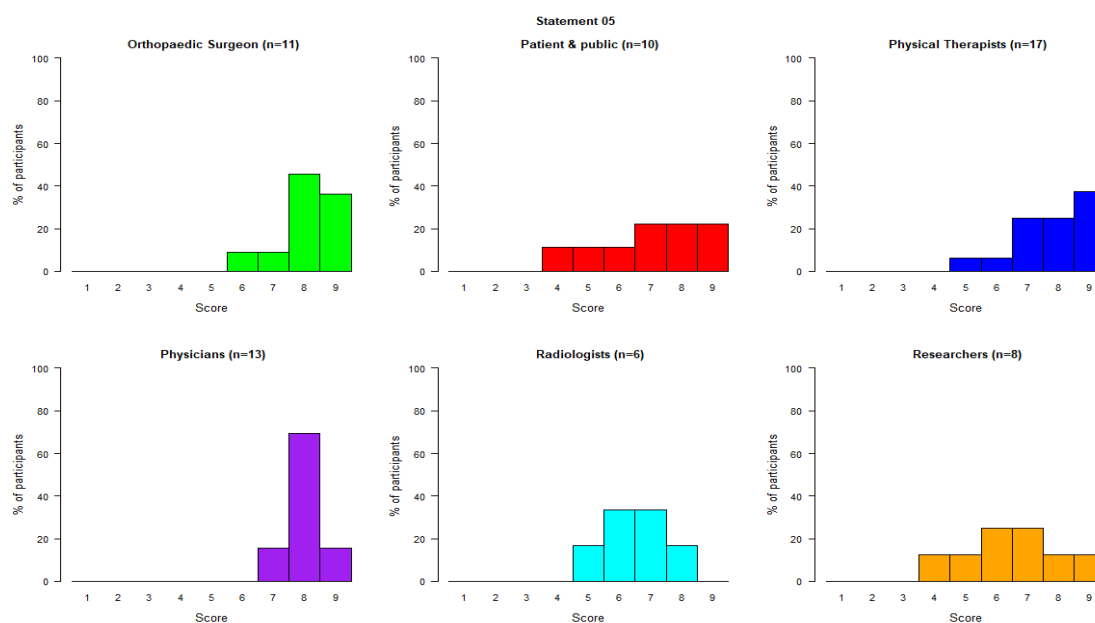
	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	8	9
Patient & Public In	7	5	9



Physical Therapists	8	7	9
Physicians	8	7	8
Radiologists	7	6	7
Researchers	7	6	7

Percentage panelists that scored the statement as critical	73.8%
Percentage panelists that scored the statement as not important	4.9%
<b>RESULT</b>	<b>CONSENSUS IN</b>

## RESULTS: ROUND 2



## Reasons for score boundary changes

R1	R2	
6	8	Strengthened belief in statement
6	7	Small (1 point change) isn't too large; but our recent research on young athletes in our pediatric population tend to make me think this is more important than my first answer.
6	7	Reviewing the statement I felt it was more important
5	8	I misunderstood the question - will elaborate in person
3	4	I struggle with this statement because I Believe there to be a paucity of research in females.
10	5	Felt more confident in being able to answer question

**Median, IQR**

	<b>ROUND 1</b>			<b>ROUND 2</b>		
	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>
<b>Orthopaedic Surgeon</b>	8	8	9	8	8	9
<b>Patient &amp; Public In</b>	7	5	9	7	6	8
<b>Physical Therapists</b>	8	7	9	8	7	9
<b>Physicians</b>	8	7	8	8	8	8
<b>Radiologists</b>	7	6	7	7	6	7
<b>Researchers</b>	7	6	7	7	6	8

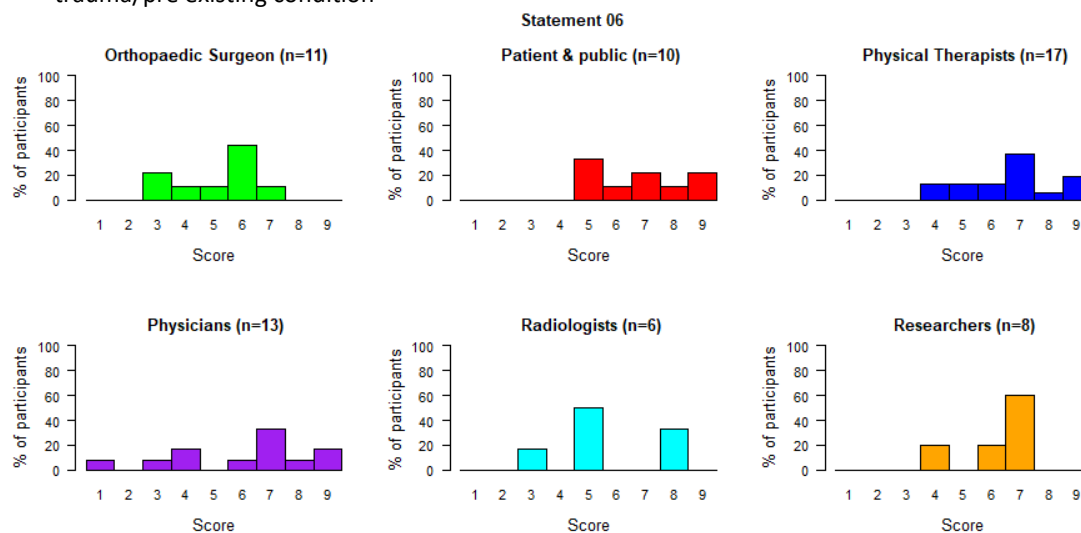
	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	73.8%	79.4%
Percentage panelists that scored the statement as not important	4.9%	0%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>

**Statement 6: Primary cam morphology includes cam morphology of unknown origin****R1: NO CONSENSUS****R2: NO CONSENSUS**

**HELPTXT:** A primary medical condition is one that arises spontaneously and is not associated with or caused by a previous disease, injury, or acute event while a secondary medical condition develops due to a pre-existing medical condition. For example, primary osteoporosis, bone loss due to aging or the loss of sex steroids at menopause, differs from secondary osteoporosis which is due to conditions such as thyroid hormone imbalance or renal disease. Thus, primary cam morphology is cam morphology that is not caused by previous disease, injury or an acute event. Secondary cam morphology develops due to pre-existing hip disease or acute trauma including Perthes disease, slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture. Skeletal maturation is the process of tissue change from the embryonic beginning of bone to the adult form. Puberty is the period during which growing boys or girls undergo the process of sexual maturation.

**RESULTS: ROUND 1**

1. why then call it primary cam and not just cam morphology? Decades ago they proposed the same for osteoarthritis (primary and secondary) but hardly anybody uses these terms because the actual cause is simply often unknown.
2. I am not sure if my scoring here is realistic. We have good knowledge about pathogenesis at this stage but may be not enough
3. if its unknown i find it hard to know if primary or secondary
4. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
5. So primary cam morphology is every cam morphology which cannot be explained by a well defined trauma/pre existing condition

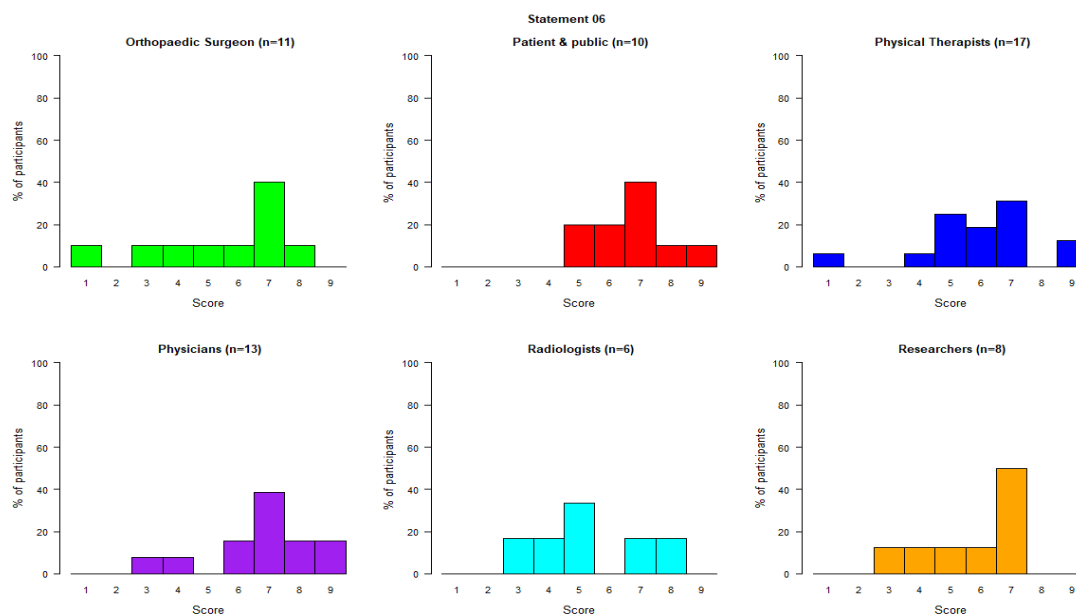


	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	6	4	6
Patient & Public In	7	5	8
Physical Therapists	7	6	8

Physicians	7	4	8
Radiologists	5	5	8
Researchers	7	6	7

Percentage panelists that scored the statement as critical	49.1%
Percentage panelists that scored the statement as not important	8.8%
<b>RESULT</b>	<b>NO CONSENSUS</b>

## RESULTS: ROUND 2



## Reasons for score boundary changes between R1 and R2

R1	R2	
1	9	changed my mind on the umbrella term including unknown
3	8	Primary CAM can include those of unknown origin
4	7	I misunderstood the question - will elaborate in person
3	4	Statement is too short; but changed it to get in range with others
7	1	I misread the question initially
10	1	I do not understand the concept sufficiently
10	3	Felt more confident in being able to answer question
5	3	Disagree as the origin is not entirely "unknown" - likely due to variable loading demands.
10	6	seeing how my colleagues scored

**Median, IQR**

	<b>ROUND 1</b>			<b>ROUND 2</b>		
	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>
<b>Orthopaedic Surgeon</b>	6	4	6	7	4	7
<b>Patient &amp; Public In</b>	7	5	8	7	6	7
<b>Physical Therapists</b>	7	6	8	6	5	7
<b>Physicians</b>	7	4	8	7	6	8
<b>Radiologists</b>	5	5	8	5	4	7
<b>Researchers</b>	7	6	7	7	5	7

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	49.1%	52.4%
Percentage panelists that scored the statement as not important	8.8%	9.5%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

**Statement 7:** Cam morphology that develops in young and active individuals without any symptoms (e.g., hip-related pain; stiffness) or history of previous/existing hip disease, is primary cam morphology until proven otherwise

**R1: NO CONSENSUS**

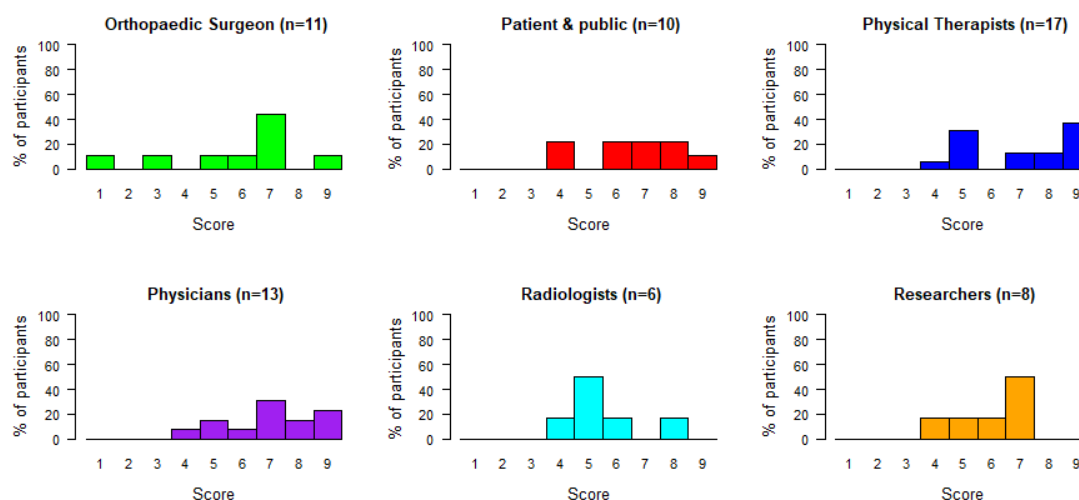
**R2: NO CONSENSUS**

HELPTXT: A primary medical condition is one that arises spontaneously and is not associated with or caused by a previous disease, injury, or acute event while a secondary medical condition develops due to a pre-existing medical condition. For example, primary osteoporosis, bone loss due to aging or the loss of sex steroids at menopause, differs from secondary osteoporosis which is due to conditions such as thyroid hormone imbalance or renal disease. Thus, primary cam morphology is cam morphology that is not caused by previous disease, injury or an acute event. Secondary cam morphology develops due to pre-existing hip disease or acute trauma including Perthes disease, slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture.

## RESULTS: ROUND 1

I do not agree that the concept of Primary and secondary CAM is commonly agreed and established

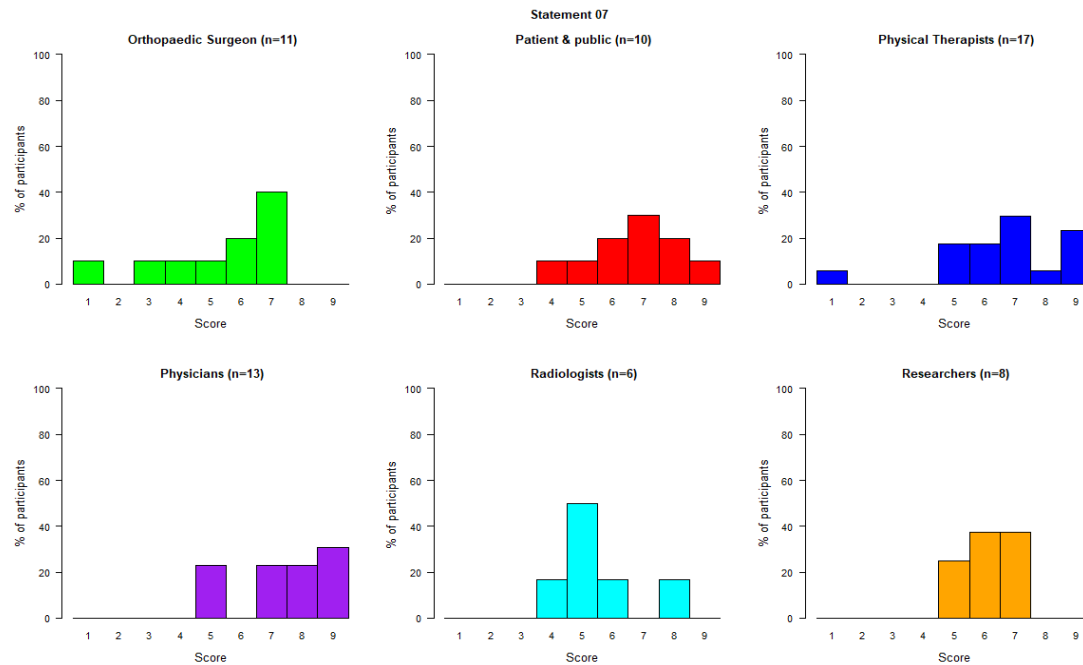
Statement 07



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	5	7
Patient & Public In	7	6	8
Physical Therapists	8	5	9
Physicians	7	6	8
Radiologists	5	5	6
Researchers	7	5	7

Percentage panelists that scored the statement as critical	55.9%
Percentage panelists that scored the statement as not important	3.4%
<b>RESULT</b>	<b>NO CONSENSUS</b>



**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
4	8	I misunderstood the question - will elaborate in person
10	1	I do not understand the concept sufficiently
10	6	seeing how my colleagues scored
10	6	Felt more confident in being able to answer question

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	5	7	6	4	7
Patient & Public In	7	6	8	7	6	8
Physical Therapists	8	5	9	7	6	8
Physicians	7	6	8	8	7	9
Radiologists	5	5	6	5	5	6
Researchers	7	5	7	6	6	7

	Round 1	Round 2
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Percentage panelists that scored the statement as critical	55.9%	53.1%
Percentage panelists that scored the statement as not important	3.4%	4.7%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

**Statement 8:** Cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical

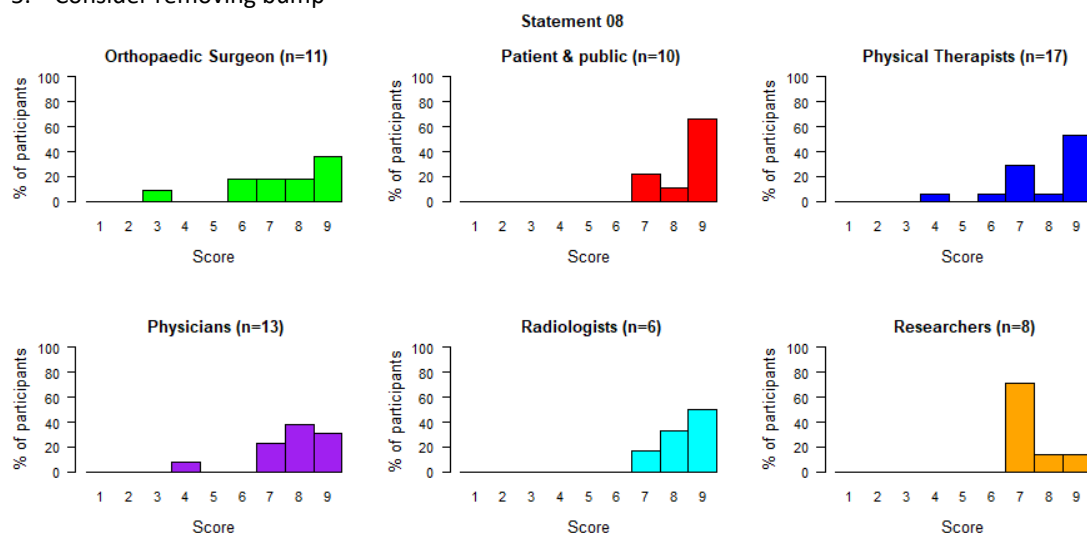
**R1: CONSENSUS IN**

**R2: CONSENSUS IN**

HELPTXT: Palmer et al (2018) quantified cam morphology using the alpha angle (as described by Notzli et al, 2000) for bone and cartilage

## RESULTS: ROUND 1

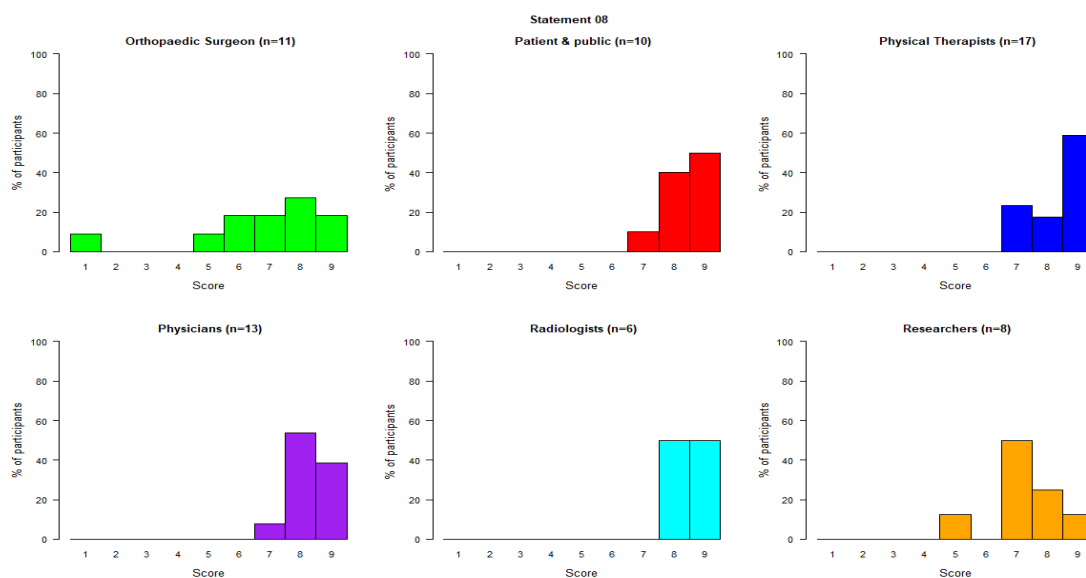
1. varying size but probably also varying shape
2. Agree is varying size at any location around the femoral head-neck junction as seen in many studies. We know about various locations as per Siebenrock 2011. More lately Hanzlik et al 2020 reported that affecting mainly Antero-superior quadrant ; following by Anteroinferior and no morphologies in the Posterosuperior or Posteroinferior
3. Umbrella definition of primary cam morphology
4. 'Any location' suggests equal occurrence in all locations but I understood it predominantly occurs at superior/anterior.
5. Consider removing bump



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	6	9
Patient & Public In	9	8	9
Physical Therapists	9	7	9
Physicians	8	7	9
Radiologists	9	8	9
Researchers	7	7	8

Percentage panelists that scored the statement as critical	90.5%
Percentage panelists that scored the statement as not important	1.6%
<b>RESULT</b>	<b>CONSENSUS IN</b>

## RESULTS: ROUND 2



## Reasons for score boundary changes between R1 and R2

R1	R2	
3	5	My initial answer related to an issue with the word "cartilage or bony". That said; it probably doesn't make the statement as low as I initially answered. The prominence is important in either case.
4	8	I misunderstood the question - will elaborate in person
9	1	any location is not true IMO
10	5	Felt more confident in being able to answer question

## Median, IQR

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	6	9	7	6	8
Patient & Public In	9	8	9	9	8	9
Physical Therapists	9	7	9	9	8	9
Physicians	8	7	9	8	8	9

Radiologists	9	8	9	9	8	9	
Researchers	7	7	8	7	7	8	

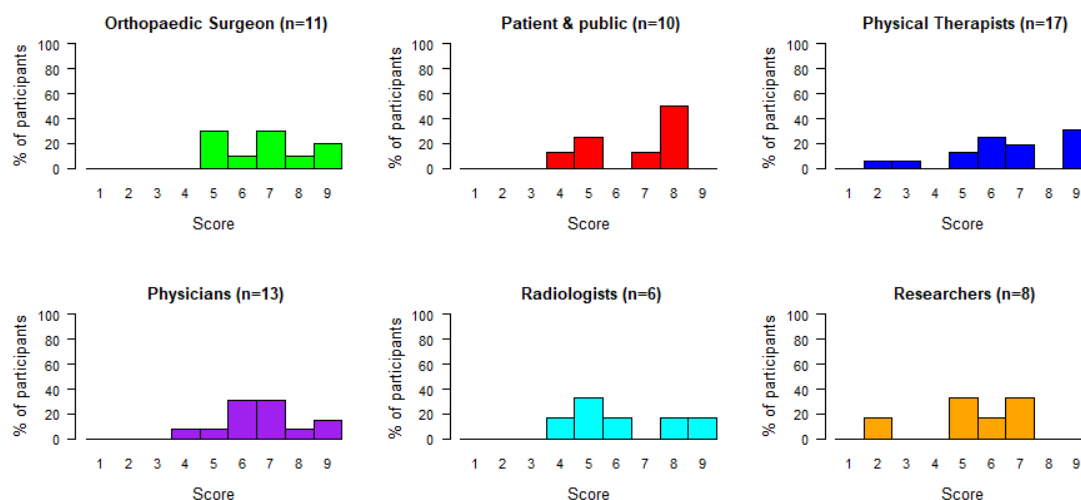
	Round 1	Round 2
Percentage panelists that scored the statement as critical	90.5%	92.3%
Percentage panelists that scored the statement as not important	1.6%	1.5%
RESULT	CONSENSUS IN	CONSENSUS IN

**Statement 9: Primary cam morphology often occurs in male athletes in both hips****R1: NO CONSENSUS****R2: NO CONSENSUS**

HELPTXT: Current scientific evidence summary: Primary cam morphology is more prevalent in male athletes vs female athletes. More research is needed in female athlete cohorts.

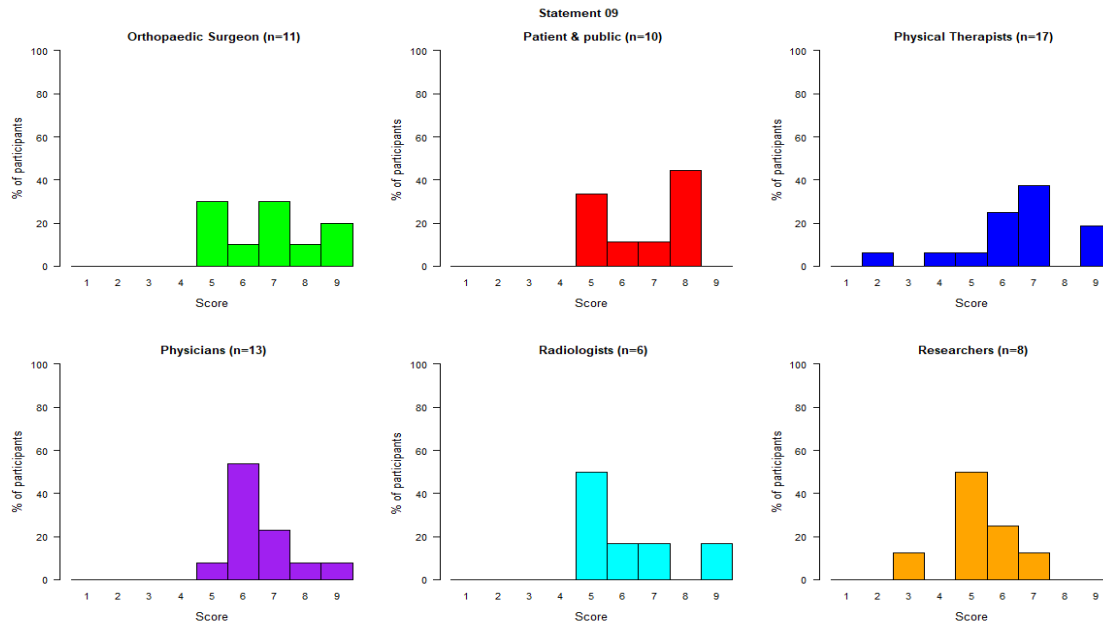
**RESULTS: ROUND 1**

1. Isn't it 50-50? 50% bilateral and 50% unilateral. At least that mostly comes out of our studies; not sure by hard if other studies show differently
2. We know the prevalence in males and bilateral appearance. The only reason I cannot score this is I am not sure if I can comment on demographics and population as we do know that most of the studies include mainly male participants. From many conversations in different podiums (conferences; webinars. BGP meeting) recently this was raised and extensively discussed
3. From my understanding; there is a paucity of research in females. This doesn't seem like an appropriate statement at this point in time
4. This suggests it is uncommon in females and in one hip only but those two things may not be the case.
5. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
6. seen in top athletes (ice hockey goaltenders); but maybe it was "unilateral secondary cam morph."?
7. See comment above - females often left out of research.

**Statement 09**

	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	5	8
Patient & Public In	8	5	8
Physical Therapists	7	6	9
Physicians	7	6	7
Radiologists	6	5	8

Researchers	6	5	7
Percentage panelists that scored the statement as critical	50.8%		
Percentage panelists that scored the statement as not important	5.1%		
<b>RESULT</b>	<b>NO CONSENSUS</b>		

**RESULTS: ROUND 2****Reasons for score boundary changes**

R1	R2	
6	7	Unrefutable so moved from mid category to high
6	7	Second webinar informations
10	6	seeing how my colleagues scored
10	5	Felt more confident in being able to answer question

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	5	8	7	5	8
Patient & Public In	8	5	8	7	5	8
Physical Therapists	7	6	9	7	6	7
Physicians	7	6	7	6	6	7



<b>Radiologists</b>	6	5	8	6	5	7
<b>Researchers</b>	6	5	7	5	5	6

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	50.8%	45.2%
Percentage panelists that scored the statement as not important	5.1%	3.2%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

**Statement 10:** The most common outcome measure for cam morphology is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, computed tomogram (CT) scans or magnetic resonance (MR) imaging, reported per hip, per person or both

**R1: CONSENSUS IN**

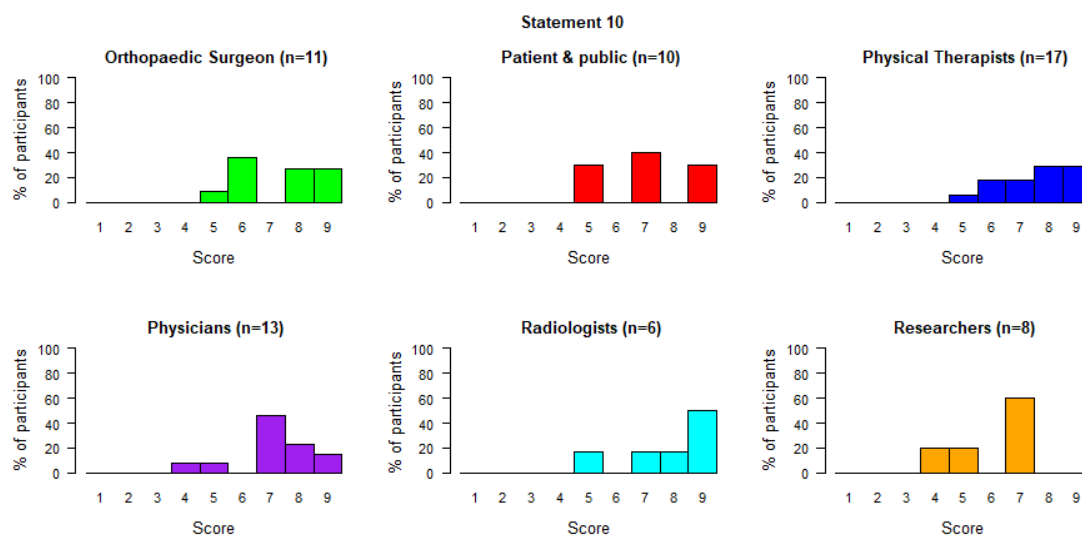
**R2: CONSENSUS IN**

HELPTXT: Alpha angle definition (Notzle et al, 2000): Using the imaging sequence (or radiograph/CT), a circle is centred over the head of the femur and adjusted to its contour. The alpha angle is the angle between: (1) a line parallel to the femoral neck axis, and (2) a line from the centre of the femoral head to the point where the femoral head neck junction contour exceeds the head radius

Definitions

## RESULTS: ROUND 1

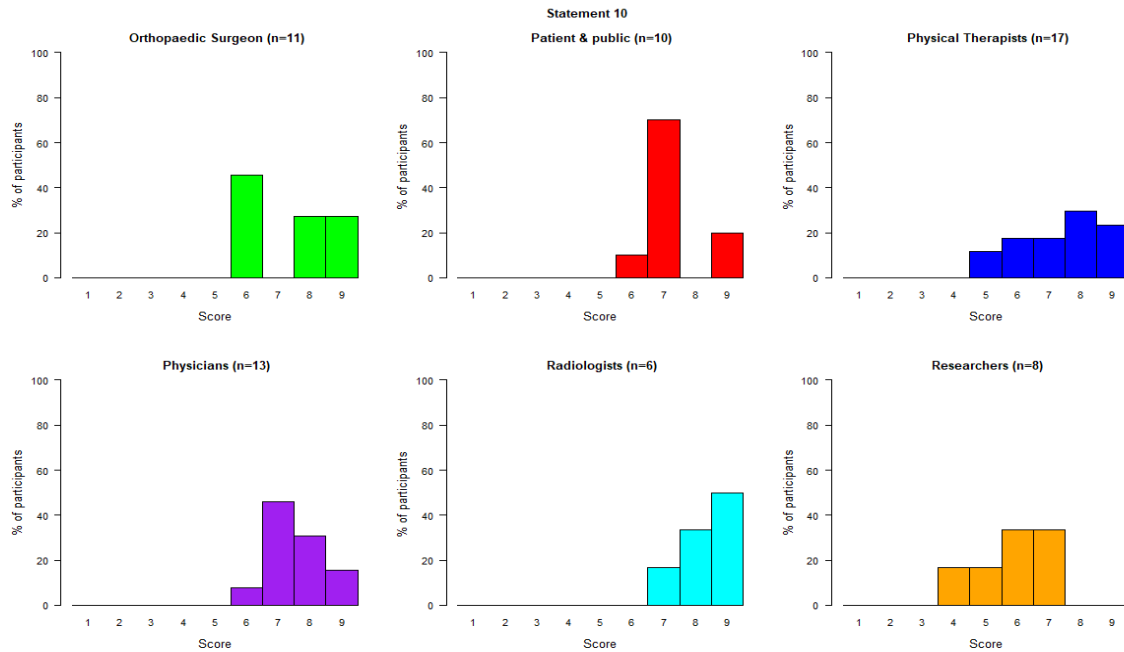
methodological issues with treating AA as both dichotomised and continuous



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	6	9
Patient & Public In	7	5	9
Physical Therapists	8	7	9
Physicians	7	7	8
Radiologists	9	7	9
Researchers	7	5	7

Percentage panelists that scored the statement as critical	72.6%
Percentage panelists that scored the statement as not important	0%

RESULT	CONSENSUS IN
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**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
5	7	I initially preferred to score this less important because of its inclusion of CT
4	7	I misunderstood the question - will elaborate in person
7	6	calibration from the other disciplines
10	4	Felt more confident in being able to answer question
7	6	Rethought the question and answer

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	6	9	8	6	9
Patient & Public In	7	5	9	7	7	7
Physical Therapists	8	7	9	8	6	8

<b>Physicians</b>	7	7	8	7	7	8
<b>Radiologists</b>	9	7	9	9	8	9
<b>Researchers</b>	7	5	7	6	5	7

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	72.6%	74.6%
Percentage panelists that scored the statement as not important	0%	0%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>

**Statement 11:** Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors

**R1: CONSENSUS IN**

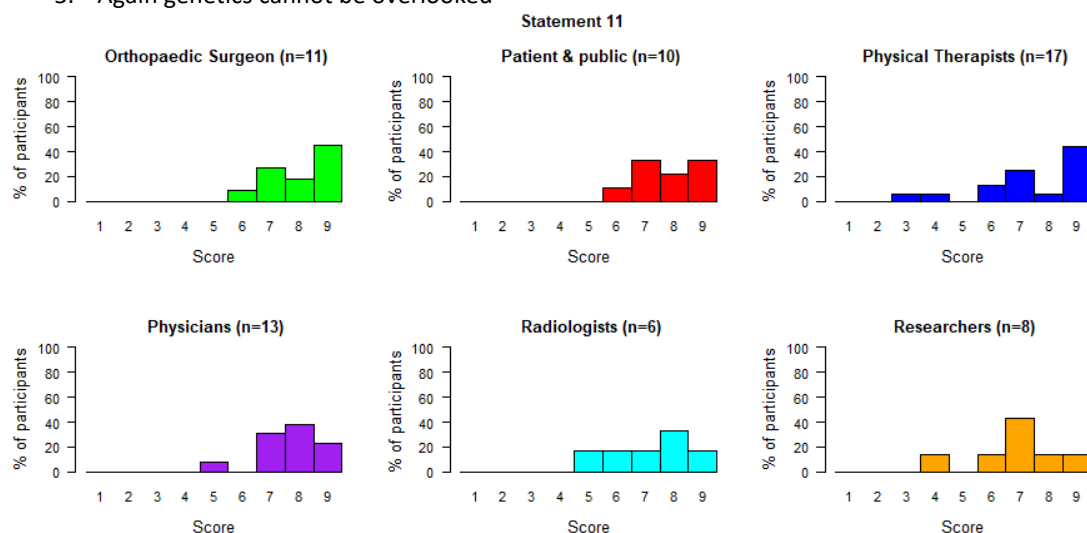
**R2: CONSENSUS IN**

Skeletal maturation is the process of tissue change from the embryonic beginning of bone to the adult form. Puberty is the period during which growing boys or girls undergo the process of sexual maturation. A primary medical condition is one that arises spontaneously and is not associated with or caused by a previous disease, injury, or acute event while a secondary medical condition develops due to a pre-existing medical condition. For example, primary osteoporosis, bone loss due to aging or the loss of sex steroids at menopause, differs from secondary osteoporosis which is due to conditions such as thyroid hormone imbalance or renal disease. Thus, primary cam morphology is cam morphology that is not caused by previous disease, injury or an acute event. Secondary cam morphology develops due to pre-existing hip disease or acute trauma including Perthes disease, slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture.

Definitions

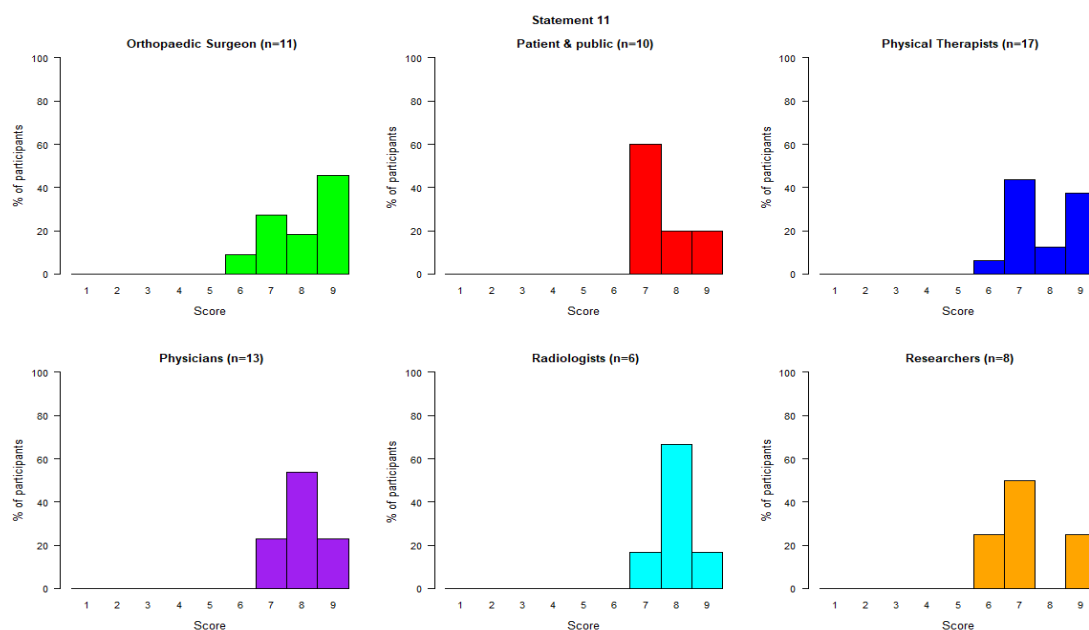
## RESULTS: ROUND 1

1. Covered better in earlier statement
2. This seems to contradict item 4 above which is v clear; whereas this statement uses 'likely' and 'possibly' so leaves some ambiguity.
3. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
4. I do not disagree with this statement; but I believe the phrasing in the earlier statement is better (e.g. "likely" preferred over "possibly")
5. Again genetics cannot be overlooked



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	7	9
Patient & Public In	8	7	9
Physical Therapists	8	7	9
Physicians	8	7	8

Radiologists	8	6	8
Researchers	7	6	8
Percentage panelists that scored the statement as critical			82.3%
Percentage panelists that scored the statement as not important			1.6%
<b>RESULT</b>			<b>CONSENSUS IN</b>

**RESULTS: ROUND 2****Reasons for score boundary changes**

R1	R2	
3	7	NB mention high-load
6	8	Strengthened belief in statement
6	7	minor adjustment
5	7	I misunderstood the question - will elaborate in person
6	8	true on second thought more important

**Median, IQR**

	ROUND 1	ROUND 2
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	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	7	9	8	7	9
Patient & Public In	8	7	9	7	7	8
Physical Therapists	8	7	9	8	7	9
Physicians	8	7	8	8	8	8
Radiologists	8	6	8	8	8	8
Researchers	7	6	8	7	7	8

	Round 1	Round 2
Percentage panelists that scored the statement as critical	82.3%	93.8%
Percentage panelists that scored the statement as not important	1.6%	0%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>



**Statement 12:** A comprehensive definition for primary cam morphology would be: Primary cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical. It often occurs in male athletes in both hips. The most common outcome measure is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, CT scans or MR imaging, reported per hip, per person or both. Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors.

#### **R1: CONSENSUS IN**

#### **R2: CONSENSUS IN**

HELPTXT: This definition is based on 5 conceptual attributes: (1) tissue type, (2) size, (3) location, (4) shape, and (5) ownership ('ownership' = who 'owns' primary cam morphology: common in male athletes in both hips). This is the current definition in a paper accepted for publication in BJSM: "Primary cam morphology; bump, burden or bog-standard? A concept analysis. Continuous outcome variables (like the alpha angle) should not be dichotomised in regression models of aetiology or prognosis. A dichotomised alpha angle might be useful in clinical practice and/or clinical research. Current scientific evidence summary: Primary cam morphology is more prevalent in male athletes vs female athletes. More research is needed in female athlete cohorts.

#### Definitions

#### **RESULTS: ROUND 1**

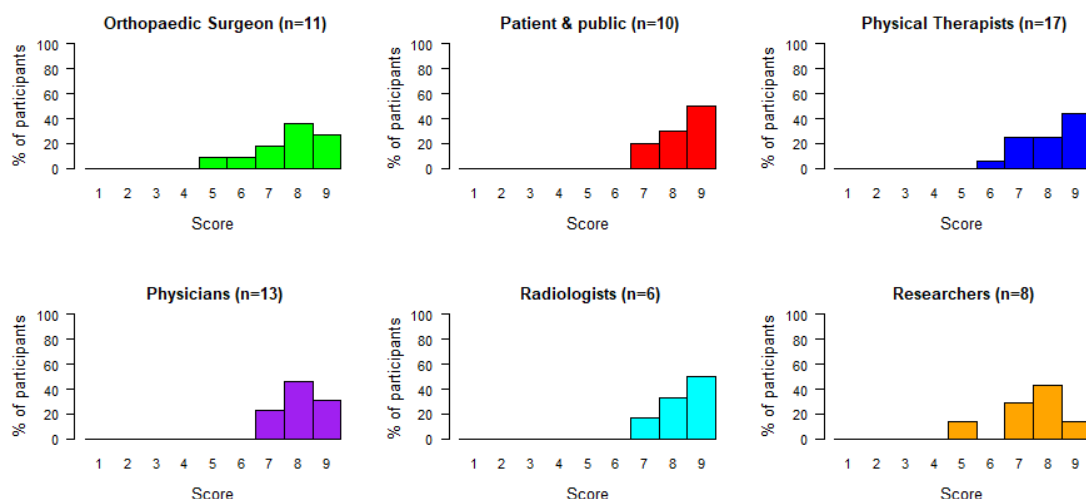
1. If this is a definition - I wouldn't have the text that says 'CT scans or MR imaging; reported per hip; per person or both.' I think it distracts the reader and we know that we need to measure the alpha angle - how we achieve that I am not sure needs to be in the overall definition.
2. see the bilateral aspect
3. I think the most common outcome measure part is better to be mentioned in taxonomy.
4. It often occurs in male athletes in both hips seems less relevant than that it occurs in young and active individuals. Instead of "the most common outcome measure..."; might consider something such as "It is often diagnosed using a cartilage or bone alpha angle on radiographs; CT scans....." Incorporation of "outcome measure" and "dichotomised or continuous variable" is really an operationalization of the definition.
5. maybe adding: During maturation in young adolescents when physyeal plate is not yet closed
6. Agree but see caveats above about 'any location' and 'males'.
7. I'm reacting to the suggestion that this is for "male athletes". Female athletes also have cam (and; when they do; have worse outcomes).
8. Consider removing bump
9. This is the definition of CAM morphology. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
10. I would prefer the last part to use the earlier phrasing "likely due to sporting activity during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate likely due to sporting activity during prepubertal and

pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate "likely due to load (e.g. sporting activity) during prepubertal and pubertal skeletal maturation....

11. I would hesitate to include gender in the definition to avoid people thinking that it is a male-only problem

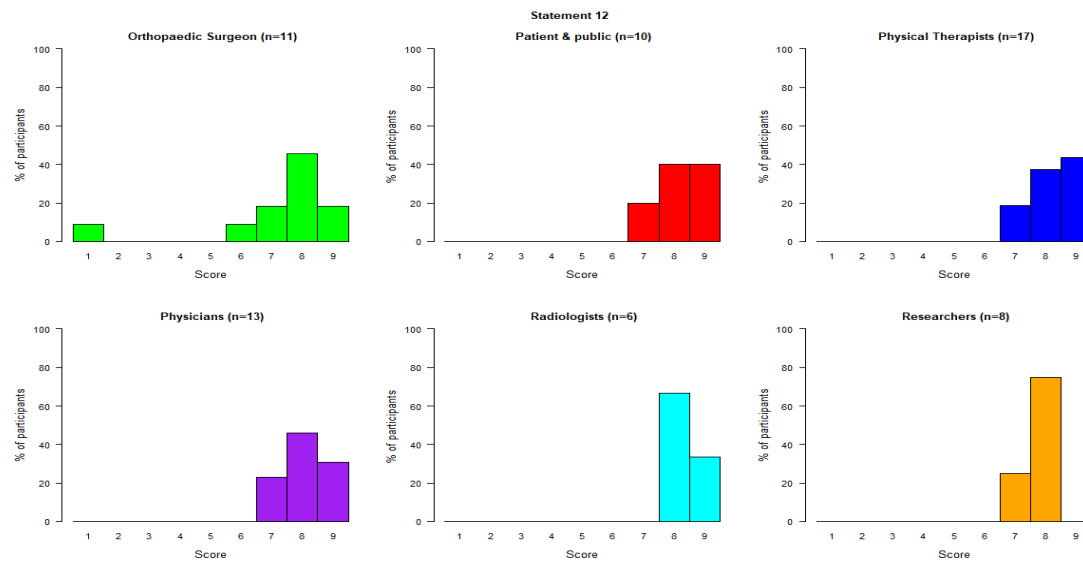
12. Would include a statement on genetic influences

Statement 12



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	7	9
Patient & Public In	9	8	9
Physical Therapists	8	7	9
Physicians	8	8	9
Radiologists	9	8	9
Researchers	8	7	8

Percentage panelists that scored the statement as critical	93.7%
Percentage panelists that scored the statement as not important	0%
<b>RESULT</b>	<b>CONSENSUS IN</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
6	7	In second view it seems more critical to agree on a definition.
5	7	I don't like the phrasing "outcome measure" for the description of alpha angle; but in reading the rest of the definition I found it acceptable.
9	1	any location is not true IMO

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	7	9	8	7	8
Patient & Public In	9	8	9	8	8	9
Physical Therapists	8	7	9	8	8	9
Physicians	8	8	9	8	8	9
Radiologists	9	8	9	8	8	9
Researchers	8	7	8	8	8	8

	Round 1	Round 2
Percentage panelists that scored the statement as critical	93.7%	96.9%
Percentage panelists that scored the statement as not important	0%	1.6%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>

## TERMINOLOGY

**Statement 13:** Cam morphology is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction

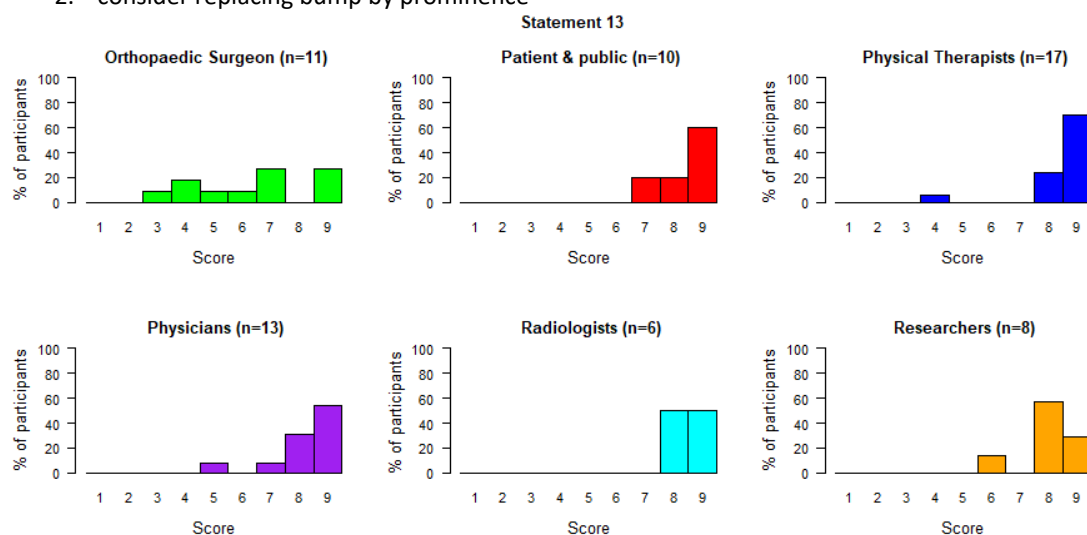
**R1: CONSENSUS IN**

**R2: CONSENSUS IN**

HELPTXT: The Warwick Agreement on femoroacetabular impingement (FAI) syndrome (2016) recommended the following terminology: FAI syndrome and cam morphology. It recommended for the following terminology to be avoided: asymptomatic FAI, symptomatic FAI, FAI morphology, and deformity, abnormality or lesion when referring to cam morphology.

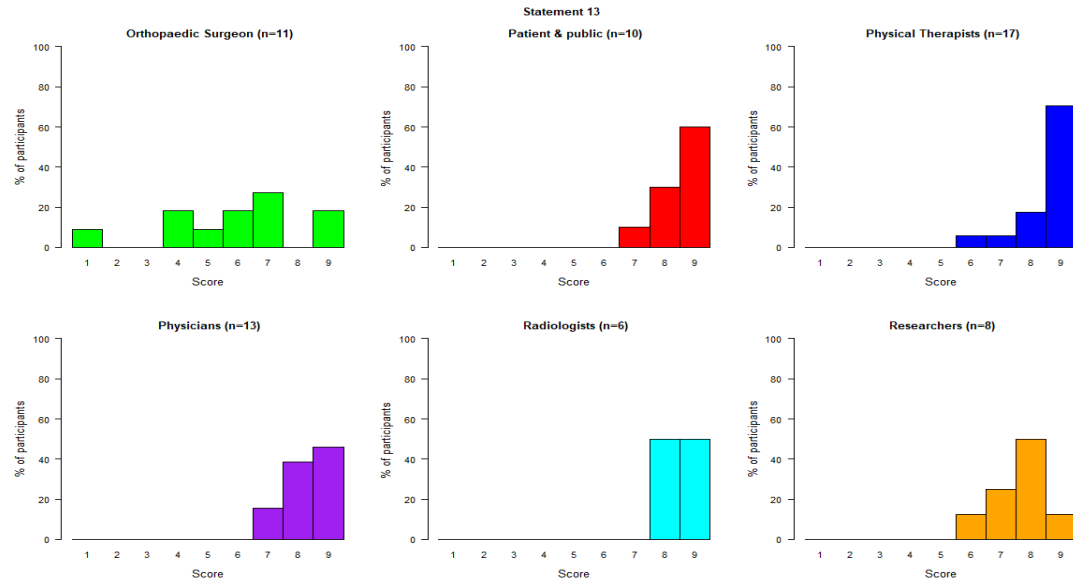
## RESULTS: ROUND 1

1. I prefer this one as we've agreed it is a 'normal physiological response' and therefore shouldn't be called a lesion/deformity with their connotations of abnormality.
2. consider replacing bump by prominence



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	4	9
Patient & Public In	9	8	9
Physical Therapists	9	8	9
Physicians	9	8	9
Radiologists	9	8	9
Researchers	8	8	9

Percentage panelists that scored the statement as critical	87.5%
Percentage panelists that scored the statement as not important	1.6%
<b>RESULT</b>	<b>CONSENSUS IN</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
6	7	I think is probably necessary to provide a better definition and I moved above the cut off to be considered
9	1	any location is not true IMO
8	6	influenced by scores from other respondents

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	4	9	6	4	7
Patient & Public In	9	8	9	9	8	9
Physical Therapists	9	8	9	9	8	9
Physicians	9	8	9	8	8	9
Radiologists	9	8	9	9	8	9
Researchers	8	8	9	8	7	8

	Round 1	Round 2
Percentage panelists that scored the statement as critical	87.5%	87.7%
Percentage panelists that scored the statement as not important	1.6%	1.5%

RESULT	CONSENSUS IN	CONSENSUS IN
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**Statement 14:** Cam lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction

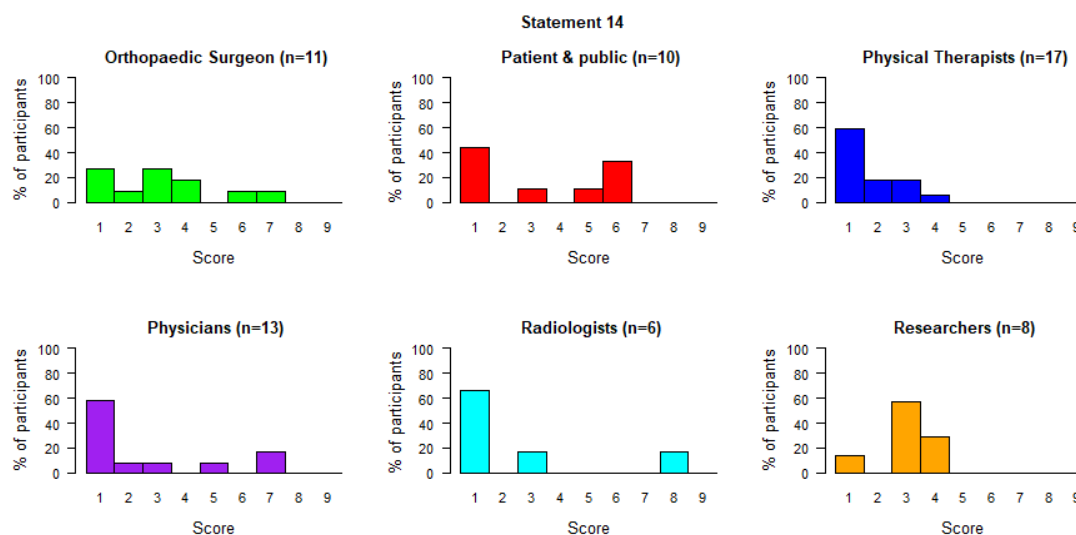
**R1: CONSENSUS OUT**

**R2: CONSENSUS OUT**

HELPTXT: The Warwick Agreement on femoroacetabular impingement (FAI) syndrome (2016) recommended the following terminology: FAI syndrome and cam morphology. It recommended for the following terminology to be avoided: asymptomatic FAI, symptomatic FAI, FAI morphology, and deformity, abnormality or lesion when referring to cam morphology.

## RESULTS: ROUND 1

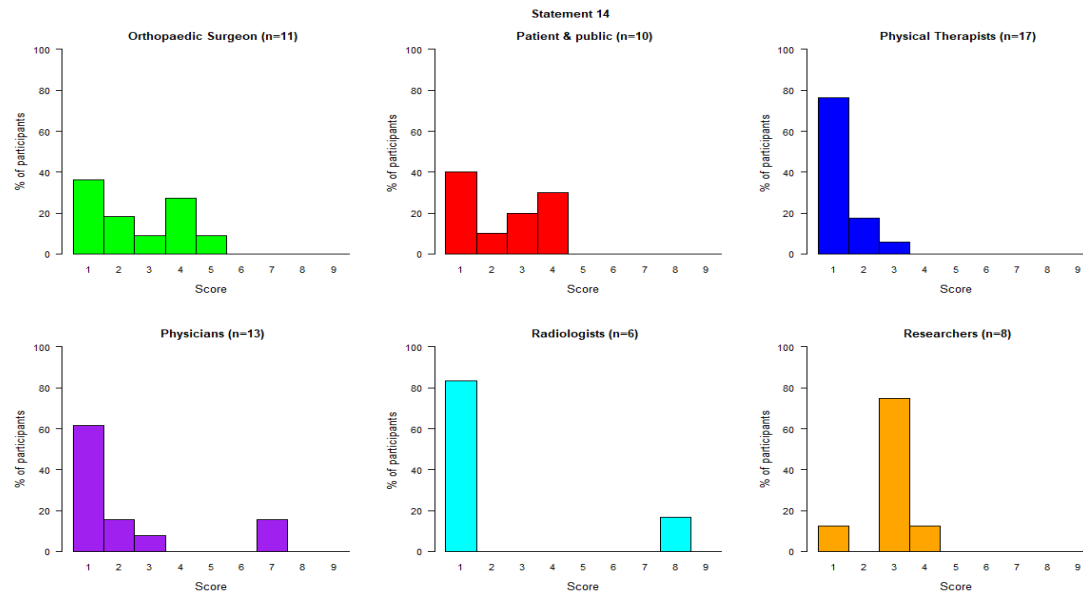
1. Add "is not" in place of "is". This will then be critical in all instances below; but is difficult to score as it currently stands. I therefore marked Unable to score.
2. Assuming that by "not important" you mean not in agreement with statement



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	3	1	4
Patient & Public In	3	1	6
Physical Therapists	1	1	2
Physicians	1	1	4
Radiologists	1	1	3
Researchers	3	3	4

Percentage panelists that scored the statement as critical	6.5%
Percentage panelists that scored the statement as not important	75.8%
<b>RESULT</b>	<b>CONSENSUS OUT</b>



**RESULTS: ROUND 2****Reasons for score boundary change between R1 and R2**

R1	R2	
1	4	Can refer to CAM morphology
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc.
10	2	seeing how my colleagues scored
4	3	In comparing with other definitions; I did not prefer this one.

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	3	1	4	2	1	4
Patient & Public In	3	1	6	3	1	4
Physical Therapists	1	1	2	1	1	1
Physicians	1	1	4	1	1	2
Radiologists	1	1	3	1	1	1
Researchers	3	3	4	3	3	3

	Round 1	Round 2
Percentage panelists that scored the statement as critical	6.5%	4.6%
Percentage panelists that scored the statement as not important	75.8%	83.1%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>

**Statement 15:** Cam deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction

**R1: CONSENSUS OUT**

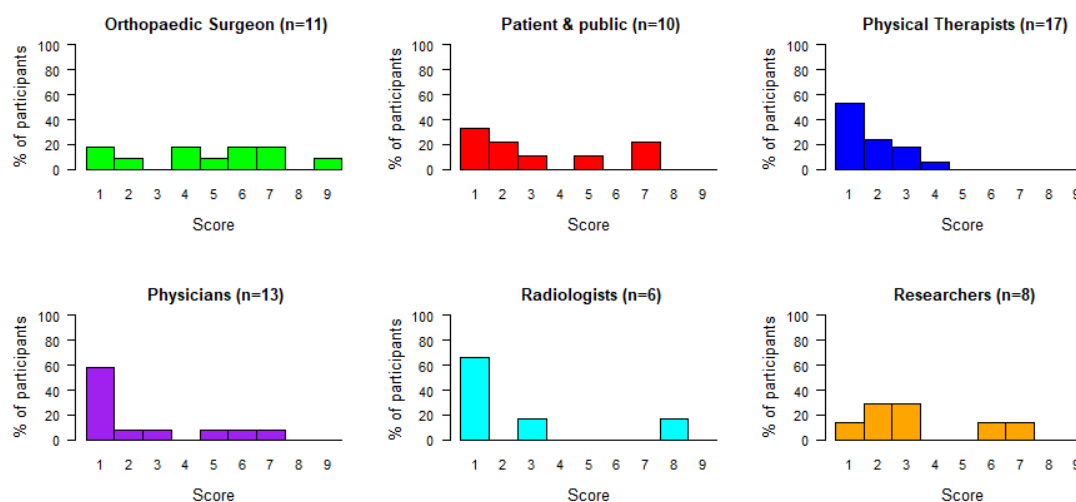
**R2: CONSENSUS OUT**

HELPTXT: The Warwick Agreement on femoroacetabular impingement (FAI) syndrome (2016) recommended the following terminology: FAI syndrome and cam morphology. It recommended for the following terminology to be avoided: asymptomatic FAI, symptomatic FAI, FAI morphology, and deformity, abnormality or lesion when referring to cam morphology. Terminology

## RESULTS: ROUND 1

1. Add "is not" in place of "is"
2. agree with lecturer that deformity may not be the best term

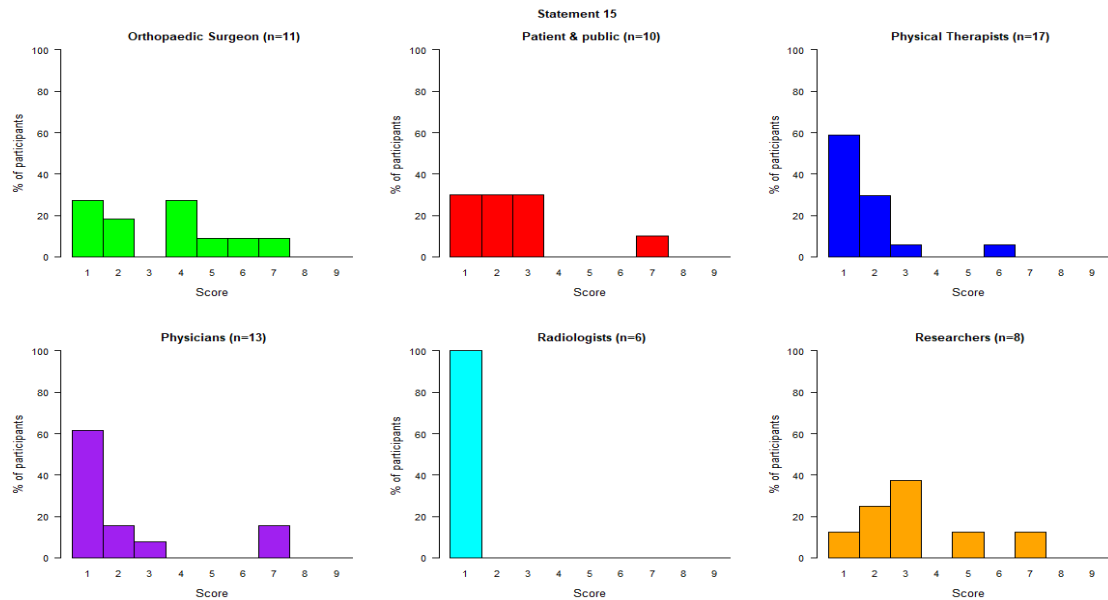
Statement 15



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	5	2	7
Patient & Public In	2	1	5
Physical Therapists	1	1	2
Physicians	1	1	4
Radiologists	1	1	3
Researchers	3	2	6

Percentage panelists that scored the statement as critical	12.9%
Percentage panelists that scored the statement as not important	71%
<b>RESULT</b>	<b>CONSENSUS OUT</b>

RESULTS: ROUND 2



Reasons for score boundary changes between R1 and R2

R1	R2	
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
7	1	ditto and so on for all Q WITH "ANY LOCATION"
10	2	seeing how my colleagues scored

Median, IQR

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	5	2	7	4	1	5
Patient & Public In	2	1	5	2	1	3
Physical Therapists	1	1	2	1	1	2
Physicians	1	1	4	1	1	2
Radiologists	1	1	3	1	1	1
Researchers	3	2	6	3	2	4

	Round 1	Round 2
Percentage panelists that scored the statement as critical	12.9%	7.7%

Percentage panelists that scored the statement as not important	71%	81.5%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>

**Statement 16:** Cam abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction

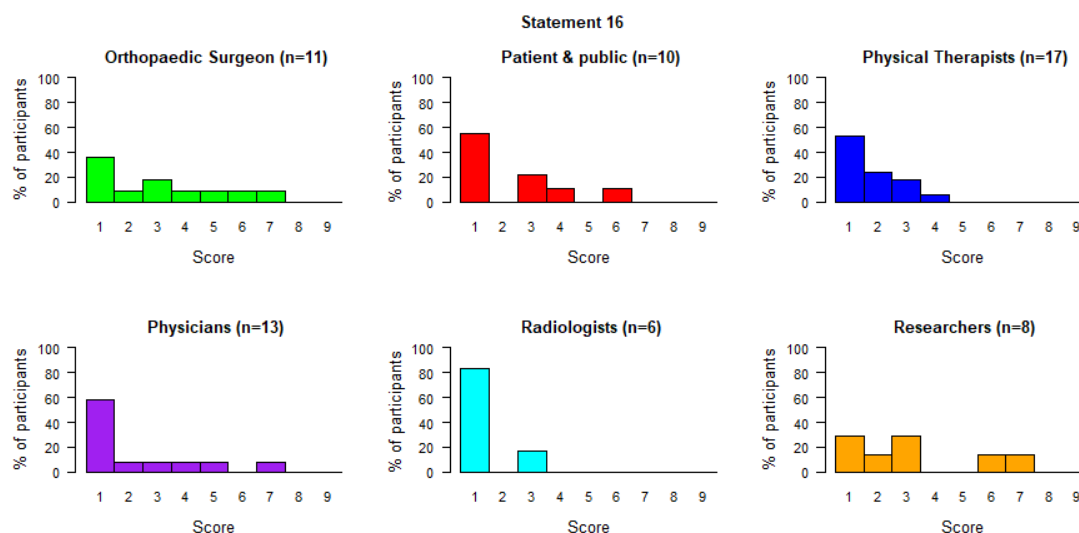
**R1: CONSENSUS OUT**

**R2: CONSENSUS OUT**

HELPTXT: The Warwick Agreement on femoroacetabular impingement (FAI) syndrome (2016) recommended the following terminology: FAI syndrome and cam morphology. It recommended for the following terminology to be avoided: asymptomatic FAI, symptomatic FAI, FAI morphology, and deformity, abnormality or lesion when referring to cam morphology. Terminology

## RESULTS: ROUND 1

1. Add "is not" in place of "is"
2. same with abnormality...not a very optimistic term

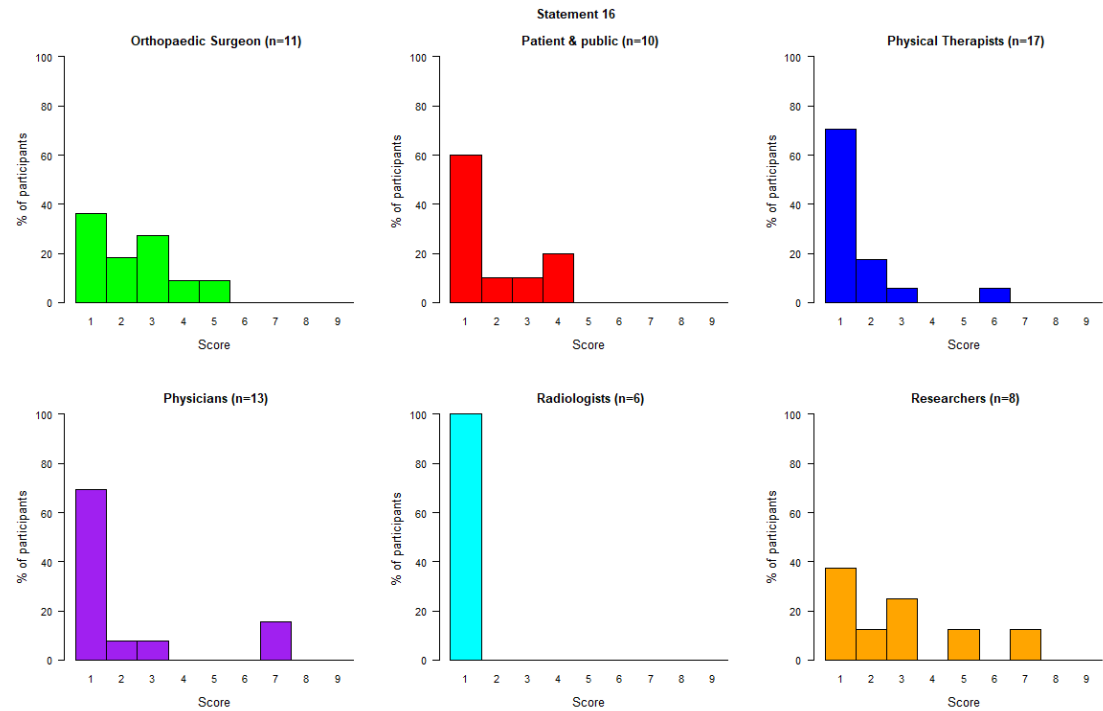


	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	3	1	5
Patient & Public In	1	1	3
Physical Therapists	1	1	2
Physicians	1	1	4
Radiologists	1	1	1
Researchers	3	1	6

Percentage panelists that scored the statement as critical	4.8%
Percentage panelists that scored the statement as not important	80.6%

RESULT	CONSENSUS OUT
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RESULTS: ROUND 2



Reasons for score boundary changes between R1 and R2

R1	R2	
1	4	Can refer to CAM morphology
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
10	1	seeing how my colleagues scored
6	2	Global view and reading more in the literature

Median, IQR

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	3	1	5	2	1	3
Patient & Public In	1	1	3	1	1	3
Physical Therapists	1	1	2	1	1	2

<b>Physicians</b>	1	1	4	1	1	2
<b>Radiologists</b>	1	1	1	1	1	1
<b>Researchers</b>	3	1	6	3	1	4

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	4.8%	4.6%
Percentage panelists that scored the statement as not important	80.6%	86.2%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>



**Statement 17:** Cam-type deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction

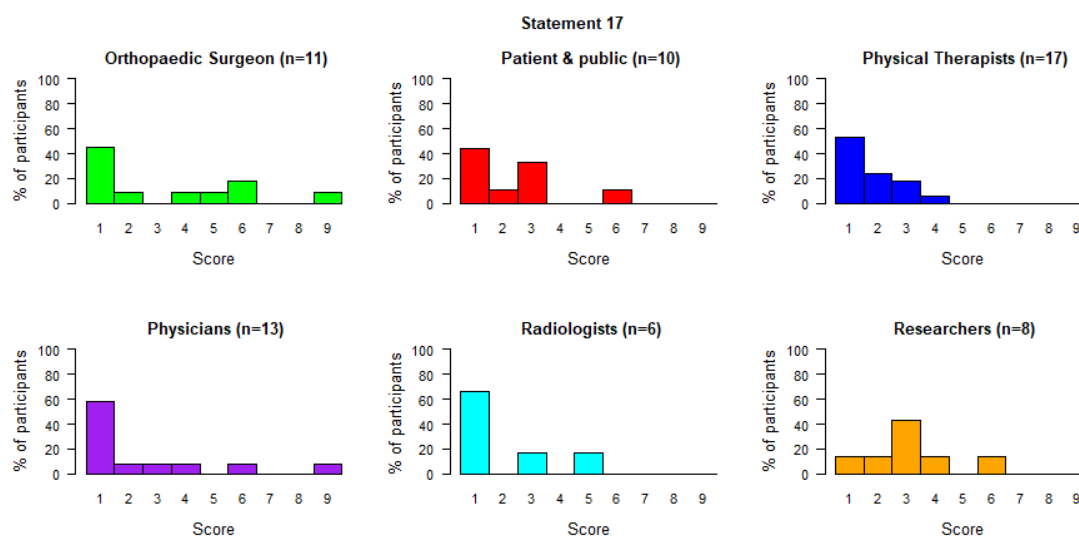
**R1: CONSENSUS OUT**

**R2: CONSENSUS OUT**

HELPTXT: The Warwick Agreement on femoroacetabular impingement (FAI) syndrome (2016) recommended the following terminology: FAI syndrome and cam morphology. It recommended for the following terminology to be avoided: asymptomatic FAI, symptomatic FAI, FAI morphology, and deformity, abnormality or lesion when referring to cam morphology. Terminology

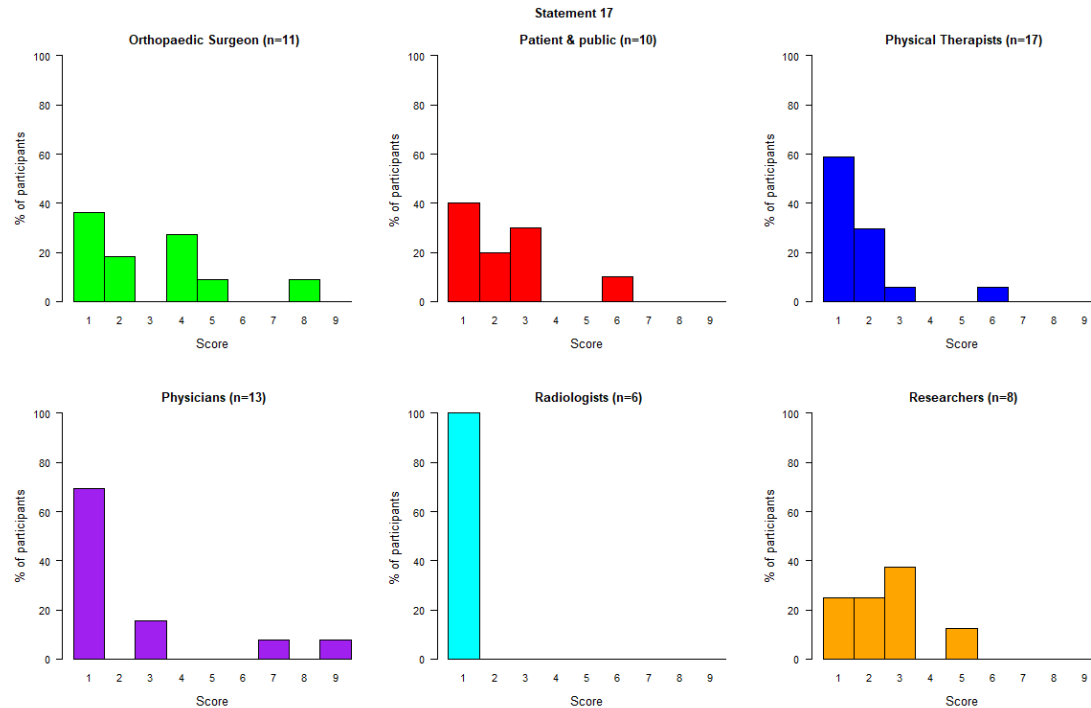
## RESULTS: ROUND 1

Add "is not" in place of "is"



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	6
Patient & Public In	2	1	3
Physical Therapists	1	1	2
Physicians	1	1	4
Radiologists	1	1	3
Researchers	3	2	4

Percentage panelists that scored the statement as critical	3.2%
Percentage panelists that scored the statement as not important	79%
<b>RESULT</b>	<b>CONSENSUS OUT</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
1	4	Can refer to CAM morphology
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
10	2	seeing how my colleagues scored
4	3	In comparing with other definitions; I did not prefer this one.
6	2	Global view and reading more in the literature

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	6	2	1	4
Patient & Public In	2	1	3	2	1	3
Physical Therapists	1	1	2	1	1	2
Physicians	1	1	4	1	1	3

<b>Radiologists</b>	1	1	3	1	1	1
<b>Researchers</b>	3	2	4	3	2	3

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	3.2%	4.6%
Percentage panelists that scored the statement as not important	79%	84.6%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>

**Statement 18:** Cam-type abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction

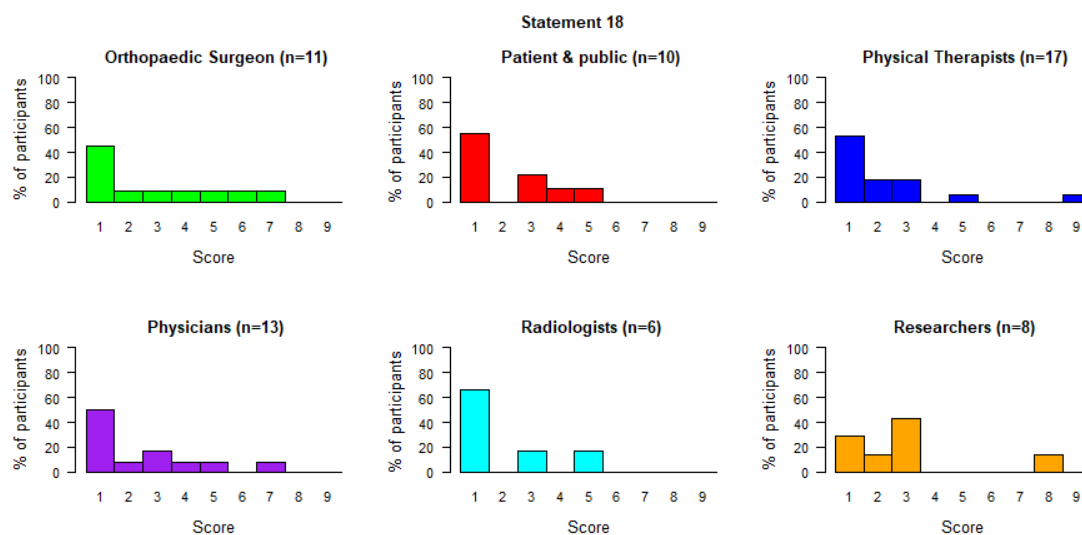
**R1: CONSENSUS OUT**

**R2: CONSENSUS OUT**

HELPTXT: The Warwick Agreement on femoroacetabular impingement (FAI) syndrome (2016) recommended the following terminology: FAI syndrome and cam morphology. It recommended for the following terminology to be avoided: asymptomatic FAI, symptomatic FAI, FAI morphology, and deformity, abnormality or lesion when referring to cam morphology. Terminology

## RESULTS: ROUND 1

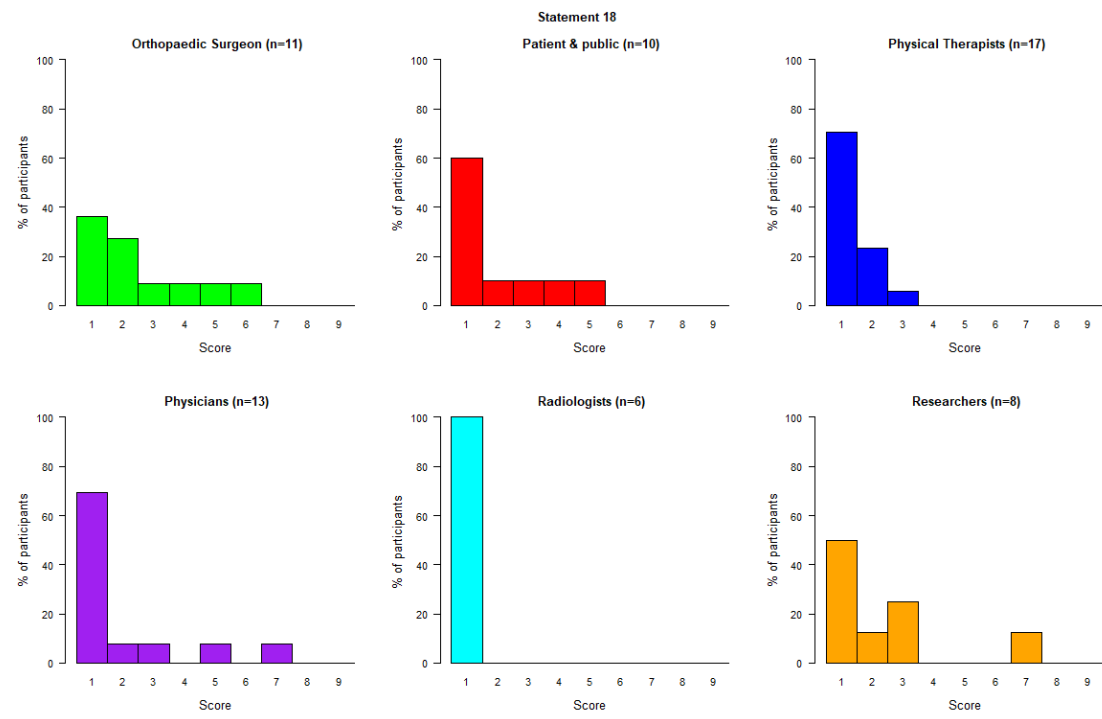
Add "is not" in place of "is"



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	5
Patient & Public In	1	1	3
Physical Therapists	1	1	3
Physicians	2	1	4
Radiologists	1	1	3
Researchers	3	1	3

Percentage panelists that scored the statement as critical	6.5%
Percentage panelists that scored the statement as not important	79%
<b>RESULT</b>	<b>CONSENSUS OUT</b>

RESULTS: ROUND 2



Reasons for score boundary changes between R1 and R2

R1	R2	
1	5	Can refer to CAM morphology
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
10	1	seeing how my colleagues scored
6	2	Global view and reading more in the literature
5	1	Term abnormality

Median, IQR

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	5	2	1	4
Patient & Public In	1	1	3	1	1	3
Physical Therapists	1	1	3	1	1	2
Physicians	2	1	4	1	1	2
Radiologists	1	1	3	1	1	1
Researchers	3	1	3	2	1	3

	Round 1	Round 2
Percentage panelists that scored the statement as critical	6.5%	3.1%
Percentage panelists that scored the statement as not important	79%	87.7%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>

**Statement 19:** Cam-type lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction

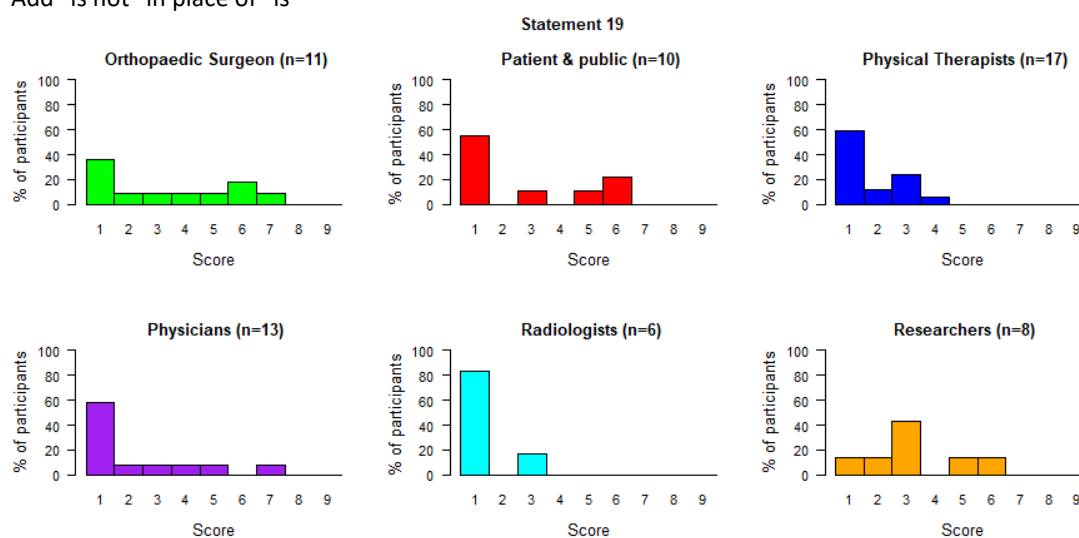
**R1: CONSENSUS OUT**

**R2: CONSENSUS OUT**

HELPTXT: The Warwick Agreement on femoroacetabular impingement (FAI) syndrome (2016) recommended the following terminology: FAI syndrome and cam morphology. It recommended for the following terminology to be avoided: asymptomatic FAI, symptomatic FAI, FAI morphology, and deformity, abnormality or lesion when referring to cam morphology. Terminology

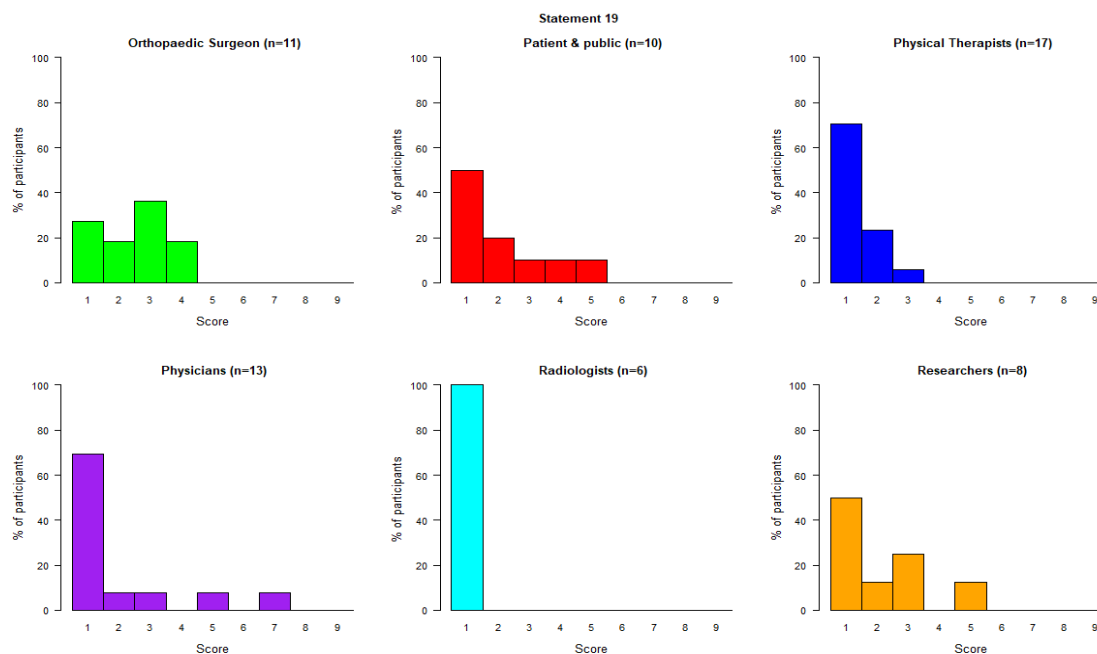
## RESULTS: ROUND 1

Add "is not" in place of "is"



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	3	1	6
Patient & Public In	1	1	5
Physical Therapists	1	1	3
Physicians	1	1	4
Radiologists	1	1	1
Researchers	3	2	5

Percentage panelists that scored the statement as critical	3.2%
Percentage panelists that scored the statement as not important	77.4%
<b>RESULT</b>	<b>CONSENSUS OUT</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
1	4	Can refer to CAM morphology
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
10	2	seeing how my colleagues scored
6	2	Global view and reading more in the literature
6	3	Reviewing the statement I felt it was less important
5	2	Having followed webinar; I think that it is less important.

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
<b>Orthopaedic Surgeon</b>	3	1	6	3	1	3
<b>Patient &amp; Public In</b>	1	1	5	2	1	3
<b>Physical Therapists</b>	1	1	3	1	1	2
<b>Physicians</b>	1	1	4	1	1	2
<b>Radiologists</b>	1	1	1	1	1	1
<b>Researchers</b>	3	2	5	2	1	3



	Round 1	Round 2
Percentage panelists that scored the statement as critical	3.2%	1.5%
Percentage panelists that scored the statement as not important	77.4%	89.2%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>

**Statement 20:** Pistol grip deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction

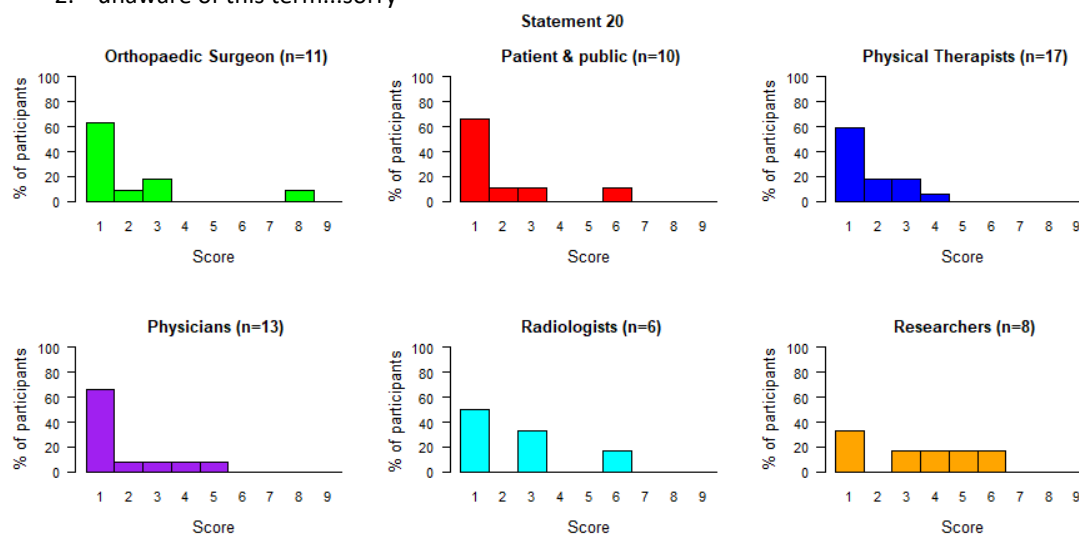
**R1: CONSENSUS OUT**

**R2: CONSENSUS OUT**

HELPTXT: The Warwick Agreement on femoroacetabular impingement (FAI) syndrome (2016) recommended the following terminology: FAI syndrome and cam morphology. It recommended for the following terminology to be avoided: asymptomatic FAI, symptomatic FAI, FAI morphology, and deformity, abnormality or lesion when referring to cam morphology. Terminology

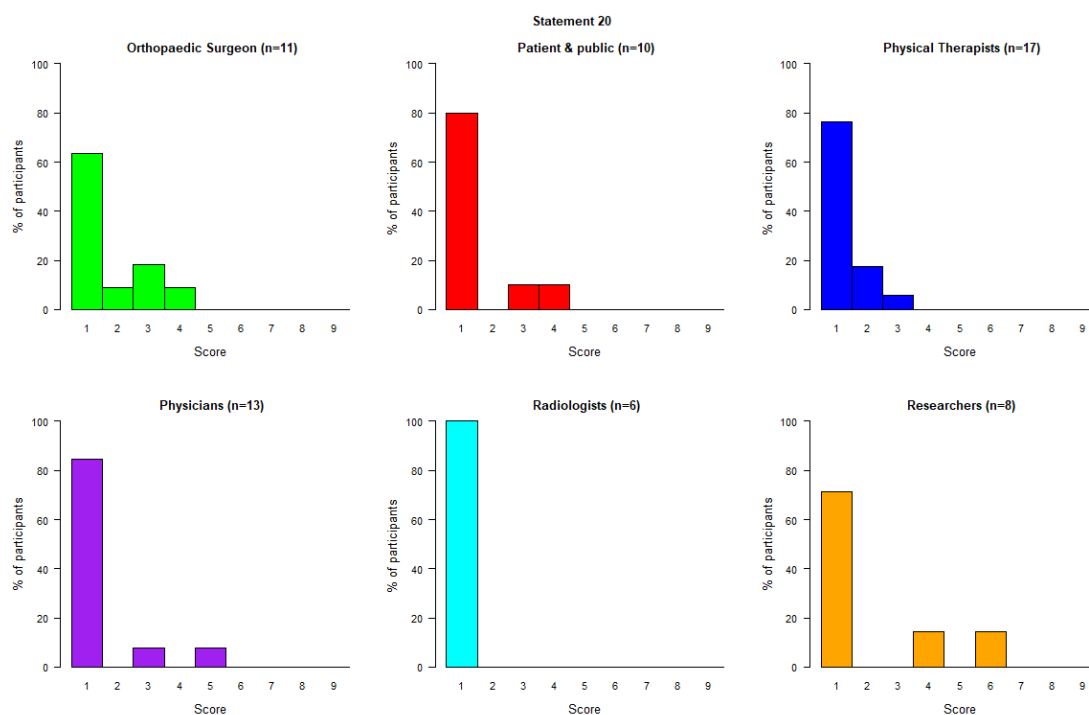
## RESULTS: ROUND 1

1. Add "is not" in place of "is"
2. unaware of this term...sorry



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	1	1	3
Patient & Public In	1	1	2
Physical Therapists	1	1	2
Physicians	1	1	3
Radiologists	2	1	3
Researchers	4	1	5

Percentage panelists that scored the statement as critical	1.6%
Percentage panelists that scored the statement as not important	85.2%
<b>RESULT</b>	<b>CONSENSUS OUT</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
10	1	seeing how my colleagues scored
5	1	Rethought the question and answer

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	1	1	3	1	1	3
Patient & Public In	1	1	2	1	1	1
Physical Therapists	1	1	2	1	1	1
Physicians	1	1	3	1	1	1
Radiologists	2	1	3	1	1	1
Researchers	4	1	5	1	1	4

	Round 1	Round 2
Percentage panelists that scored the statement as critical	1.6%	0%
Percentage panelists that scored the statement as not important	85.2%	92.2%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>

**Statement 21:** Pistol grip lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction

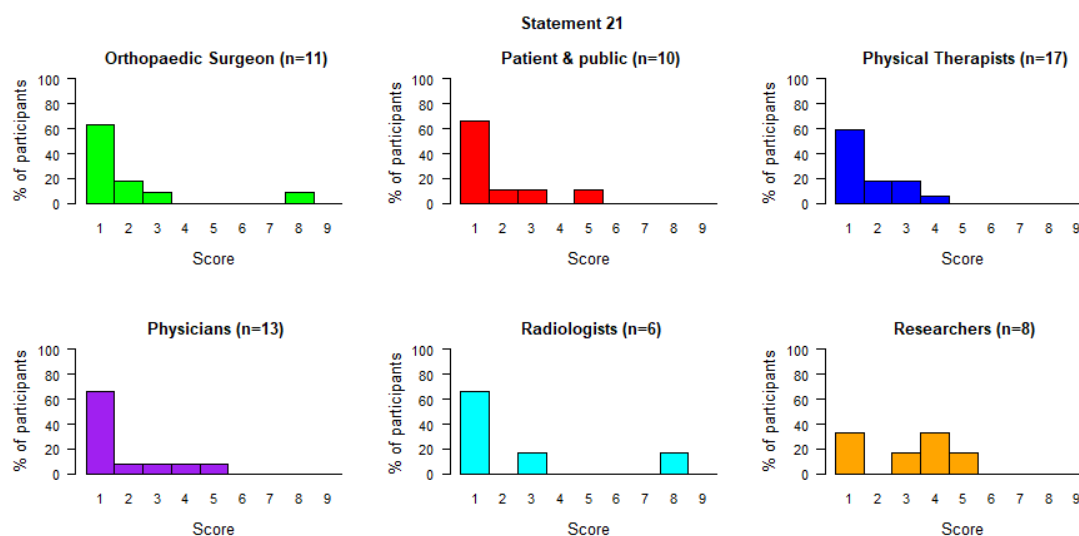
**R1: CONSENSUS OUT**

**R2: CONSENSUS OUT**

HELPTXT: The Warwick Agreement on femoroacetabular impingement (FAI) syndrome (2016) recommended the following terminology: FAI syndrome and cam morphology. It recommended for the following terminology to be avoided: asymptomatic FAI, symptomatic FAI, FAI morphology, and deformity, abnormality or lesion when referring to cam morphology. Terminology

### RESULTS: ROUND 1

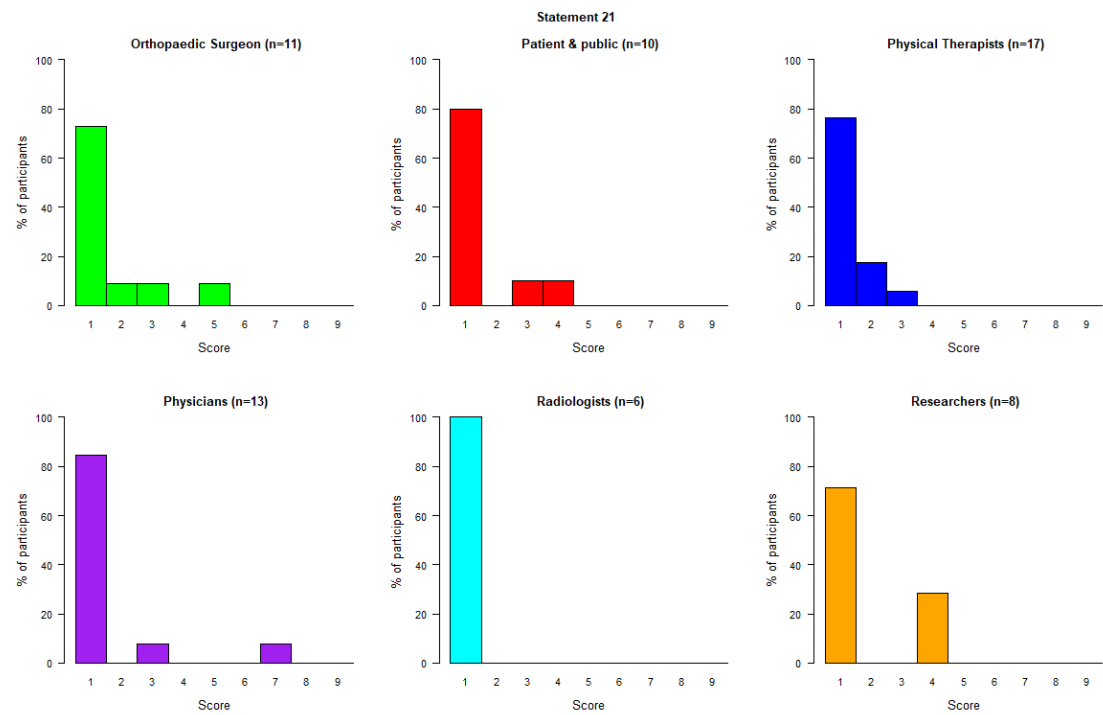
Add "is not" in place of "is"



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	1	1	2
Patient & Public In	1	1	2
Physical Therapists	1	1	2
Physicians	1	1	3
Radiologists	1	1	3
Researchers	4	1	4

Percentage panelists that scored the statement as critical	3.3%
Percentage panelists that scored the statement as not important	85.2%
<b>RESULT</b>	<b>CONSENSUS OUT</b>

RESULTS: ROUND 2



Reasons for score boundary changes between R1 and R2

R1	R2	
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
10	1	seeing how my colleagues scored
5	1	Rethought the question and answer

Median, IQR

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	1	1	2	1	1	2
Patient & Public In	1	1	2	1	1	1
Physical Therapists	1	1	2	1	1	1
Physicians	1	1	3	1	1	1
Radiologists	1	1	3	1	1	1
Researchers	4	1	4	1	1	4

	Round 1	Round 2
Percentage panelists that scored the statement as critical	3.3%	1.6%
Percentage panelists that scored the statement as not important	85.2%	92.2%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>

**Statement 22:** Pistol grip abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction

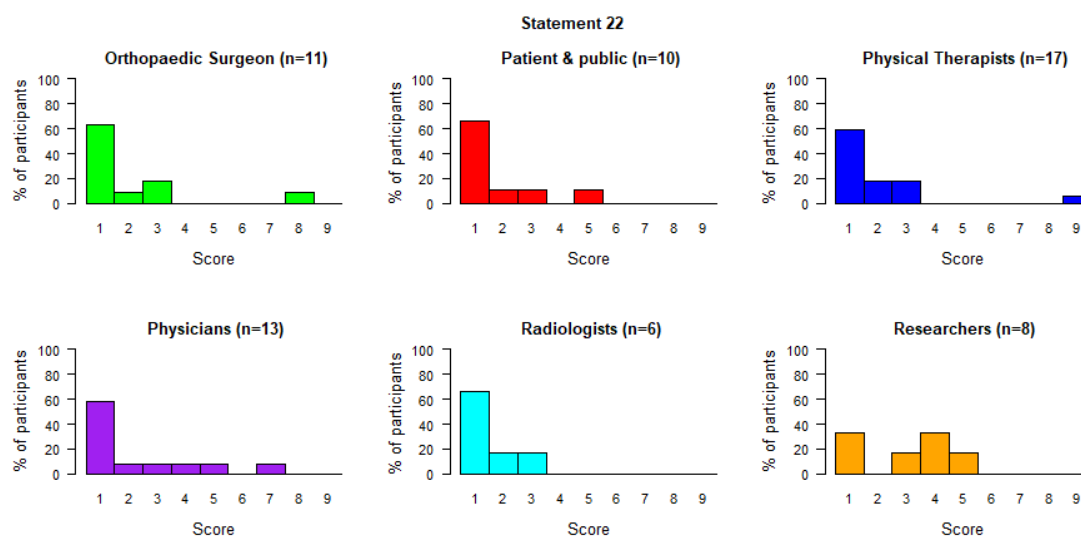
**R1: CONSENSUS OUT**

**R2: CONSENSUS OUT**

HELPTXT: The Warwick Agreement on femoroacetabular impingement (FAI) syndrome (2016) recommended the following terminology: FAI syndrome and cam morphology. It recommended for the following terminology to be avoided: asymptomatic FAI, symptomatic FAI, FAI morphology, and deformity, abnormality or lesion when referring to cam morphology. Terminology

## RESULTS: ROUND 1

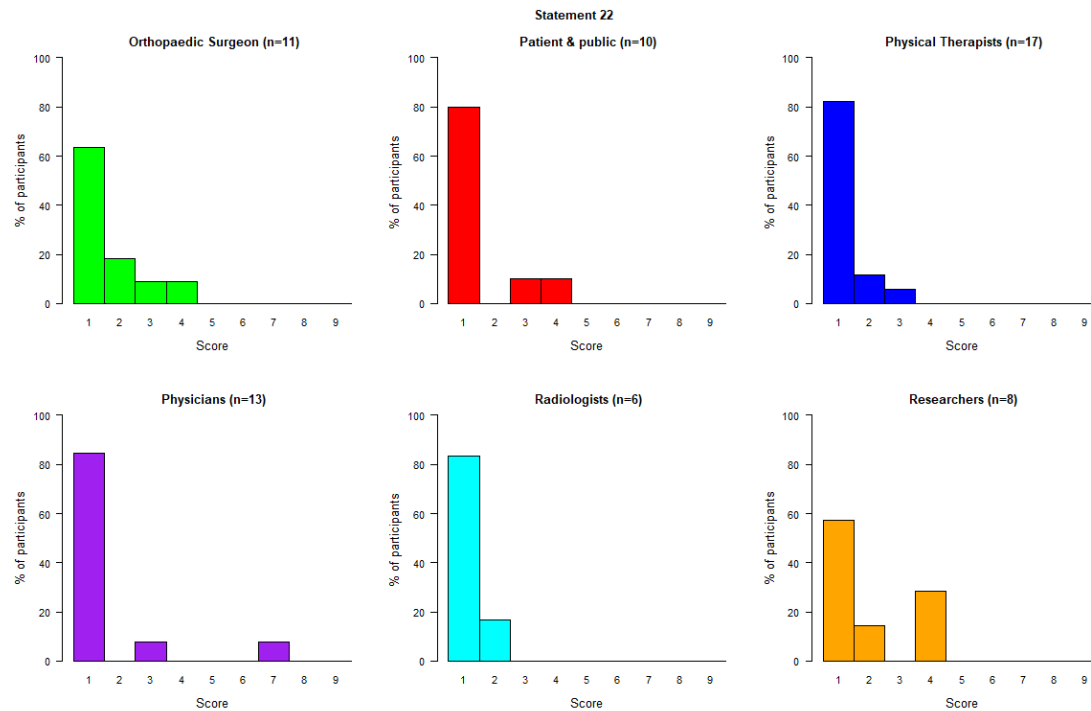
Add "is not" in place of "is"



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	1	1	3
Patient & Public In	1	1	2
Physical Therapists	1	1	2
Physicians	1	1	4
Radiologists	1	1	2
Researchers	4	1	4

Percentage panelists that scored the statement as critical	4.9%
Percentage panelists that scored the statement as not important	85.2%
<b>RESULT</b>	<b>CONSENSUS OUT</b>



**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
10	1	seeing how my colleagues scored
7	1	better definition exists upon reflection
5	1	Rethought the question and answer

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	1	1	3	1	1	2
Patient & Public In	1	1	2	1	1	1
Physical Therapists	1	1	2	1	1	1
Physicians	1	1	4	1	1	1
Radiologists	1	1	2	1	1	1
Researchers	4	1	4	1	1	4

	Round 1	Round 2
Percentage panelists that scored the statement as critical	4.9%	1.6%
Percentage panelists that scored the statement as not important	85.2%	92.2%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>

**Statement 23:** Cam-type impingement is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

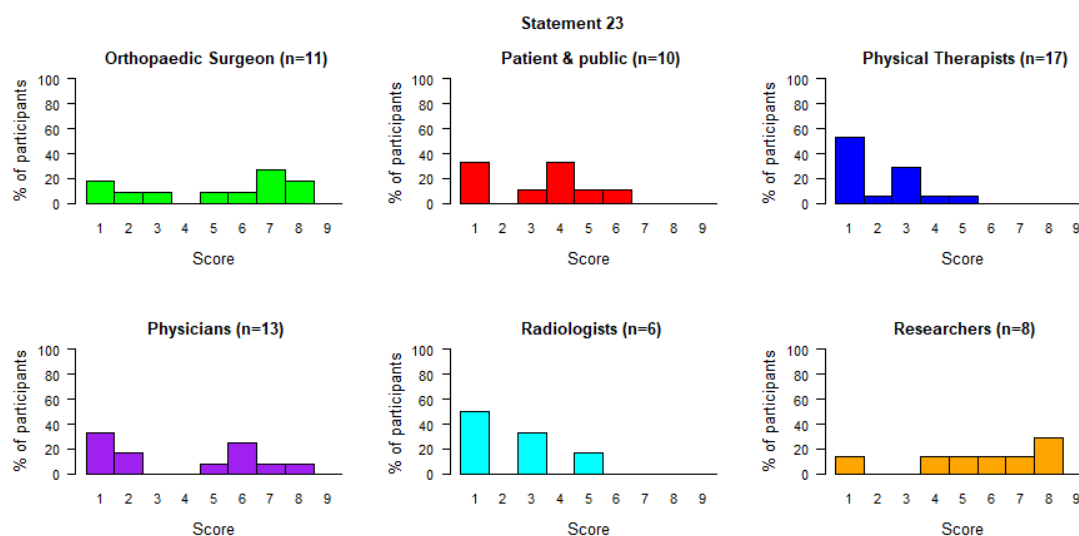
**R1: NO CONSENSUS**

**R2: NO CONSENSUS**

HELPTXT: Femoroacetabular impingement (FAI) syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum. Symptoms therefore occur due to repeated 'earlier than normal' contact between the ball and socket of the hip. Terminology

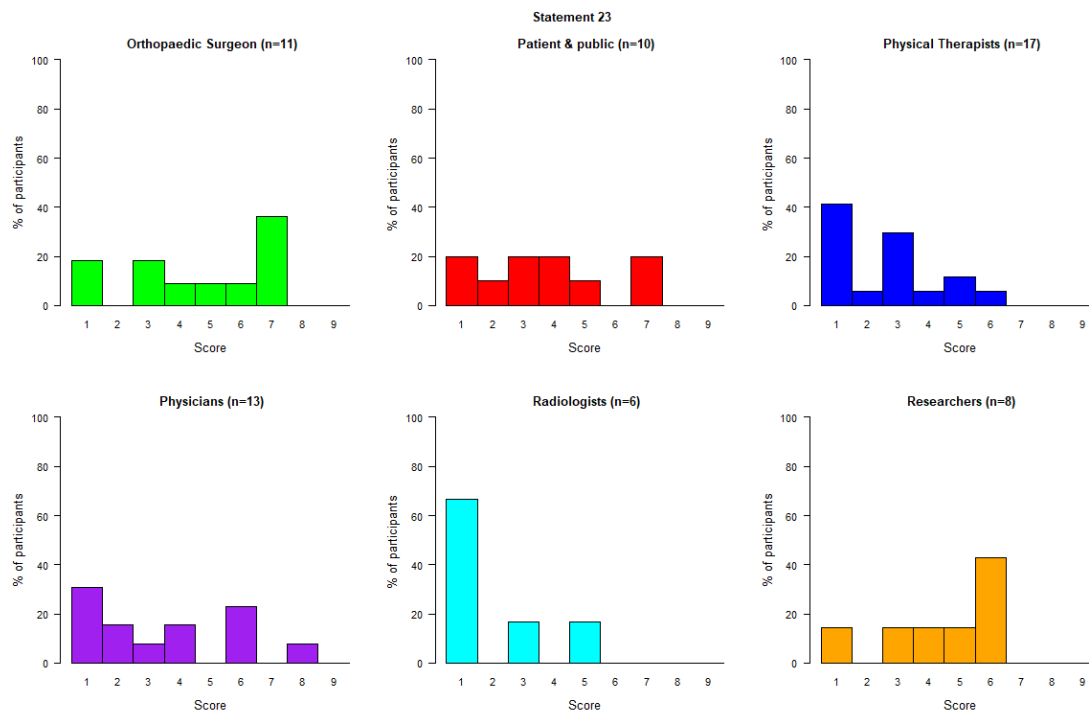
### RESULTS: ROUND 1

Add "is not" in place of "is"



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	6	2	7
Patient & Public In	4	1	4
Physical Therapists	1	1	3
Physicians	4	1	6
Radiologists	2	1	3
Researchers	6	4	8

Percentage panelists that scored the statement as critical	16.1%
Percentage panelists that scored the statement as not important	56.5%
<b>RESULT</b>	<b>NO CONSENSUS</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
1	7	Better understood the statement. Following my FAI diagnosis; the use of the term impingement for both cam and pincer was common.
3	5	I prefer the FAIS part of the earlier statement but feel this one is ok; took it out of the 'not agreed' category
1	5	I initially wanted syndrome in the term; but now feel this is not essential - I prefer to include femoroacetabular - therefore 5 here and 7 in previous statement.
6	7	Changed due to: mechanism is described in the terminology
1	4	mistake - syndrome is missing
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
10	3	seeing how my colleagues scored
8	3	better definition exists upon reflection
8	6	In comparing with other definitions; I did not prefer this one.
7	4	Reviewing the statement I felt there are better terms than this one
8	6	influenced by scores from other respondents

**Median, IQR**

	<b>ROUND 1</b>			<b>ROUND 2</b>		
	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>
<b>Orthopaedic Surgeon</b>	6	2	7	5	3	7
<b>Patient &amp; Public In</b>	4	1	4	4	2	5
<b>Physical Therapists</b>	1	1	3	3	1	3
<b>Physicians</b>	4	1	6	3	1	6
<b>Radiologists</b>	2	1	3	1	1	3
<b>Researchers</b>	6	4	8	5	3	6

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	16.1%	10.9%
Percentage panelists that scored the statement as not important	56.5%	56.3%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

**Statement 24:** Cam femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

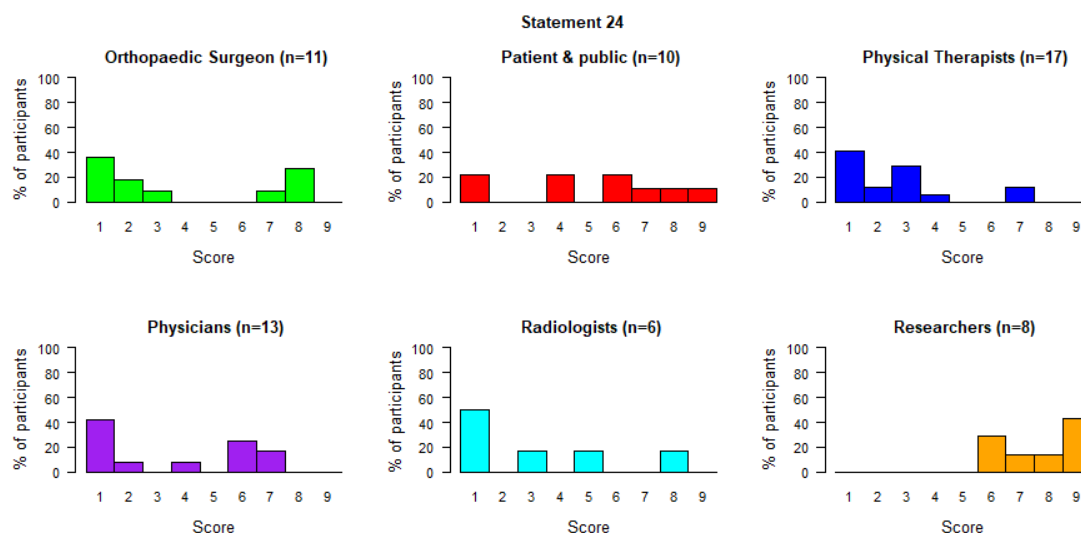
**R1: NO CONSENSUS**

**R2: NO CONSENSUS**

HELPTXT: Femoroacetabular impingement (FAI) syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum. Symptoms therefore occur due to repeated 'earlier than normal' contact between the ball and socket of the hip. Terminology

#### RESULTS: ROUND 1

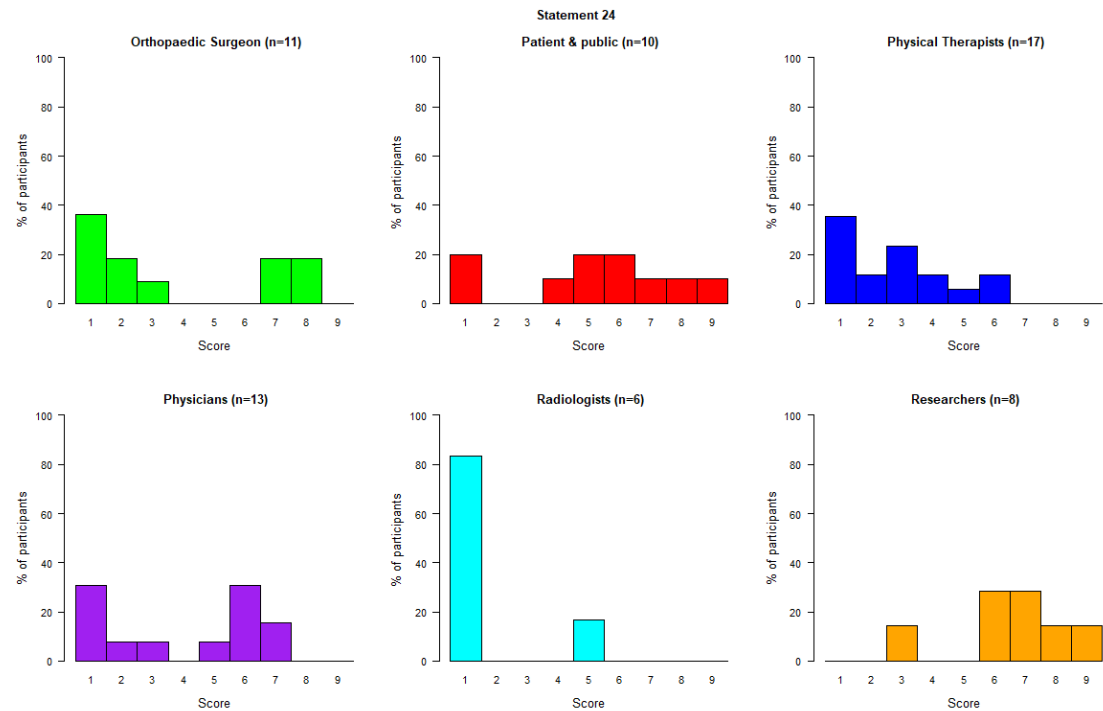
1. Add "is not" in place of "is"
2. with the addition of syndrome to FAI



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	8
Patient & Public In	6	4	7
Physical Therapists	2	1	3
Physicians	3	1	6
Radiologists	2	1	5
Researchers	8	6	9

Percentage panelists that scored the statement as critical	27.4%
Percentage panelists that scored the statement as not important	53.2%
<b>RESULT</b>	<b>NO CONSENSUS</b>

RESULTS: ROUND 2



Reasons for score boundary changes between R1 and R1

R1	R2	
1	6	Second webinar information
1	5	mistake - syndrome is missing
3	6	I misread the question initially
7	3	Realized that "syndrome" was not in there and FAI syndrome is preferred.
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
10	5	seeing how my colleagues scored
4	3	better definition exists upon reflection
7	6	important perspective of other colleagues to more clearly delineate

**Median, IQR**

	<b>ROUND 1</b>			<b>ROUND 2</b>		
	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>
<b>Orthopaedic Surgeon</b>	2	1	8	2	1	7
<b>Patient &amp; Public In</b>	6	4	7	6	4	7
<b>Physical Therapists</b>	2	1	3	3	1	4
<b>Physicians</b>	3	1	6	5	1	6
<b>Radiologists</b>	2	1	5	1	1	1
<b>Researchers</b>	8	6	9	7	6	8

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	27.4%	20.3%
Percentage panelists that scored the statement as not important	53.2%	51.6%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>



**Statement 25:** Cam-type femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

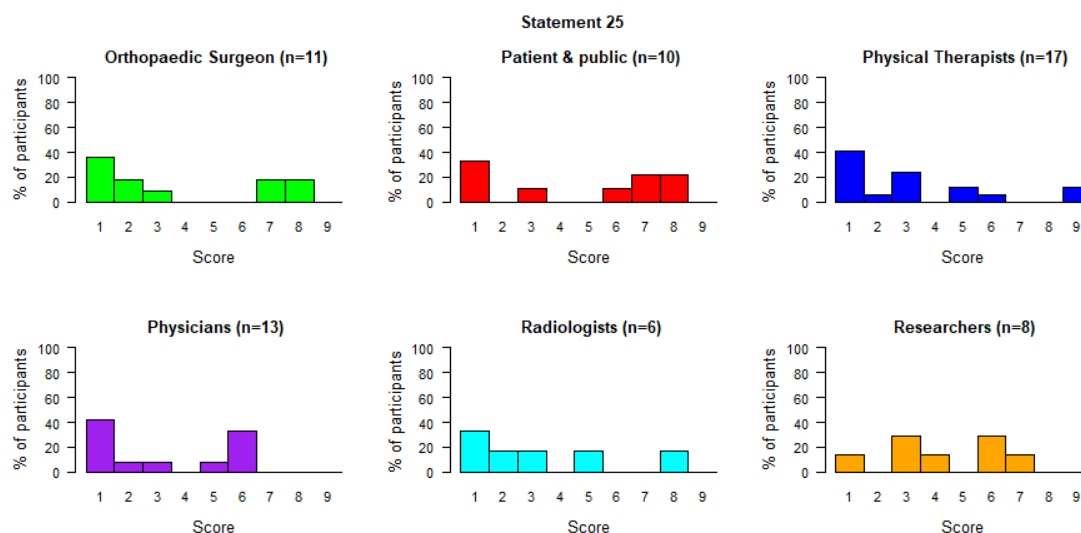
**R1: NO CONSENSUS**

**R2: NO CONSENSUS**

HELPTXT: Femoroacetabular impingement (FAI) syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum. Symptoms therefore occur due to repeated 'earlier than normal' contact between the ball and socket of the hip. Terminology

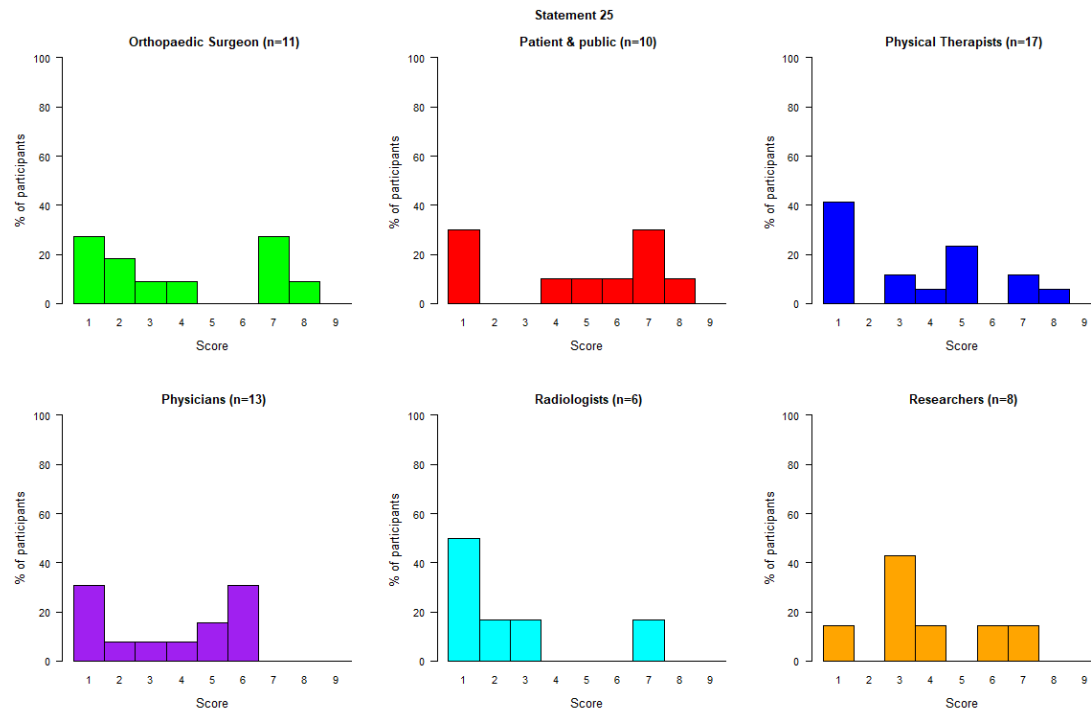
## RESULTS: ROUND 1

Add "is not" in place of "is"



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	7
Patient & Public In	6	1	7
Physical Therapists	3	1	5
Physicians	3	1	6
Radiologists	3	1	5
Researchers	4	3	6

Percentage panelists that scored the statement as critical	19.4%
Percentage panelists that scored the statement as not important	59.7%
<b>RESULT</b>	<b>NO CONSENSUS</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
3	7	Happy that 'cam type' impingement is an acceptable descriptor
3	7	I initially wanted syndrome in the term; but now feel this is not essential.
1	6	Second webinar informations
3	5	I misread the question initially
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
6	3	Realized that "syndrome" was not in there and FAI syndrome is preferred.
5	3	the clinical aspect is not known

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	7	3	1	7
Patient & Public In	6	1	7	6	1	7
Physical Therapists	3	1	5	3	1	5
Physicians	3	1	6	4	1	6

<b>Radiologists</b>	3	1	5	2	1	3
<b>Researchers</b>	4	3	6	3	3	6

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	19.4%	20.3%
Percentage panelists that scored the statement as not important	59.7%	51.6%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

**Statement 26:** Femoroacetabular impingement (FAI) Syndrome with cam morphology is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

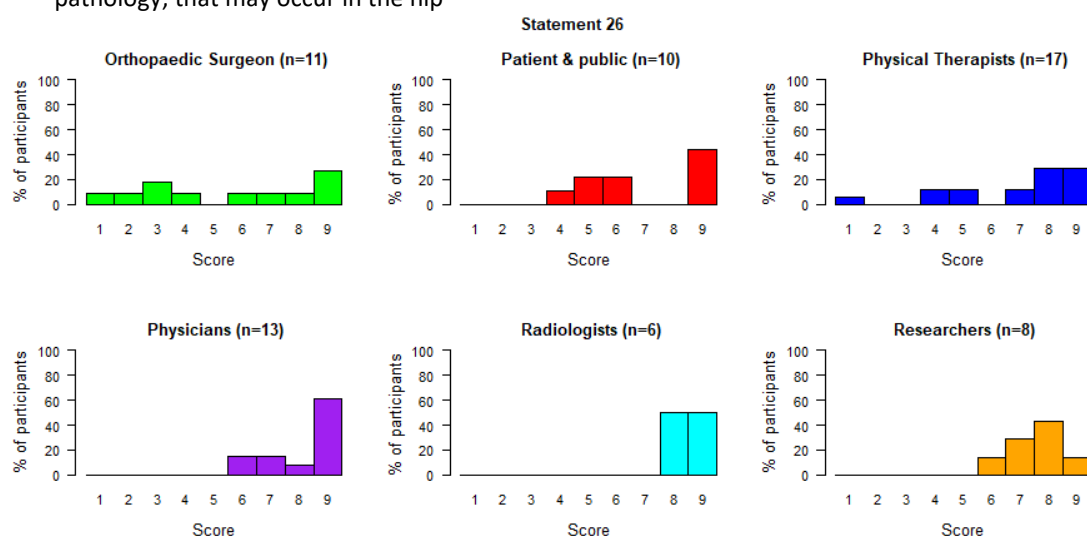
**R1: NO CONSENSUS**

**R2: CONSENSUS IN**

HELPTXT: Femoroacetabular impingement (FAI) syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum. Symptoms therefore occur due to repeated 'earlier than normal' contact between the ball and socket of the hip.

### RESULTS: ROUND 1

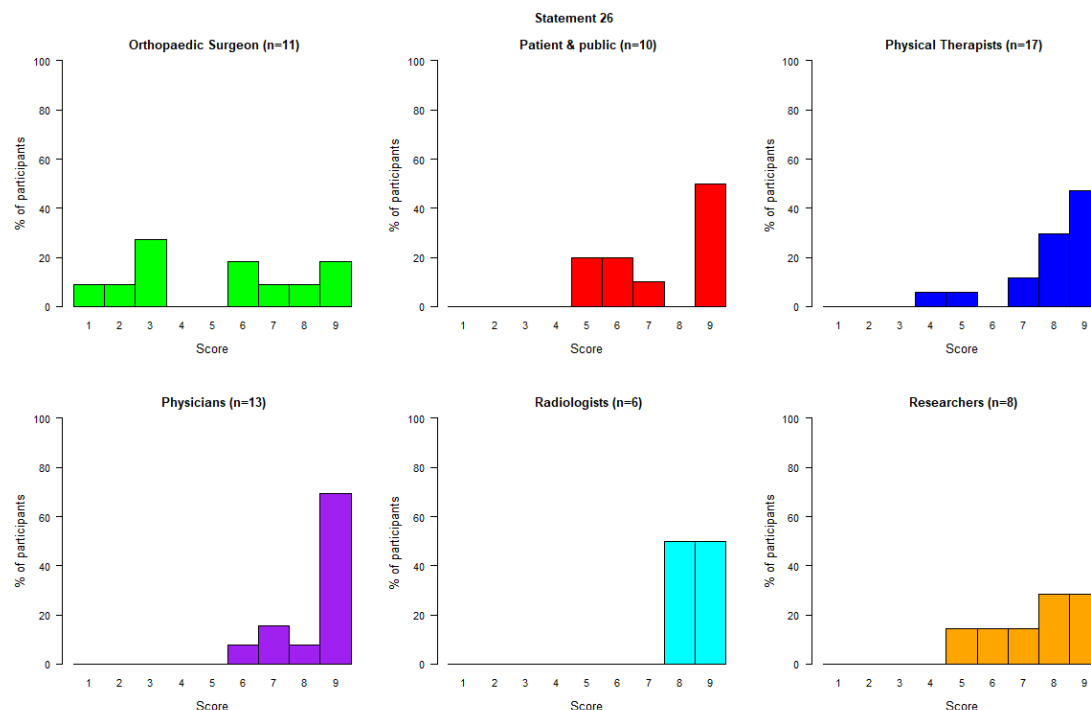
1. This would be my 2nd placed vote; if we want to widen the definition to include FAI.
2. consider replacing bump by prominence. Not every cam morphology has a "bump". It might has only decreased offset and that certainly does not constitute a "bump"
3. I do not agree that you can say it is the preferred term for hip-related pain; but this is one type of pathology; that may occur in the hip



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	6	3	9
Patient & Public In	6	5	9
Physical Therapists	8	5	9
Physicians	9	7	9
Radiologists	9	8	9
Researchers	8	7	8

Percentage panelists that scored the statement as critical	69.8%
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Percentage panelists that scored the statement as not important	7.9%
<b>RESULT</b>	<b>NO CONSENSUS</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
1	8	Relevant to indicate FAI syndrome with the actual morphology (cam)
6	8	Second webinar informations
4	9	Change of mindset
6	7	I think is probably necessary to provide a better definition and I moved above the cut off to be considere
5	7	important perspective of other colleagues
6	7	Having followed webinar; I think that it is important.
9	5	I now preferred the cam-type FAI - and keep use of morphology for the specific finding of cam.
7	6	influenced by scores from other respondents

**Median, IQR**

	ROUND 1	ROUND 2
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	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	6	3	9	6	3	8
Patient & Public In	6	5	9	8	6	9
Physical Therapists	8	5	9	8	8	9
Physicians	9	7	9	9	8	9
Radiologists	9	8	9	9	8	9
Researchers	8	7	8	8	6	9

	Round 1	Round 2
Percentage panelists that scored the statement as critical	69.8%	75%
Percentage panelists that scored the statement as not important	7.9%	7.8%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>CONSENSUS IN</b>

**Statement 27:** Femoroacetabular impingement (FAI) Syndrome with cam deformity is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

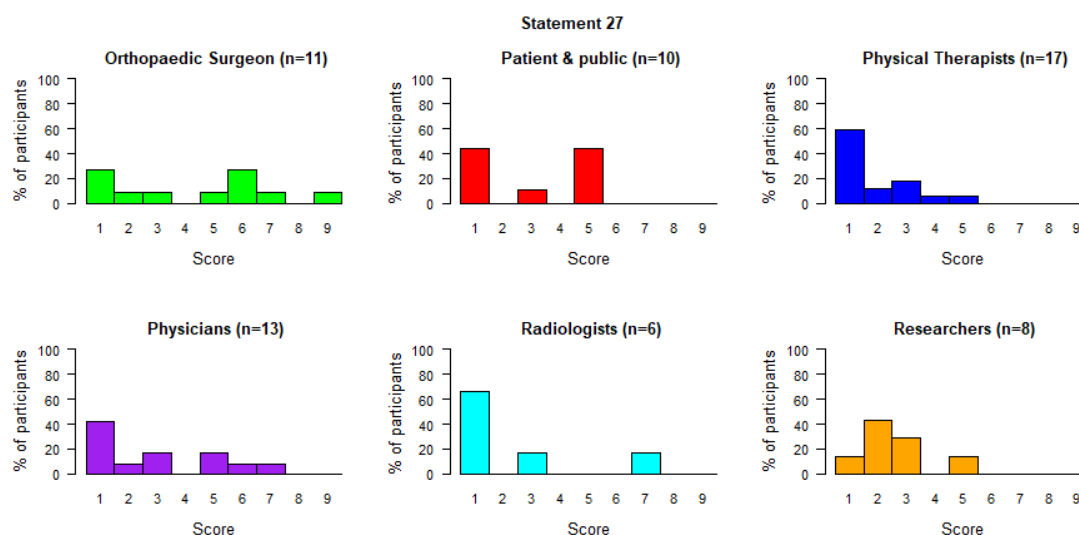
**R1: CONSENSUS OUT**

**R2: CONSENSUS OUT**

HELPTXT: Femoroacetabular impingement (FAI) syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum. Symptoms therefore occur due to repeated 'earlier than normal' contact between the ball and socket of the hip Terminology

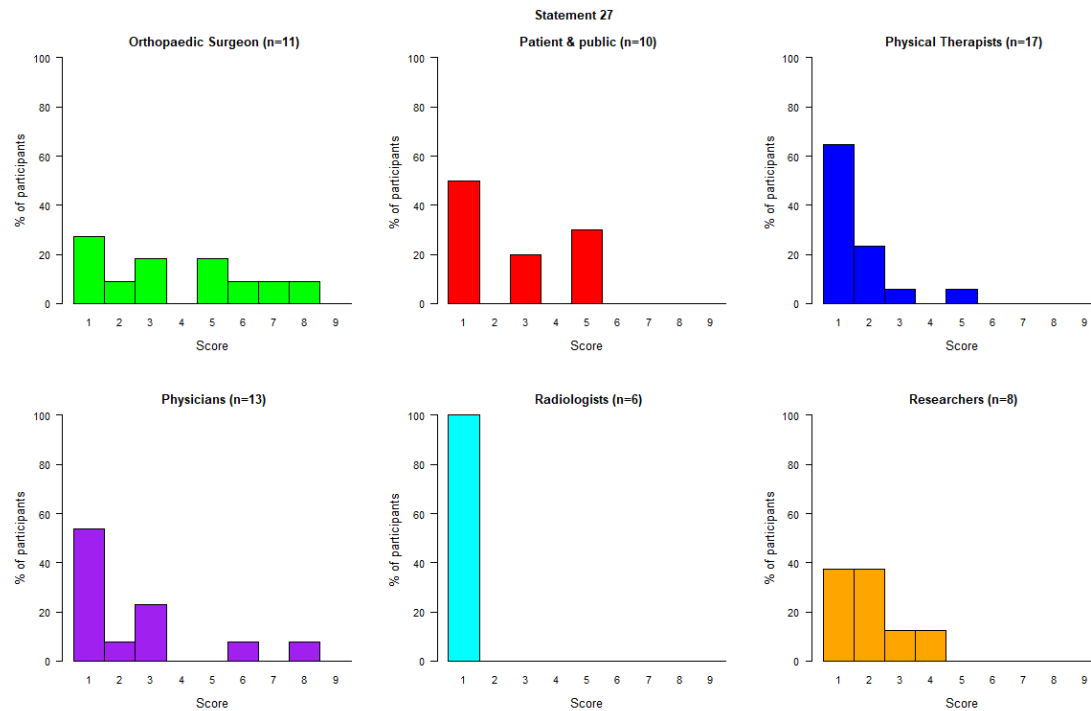
## RESULTS: ROUND 1

Add "is not" in place of "is"



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	5	1	6
Patient & Public In	3	1	5
Physical Therapists	1	1	3
Physicians	3	1	5
Radiologists	1	1	3
Researchers	2	2	3

Percentage panelists that scored the statement as critical	6.5%
Percentage panelists that scored the statement as not important	71%
<b>RESULT</b>	<b>CONSENSUS OUT</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
10	5	seeing how my colleagues scored
5	3	Having followed webinar; I think that it is less important.
5	3	More confident that 'any location' is a bad element

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	5	1	6	3	1	6
Patient & Public In	3	1	5	2	1	5
Physical Therapists	1	1	3	1	1	2
Physicians	3	1	5	1	1	3
Radiologists	1	1	3	1	1	1
Researchers	2	2	3	2	1	3



	Round 1	Round 2
Percentage panelists that scored the statement as critical	6.5%	4.6%
Percentage panelists that scored the statement as not important	71%	81.5%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>

**Statement 28:** Femoroacetabular impingement (FAI) Syndrome with cam abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

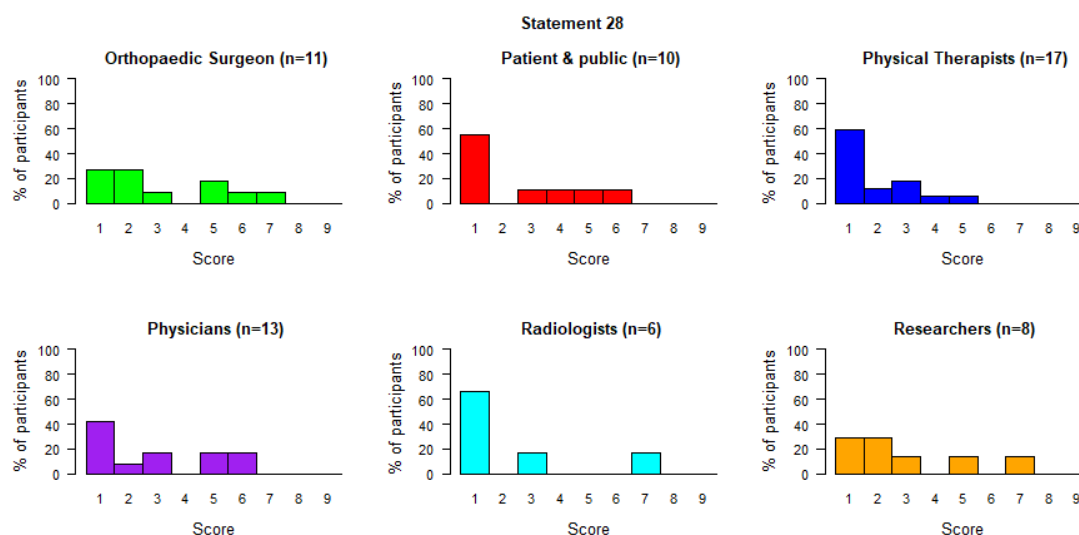
**R1: CONSENSUS OUT**

**R2: CONSENSUS OUT**

HELPTXT: Femoroacetabular impingement (FAI) syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum. Symptoms therefore occur due to repeated 'earlier than normal' contact between the ball and socket of the hip. Terminology

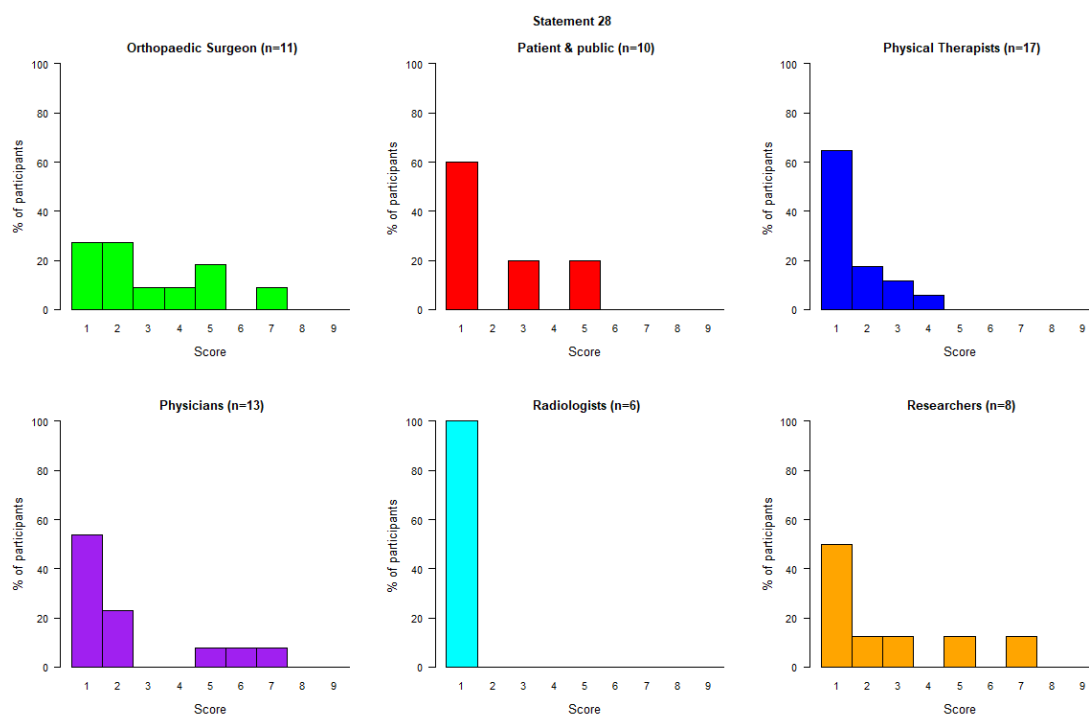
## RESULTS: ROUND 1

Add "is not" in place of "is"



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	5
Patient & Public In	1	1	4
Physical Therapists	1	1	3
Physicians	3	1	5
Radiologists	1	1	3
Researchers	2	1	5

Percentage panelists that scored the statement as critical	4.8%
Percentage panelists that scored the statement as not important	74.2%
<b>RESULT</b>	<b>CONSENSUS OUT</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
2	4	CAM abnormality not necessarily saying FAI
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
10	1	seeing how my colleagues scored
4	3	Having followed webinar; I think that it is less important.
5	2	More confident that 'any location' is a bad element

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	5	2	1	5
Patient & Public In	1	1	4	1	1	3
Physical Therapists	1	1	3	1	1	2
Physicians	3	1	5	1	1	2
Radiologists	1	1	3	1	1	1
Researchers	2	1	5	2	1	4

	Round 1	Round 2
Percentage panelists that scored the statement as critical	4.8%	4.6%
Percentage panelists that scored the statement as not important	74.2%	81.5%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>

**Statement 29:** Femoroacetabular impingement (FAI) Syndrome with cam lesion is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

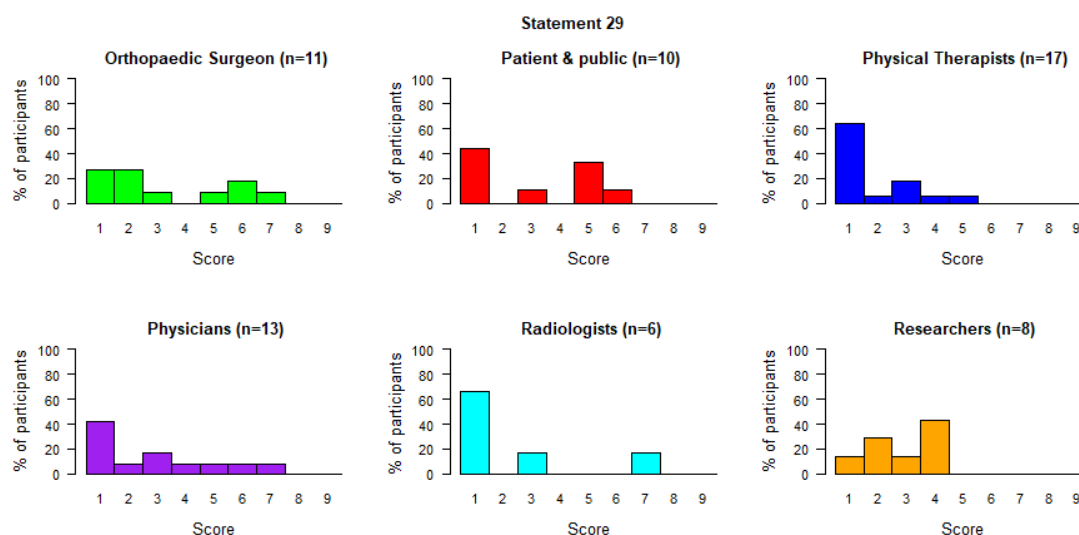
**R1: CONSENSUS OUT**

**R2: CONSENSUS OUT**

HELPTXT: Femoroacetabular impingement (FAI) syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum. Symptoms therefore occur due to repeated 'earlier than normal' contact between the ball and socket of the hip. Terminology

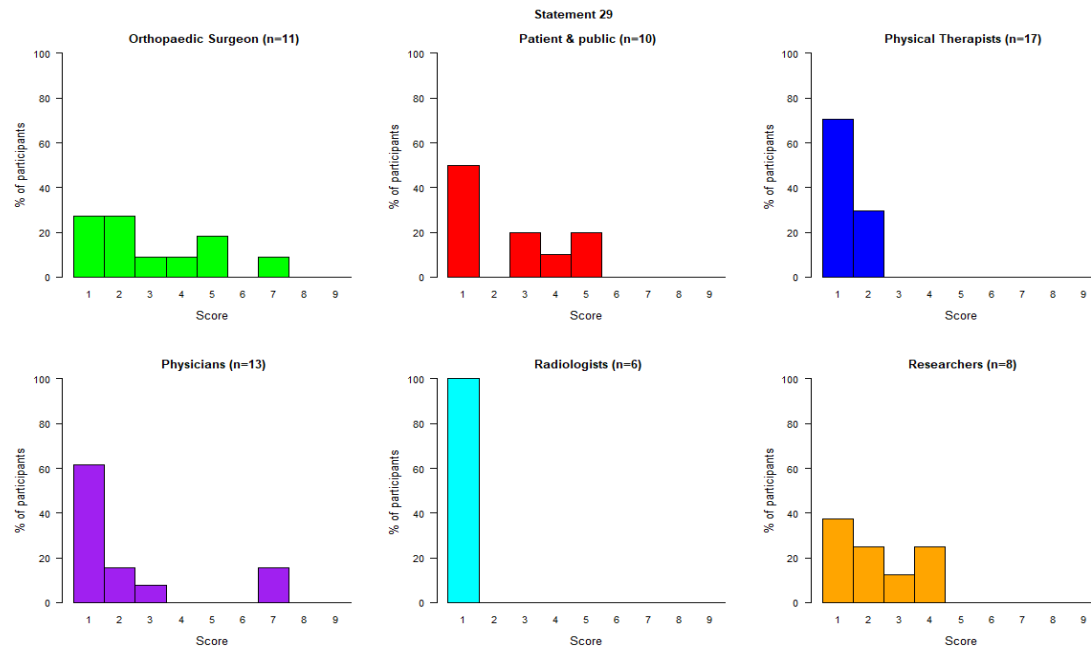
## RESULTS: ROUND 1

Add "is not" in place of "is"



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	6
Patient & Public In	3	1	5
Physical Therapists	1	1	3
Physicians	3	1	5
Radiologists	1	1	3
Researchers	3	2	4

Percentage panelists that scored the statement as critical	4.8%
Percentage panelists that scored the statement as not important	71%
<b>RESULT</b>	<b>CONSENSUS OUT</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
2	4	CAM abnormality not necessarily saying FAI
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
10	3	seeing how my colleagues scored
4	3	In comparing with other definitions; I did not prefer this one.
5	2	important perspective of other colleagues to more clearly delineate
5	2	More confident that 'any location' is a bad element

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	6	2	1	5
Patient & Public In	3	1	5	2	1	4
Physical Therapists	1	1	3	1	1	2
Physicians	3	1	5	1	1	2
Radiologists	1	1	3	1	1	1
Researchers	3	2	4	2	1	4

	Round 1	Round 2
Percentage panelists that scored the statement as critical	4.8%	4.6%
Percentage panelists that scored the statement as not important	71%	83.1%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>

**Statement 30:** Femoroacetabular impingement (FAI) Syndrome with cam-type abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

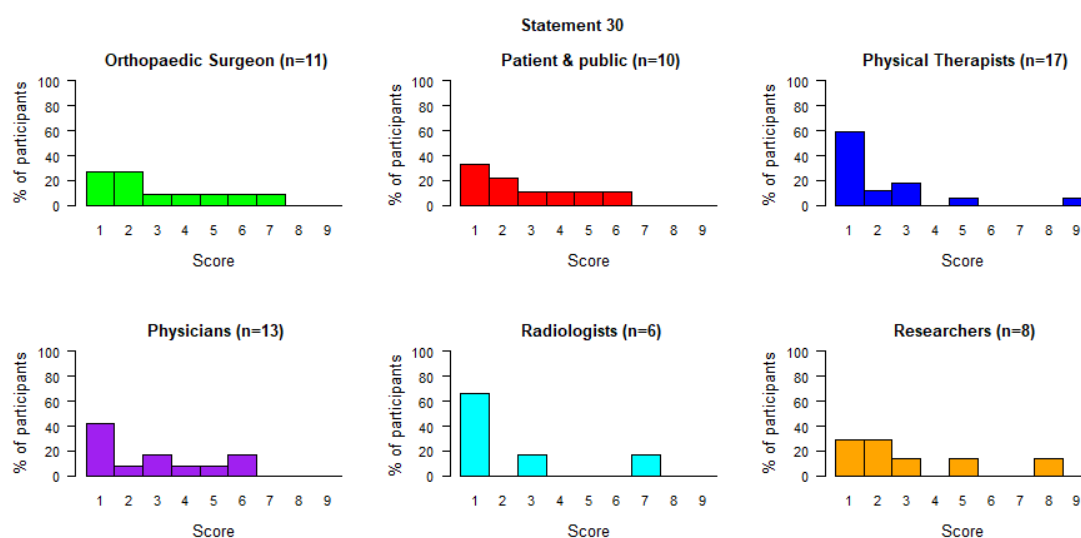
**R1: CONSENSUS OUT**

**R2: CONSENSUS OUT**

HELPTXT: Femoroacetabular impingement (FAI) syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum. Symptoms therefore occur due to repeated 'earlier than normal' contact between the ball and socket of the hip. Terminology

## RESULTS: ROUND 1

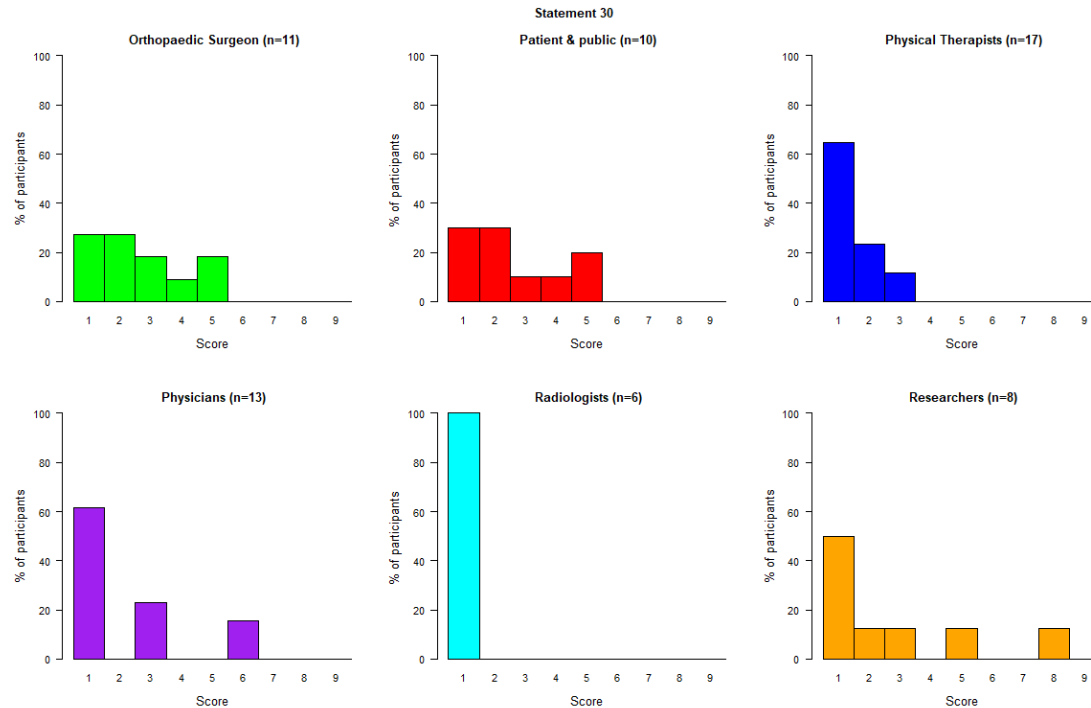
Add "is not" in place of "is"



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	5
Patient & Public In	2	1	4
Physical Therapists	1	1	3
Physicians	3	1	5
Radiologists	1	1	3
Researchers	2	1	5

Percentage panelists that scored the statement as critical	6.5%
Percentage panelists that scored the statement as not important	74.2%
<b>RESULT</b>	<b>CONSENSUS OUT</b>



**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
7	3	Global view and reading more in the literature
10	2	seeing how my colleagues scored
5	2	important perspective of other colleagues to more clearly delineate
5	3	More confident that 'any location' is a bad element

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	2	1	5	2	1	4
Patient & Public In	2	1	4	2	1	4
Physical Therapists	1	1	3	1	1	2
Physicians	3	1	5	1	1	3

<b>Radiologists</b>	1	1	3	1	1	1
<b>Researchers</b>	2	1	5	2	1	4

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	6.5%	1.5%
Percentage panelists that scored the statement as not important	74.2%	84.6%
<b>RESULT</b>	<b>CONSENSUS OUT</b>	<b>CONSENSUS OUT</b>

**Statement 31:** Femoroacetabular impingement (FAI) Syndrome with cam-type deformity is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

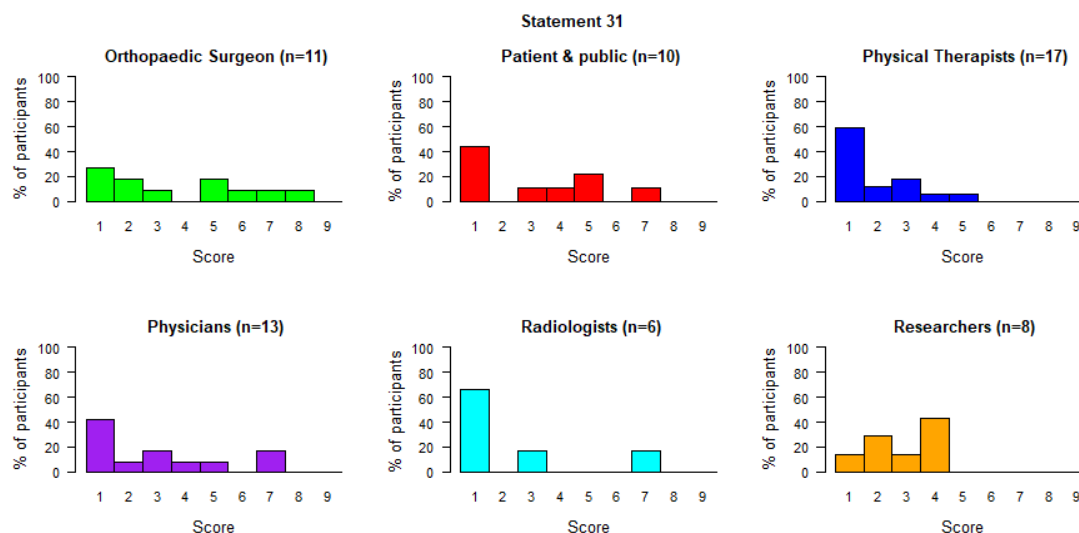
**R1: NO CONSENSUS**

**R2: CONSENSUS OUT**

HELPTXT: Femoroacetabular impingement (FAI) syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum. Symptoms therefore occur due to repeated 'earlier than normal' contact between the ball and socket of the hip. Terminology

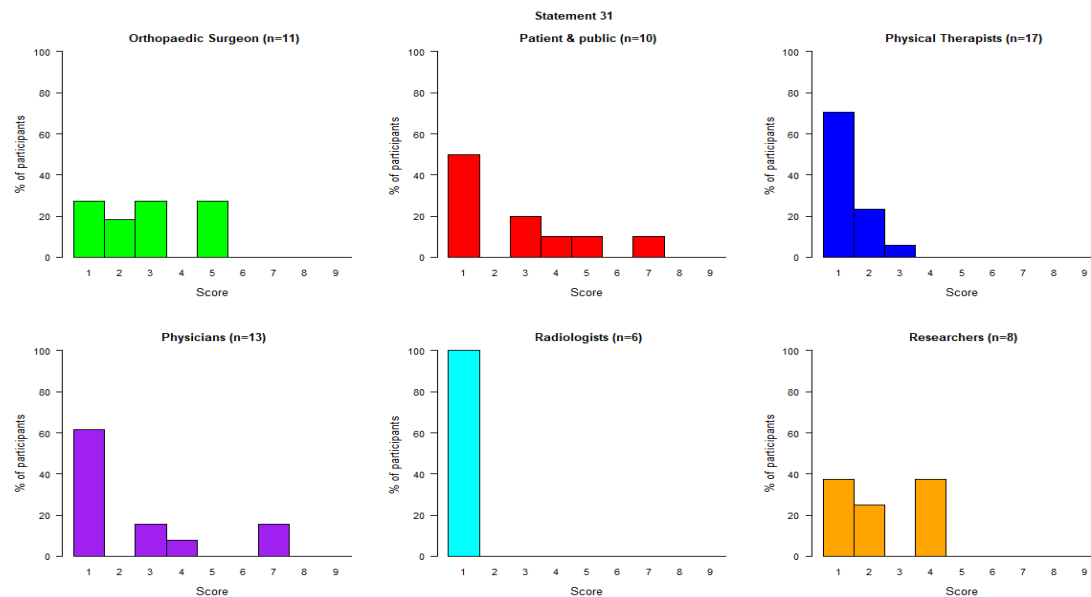
## RESULTS: ROUND 1

Add "is not" in place of "is"



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	3	1	6
Patient & Public In	3	1	5
Physical Therapists	1	1	3
Physicians	3	1	5
Radiologists	1	1	3
Researchers	3	2	4

Percentage panelists that scored the statement as critical	9.7%
Percentage panelists that scored the statement as not important	69.4%
<b>RESULT</b>	<b>NO CONSENSUS</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
10	1	The explanation in the email clarifying terminology; i.e. 'not important=disagree'; etc
7	3	Global view and reading more in the literature
10	1	seeing how my colleagues scored
5	3	More confident that 'any location' is a bad element
8	5	My second read of this statement identified "at any location". I disagree with that statement as an inferior bony bump may not lead to FAI.
5	1	important perspective of other colleagues to more clearly delineate

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	3	1	6	3	1	5
Patient & Public In	3	1	5	2	1	4
Physical Therapists	1	1	3	1	1	2
Physicians	3	1	5	1	1	3
Radiologists	1	1	3	1	1	1
Researchers	3	2	4	2	1	4

	Round 1	Round 2
--	---------	---------

Percentage panelists that scored the statement as critical	9.7%	4.6%
Percentage panelists that scored the statement as not important	69.4%	81.5%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>CONSENSUS OUT</b>

## TAXONOMY

**Statement 32:** We should distinguish between primary and secondary cam morphology in clinical practice

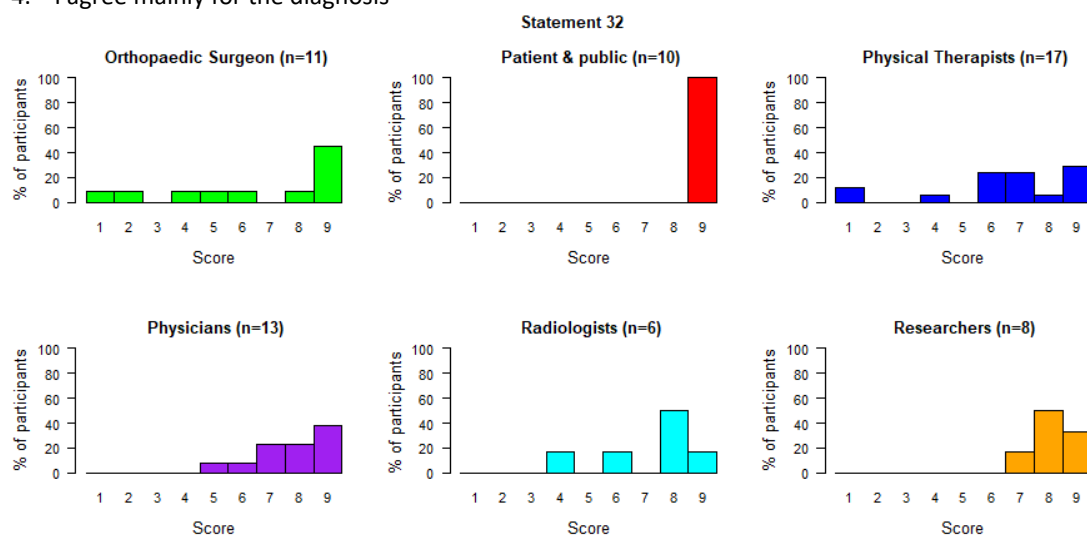
**R1: CONSENSUS IN**

**R2: CONSENSUS IN**

HELPTXT: A primary medical condition is one that arises spontaneously and is not associated with or caused by a previous disease, injury, or acute event while a secondary medical condition develops due to a pre-existing medical condition. For example, primary osteoporosis, bone loss due to aging or the loss of sex steroids at menopause, differs from secondary osteoporosis which is due to conditions such as thyroid hormone imbalance or renal disease. Thus, primary cam morphology is cam morphology that is not caused by previous disease, injury or an acute event. Secondary cam morphology develops due to pre-existing hip disease or acute trauma including Perthes disease, slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture.

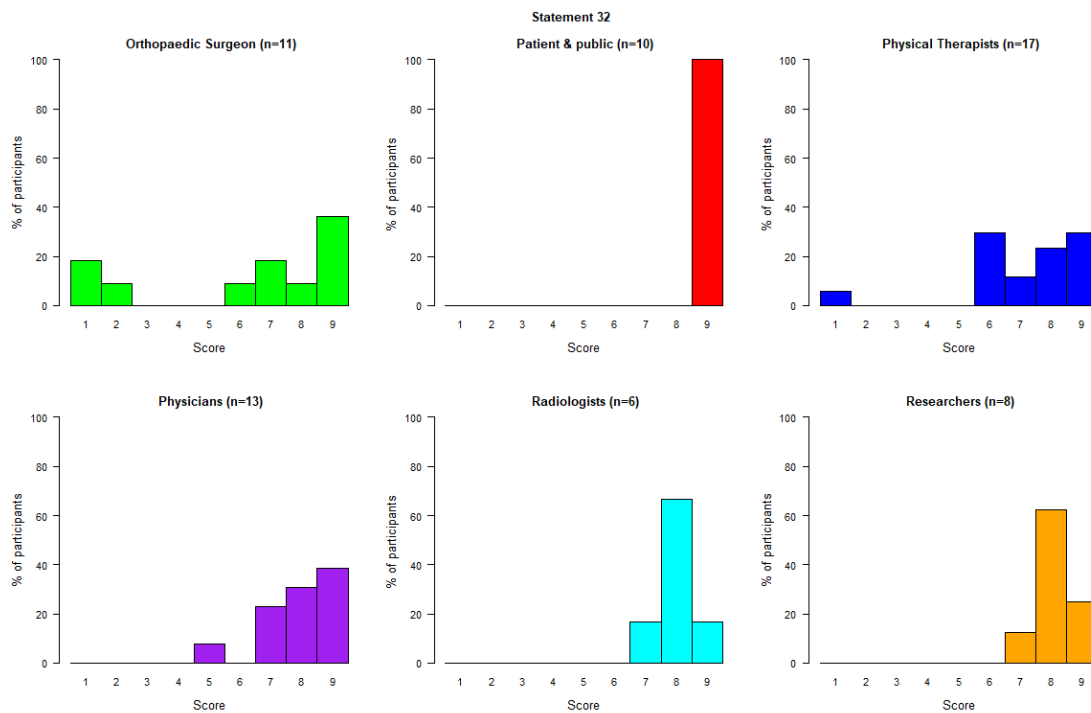
## RESULTS: ROUND 1

1. depends a bit on age - if someone is 30 years old - less relevant
2. from what I understand; treatment is different between the two...so yes
3. Agree but I wonder if there may be cases where a patient has a mix of both types. This note applies to all my answers in this section.
4. I agree mainly for the diagnosis



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	4	9
Patient & Public In	9	9	9
Physical Therapists	7	6	9
Physicians	8	7	9
Radiologists	8	6	8
Researchers	8	8	9

Percentage panelists that scored the statement as critical	74.2%
Percentage panelists that scored the statement as not important	6.5%
<b>RESULT</b>	<b>CONSENSUS IN</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
6	8	Input from clinical or research opinion
1	6	At first; I was unsure if we should distinguish between the two; if we know; the prognosis is different. I think; we should distinguish.
5	7	Could be a topic of interest in research
6	8	reviewed other responses
4	7	At first it would be obvious so why distinguish; but it is important for therapy

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	4	9	7	2	9

<b>Patient &amp; Public In</b>	9	9	9	9	9	9
<b>Physical Therapists</b>	7	6	9	8	6	9
<b>Physicians</b>	8	7	9	8	7	9
<b>Radiologists</b>	8	6	8	8	8	8
<b>Researchers</b>	8	8	9	8	8	9

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	74.2%	83.1%
Percentage panelists that scored the statement as not important	6.5%	6.2%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>



**Statement 33:** We should distinguish between primary and secondary cam morphology in research

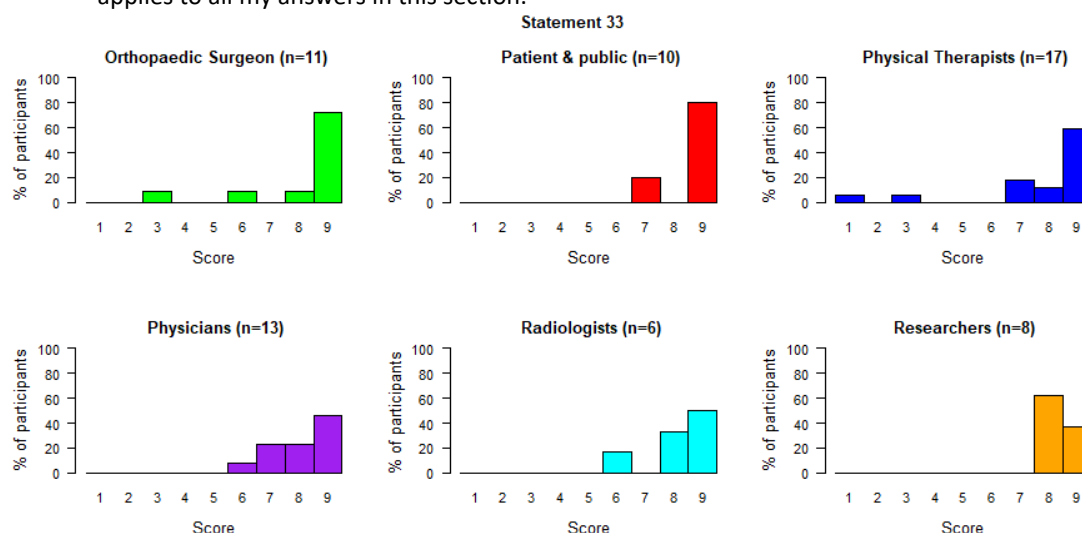
**R1: CONSENSUS IN**

**R2: CONSENSUS IN**

HELPTXT: A primary medical condition is one that arises spontaneously and is not associated with or caused by a previous disease, injury, or acute event while a secondary medical condition develops due to a pre-existing medical condition. For example, primary osteoporosis, bone loss due to aging or the loss of sex steroids at menopause, differs from secondary osteoporosis which is due to conditions such as thyroid hormone imbalance or renal disease. Thus, primary cam morphology is cam morphology that is not caused by previous disease, injury or an acute event. Secondary cam morphology develops due to pre-existing hip disease or acute trauma including Perthes disease, slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture.

## RESULTS: ROUND 1

- this assumes the distinction can be made!
- Agree but I wonder if there may be cases where a patient has a mix of both types. This note applies to all my answers in this section.

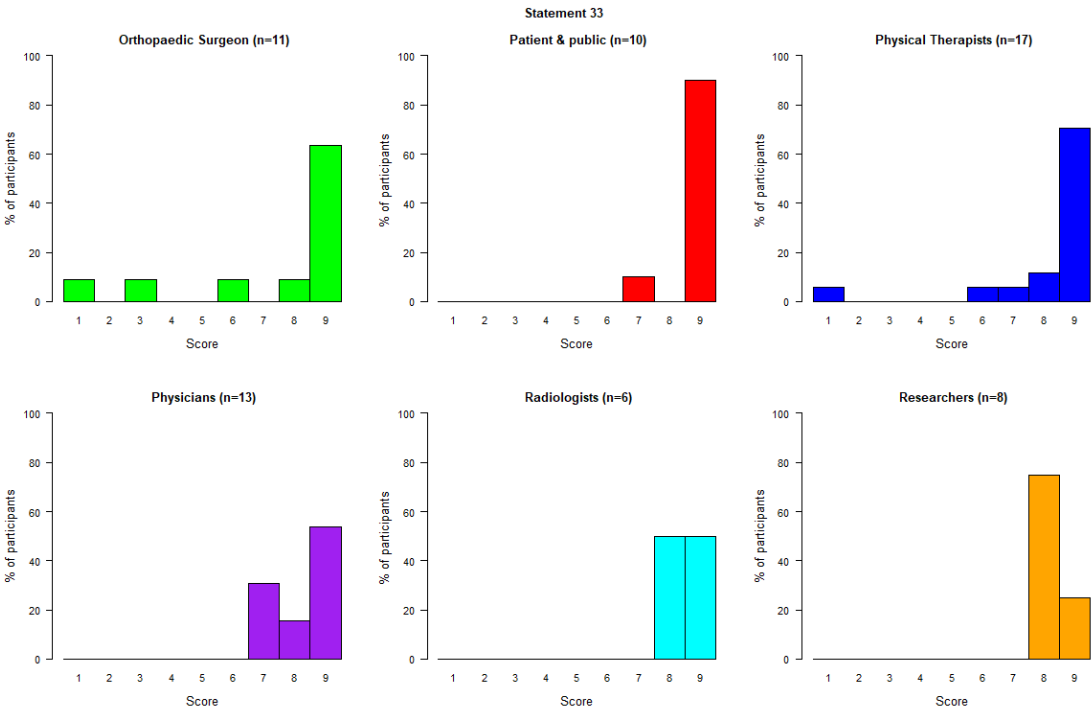


	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	9	8	9
Patient & Public In	9	9	9
Physical Therapists	9	7	9
Physicians	8	7	9
Radiologists	9	8	9
Researchers	8	8	9

Percentage panelists that scored the statement as critical	90.8%
Percentage panelists that scored the statement as not important	4.6%

RESULT	CONSENSUS IN
--------	--------------

RESULTS: ROUND 2



Reasons for score boundary changes between R1 and R2

R1	R2	
3	6	At first; I was unsure if we should distinguish between the two; if we know; the prognosis is different. I think; we should distinguish.
6	8	yes it is different.

Median, IQR

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	9	8	9	9	6	9
Patient & Public In	9	9	9	9	9	9
Physical Therapists	9	7	9	9	8	9
Physicians	8	7	9	9	7	9
Radiologists	9	8	9	9	8	9
Researchers	8	8	9	8	8	9

	Round 1	Round 2
Percentage panelists that scored the statement as critical	90.8%	92.3%
Percentage panelists that scored the statement as not important	4.6%	4.6%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>

**Statement 34:** We should distinguish between primary and secondary cam morphology in patients with femoroacetabular impingement syndrome

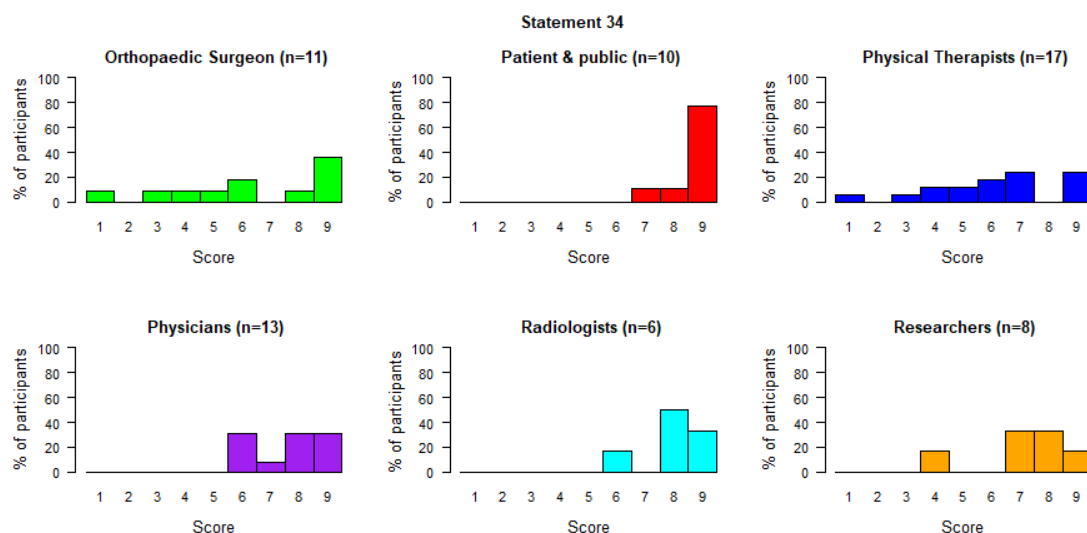
**R1: NO CONSENSUS**

**R2: NO CONSENSUS**

HELPTXT: Femoroacetabular impingement (FAI) syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum. Griffin et al., 2016 (Warwick agreement on FAI syndrome): Morphological assessment of the hip is required in order to diagnose FAI syndrome, identifying cam or pincer morphology. Cam morphology refers to a flattening or convexity at the femoral head neck junction. Pincer morphology refers to either global or focal overcoverage of the femoral head by the acetabulum. The panel emphasised that their presence, in the absence of appropriate symptoms and clinical signs, does not constitute a diagnosis of FAI syndrome. A substantial proportion of people in the general population are thought to have cam or pincer morphology. Taxonomy

### RESULTS: ROUND 1

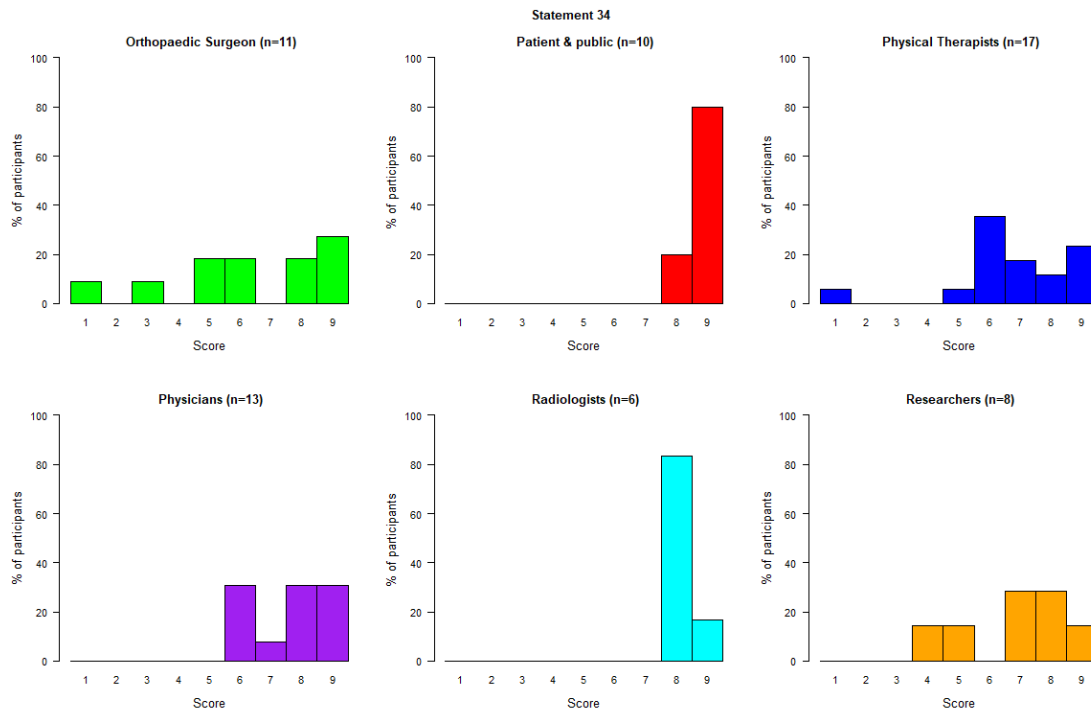
This 100% depends on prognosis - given the presence of previous injury; it would suggest secondary CAM morphology has a poorer prognosis and therefore should be distinguished to improve treatment planning.



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	6	4	9
Patient & Public In	9	9	9
Physical Therapists	6	5	7
Physicians	8	6	9
Radiologists	8	8	9
Researchers	8	7	8

Percentage panelists that scored the statement as critical	66.1%
Percentage panelists that scored the statement as not important	6.5%
<b>RESULT</b>	<b>NO CONSENSUS</b>

## RESULTS: ROUND 2



## Reasons for score boundary changes between R1 and R2

R1	R2	
6	8	Input from clinical or research opinion
3	6	If we have scientific knowledge backing it up. I know we have some.
4	9	Change of mindset
1	5	Could be a topic of interest in research
8	6	calibration from the other disciplines
10	5	Felt more confident in being able to answer question
7	6	important perspective of other colleagues to more clearly delineate

## Median, IQR

	ROUND 1	ROUND 2
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	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	6	4	9	6	5	9
Patient & Public In	9	9	9	9	9	9
Physical Therapists	6	5	7	7	6	8
Physicians	8	6	9	8	6	9
Radiologists	8	8	9	8	8	8
Researchers	8	7	8	7	5	8

	Round 1	Round 2
Percentage panelists that scored the statement as critical	66.1%	68.8% (71.0%)*
Percentage panelists that scored the statement as not important	6.5%	4.7% (1.6%)*
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

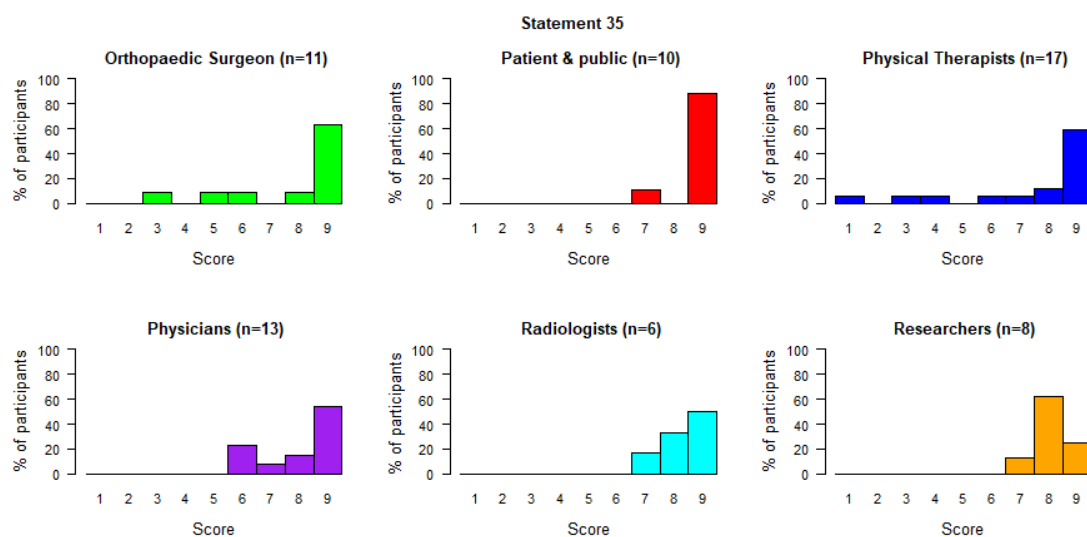
\* adjusted percentage after removing 2 outliers from round 2 are in brackets

**Statement 35:** We should distinguish between primary and secondary cam morphology in research participants with femoroacetabular impingement syndrome

#### R1: CONSENSUS IN

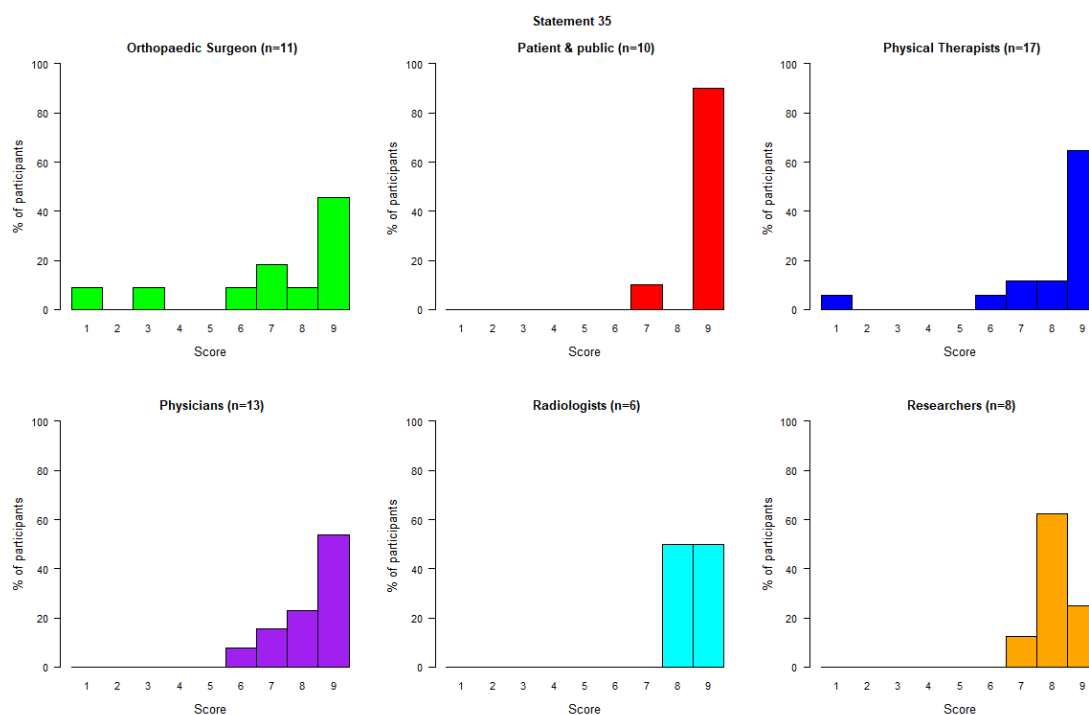
#### R2: CONSENSUS IN

HELPTXT: Femoroacetabular impingement (FAI) syndrome is a motion-related clinical disorder of the hip with a triad of symptoms, clinical signs and imaging findings. It represents symptomatic premature contact between the proximal femur and the acetabulum. Griffin et al., 2016 (Warwick agreement on FAI syndrome): Morphological assessment of the hip is required in order to diagnose FAI syndrome, identifying cam or pincer morphology. Cam morphology refers to a flattening or convexity at the femoral head neck junction. Pincer morphology refers to either global or focal overcoverage of the femoral head by the acetabulum. The panel emphasised that their presence, in the absence of appropriate symptoms and clinical signs, does not constitute a diagnosis of FAI syndrome. A substantial proportion of people in the general population are thought to have cam or pincer morphology.



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	9	6	9
Patient & Public In	9	9	9
Physical Therapists	9	7	9
Physicians	9	7	9
Radiologists	9	8	9
Researchers	8	8	9

Percentage panelists that scored the statement as critical	84.4%
Percentage panelists that scored the statement as not important	4.7%
<b>RESULT</b>	<b>CONSENSUS IN</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
3	6	If we have scientific knowledge backing it up. I know we have some.
4	9	Change of mindset

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	9	6	9	8	6	9
Patient & Public In	9	9	9	9	9	9
Physical Therapists	9	7	9	9	8	9
Physicians	9	7	9	9	8	9
Radiologists	9	8	9	9	8	9
Researchers	8	8	9	8	8	9

	Round 1	Round 2
Percentage panelists that scored the statement as critical	84.4%	90.8%



Percentage panelists that scored the statement as not important	4.7%	4.6%
RESULT	CONSENSUS IN	CONSENSUS IN

## IMAGING OUTCOMES

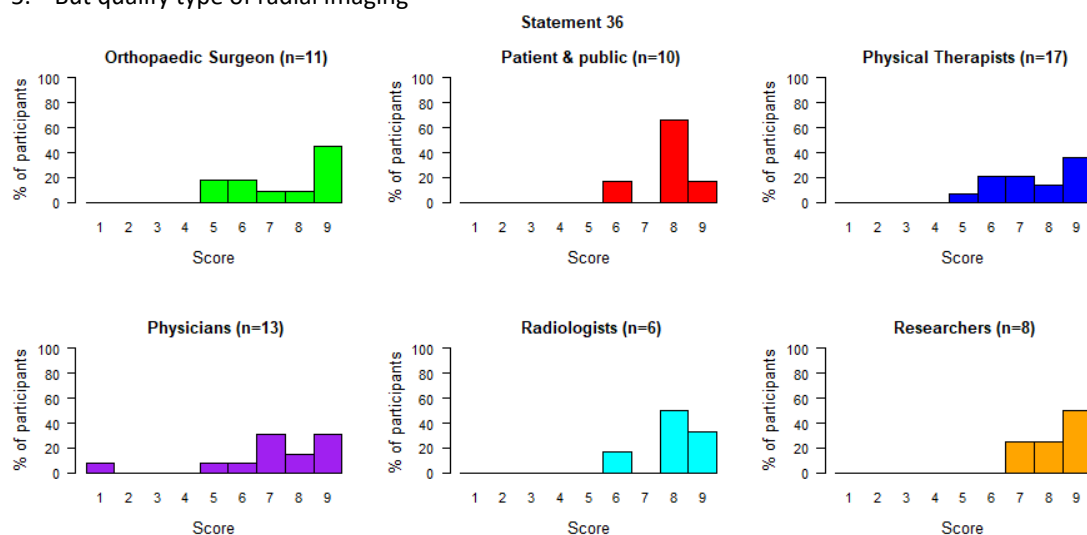
**Statement 36:** The main imaging modality for research on how primary cam morphology develops should be magnetic resonance (MR) with radial imaging (1.5T or 3 T)

**R1: CONSENSUS IN****R2: CONSENSUS IN**

HELPTXT: Magnetic resonance (MR) imaging is a medical imaging technique that uses a magnet to generate a magnetic field, causing the signal produced by the patient's body. These signals are used to form images of the anatomy and physiological processes of the body. The strength of the magnet (among other factors) affects the strength of this signal. The magnet field produced by Earth is 0.5 gauss. The magnet field produced by the magnet in a 1.5 Tesla (T) MR imaging machine is 15,000 gauss (30,000 stronger than Earth's magnetic field). A 3T MR imaging machine uses an even stronger magnetic field to provide clearer and more detailed images.

**RESULTS: ROUND 1**

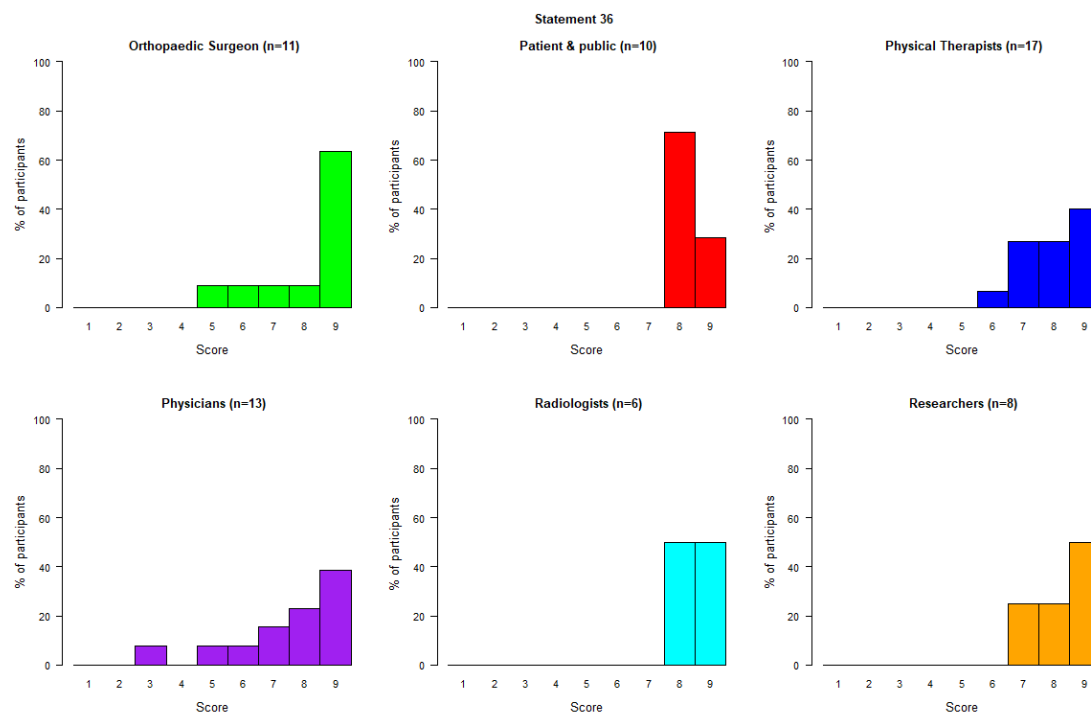
1. huge cost aspect here - depends on the research question in case
2. serial imaging seems to help with understanding with development. X-rays first option for diagnosis
3. I have watched webinars 1&2 but that is the sum of my knowledge on this topic. Apologies that I feel I do not have enough knowledge to accurately and reliably answer most qs in this section.
4. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
5. But qualify type of radial imaging



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	6	9
Patient & Public In	8	8	8
Physical Therapists	8	6	9
Physicians	7	7	9
Radiologists	8	8	9
Researchers	9	8	9

Percentage panelists that scored the statement as critical	75.9%
Percentage panelists that scored the statement as not important	1.9%
<b>RESULT</b>	<b>CONSENSUS IN</b>

## RESULTS: ROUND 2



## Reasons for score boundary changes between R1 and R2

R1	R2	
6	7	Important to agree on modalities
6	9	Changes in protocols with MRI in our institution have allowed accurate osseous and soft tissue morphology without radiation (CT); This now largely eliminates the need for other advanced imaging techniques.
5	7	Global view and reading more in the literature
6	7	reviewed other responses
6	8	agreee more; but radiographs can help
6	8	Having followed webinar; I think that it is important.
6	8	important perspective of other colleagues (radiologists)

**Median, IQR**

	<b>ROUND 1</b>			<b>ROUND 2</b>		
	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>
<b>Orthopaedic Surgeon</b>	8	6	9	9	7	9
<b>Patient &amp; Public In</b>	8	8	8	8	8	9
<b>Physical Therapists</b>	8	6	9	8	7	9
<b>Physicians</b>	7	7	9	8	7	9
<b>Radiologists</b>	8	8	9	9	8	9
<b>Researchers</b>	9	8	9	9	8	9

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	75.9%	89.3%
Percentage panelists that scored the statement as not important	1.9%	1.8%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>

**Statement 37:** The minimum acceptable number of radial sequence magnetic resonance (MR) imaging slices for research on how primary cam morphology develops should be 12 slices (30° intervals, in all 12 clock face positions from 12 o'clock to 11 o'clock positions)

**R1: NO CONSENSUS**

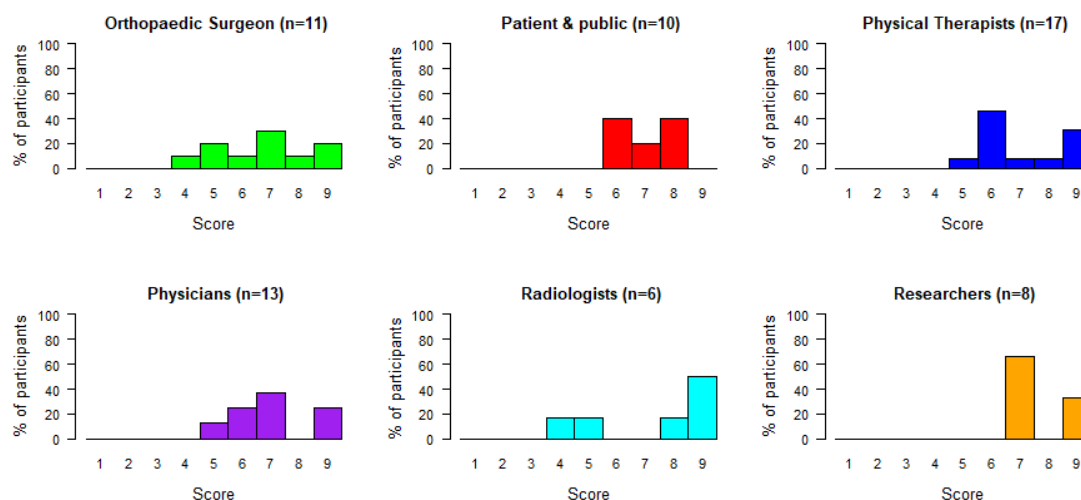
**R2: CONSENSUS IN**

HELPTXT: Many clinicians and researchers use a clock face system to describe the location of cam morphology on radial magnetic resonance (MR) or computed tomography (CT) imaging around the axis of the femoral neck, normally 30° intervals with 12 o'clock as the superior (top) location, and 3 o'clock, 6 o'clock and 9 o'clock as the anterior, inferior (bottom) and posterior locations, respectively (when facing 'the clock').

## RESULTS: ROUND 1

1. I learnt a lot from the webinar; but Radiology is not my field of expertise.
2. As a non-clinician; I don't have a strong understanding of MRI sequences and feel unqualified to answer these questions
3. Number of slices is not that important if you can do 3d imaging with MPR
4. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
5. It sounds reasonable; but I do not feel qualified to provide an answer with certainty. It for instance be influenced by the specific research question.

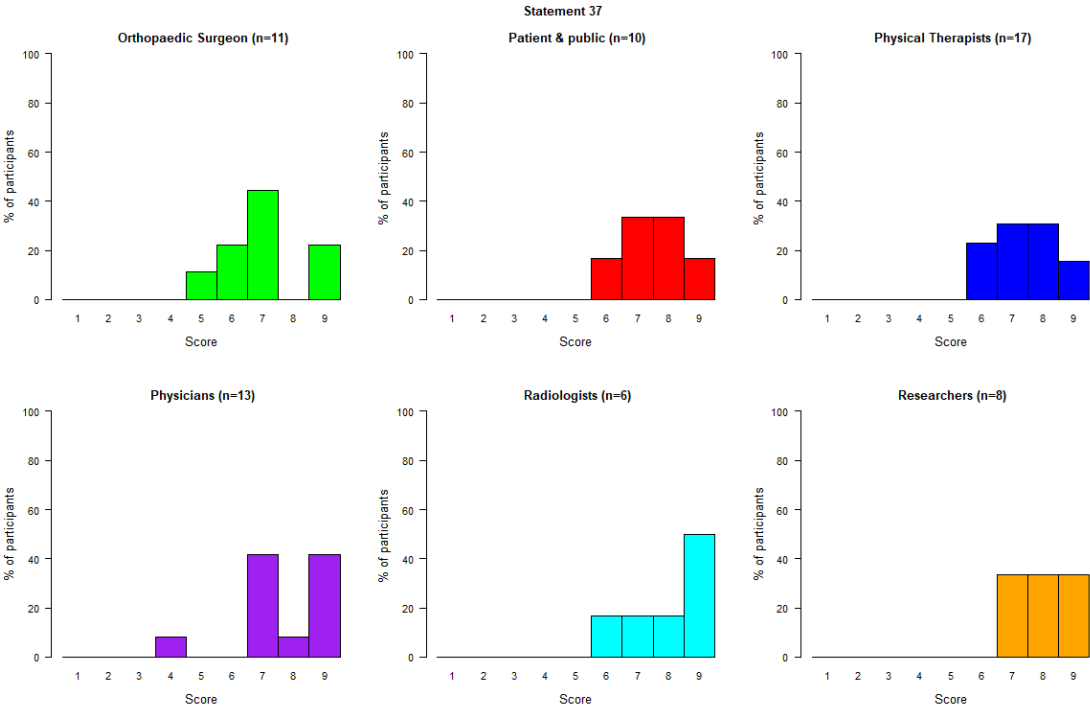
Statement 37



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	5	8
Patient & Public In	7	6	8
Physical Therapists	6	6	9
Physicians	7	6	8
Radiologists	9	5	9
Researchers	7	7	9

Percentage panelists that scored the statement as critical	60%
Percentage panelists that scored the statement as not important	0%
RESULT	NO CONSENSUS

RESULTS: ROUND 2



Reasons for score boundary changes between R1 and R2

R1	R2	
6	8	Second webinar informations
6	7	reviewed other responses
6	7	Seems important across the cohorts.
6	8	Took my lead from radiologists group response; their area of expertise
5	7	if it is the same than it is easier to compare; but some difficulties between vendors
6	7	Having followed webinar; I think that it is important.
10	4	less certain

**Median, IQR**

	<b>ROUND 1</b>			<b>ROUND 2</b>		
	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>
<b>Orthopaedic Surgeon</b>	7	5	8	7	6	7
<b>Patient &amp; Public In</b>	7	6	8	8	7	8
<b>Physical Therapists</b>	6	6	9	7	7	8
<b>Physicians</b>	7	6	8	8	7	9
<b>Radiologists</b>	9	5	9	9	7	9
<b>Researchers</b>	7	7	9	8	7	9

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	60%	81.6%
Percentage panelists that scored the statement as not important	0%	0%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>CONSENSUS IN</b>

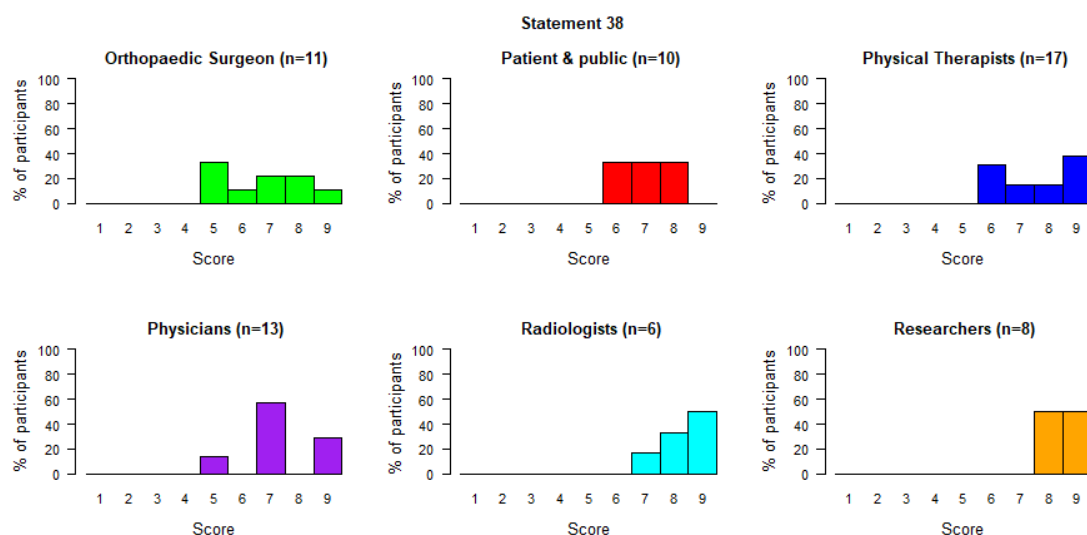
**Statement 38:** Referring to precisely quantifying the asphericity of the femoral head-neck junction on radial sequence magnetic resonance (MR) imaging: use either radial sequences along the axis of the femoral neck (providing higher resolution images) or radial reconstructions from 3-dimensional acquisitions

**R1: CONSENSUS IN**

**R2: CONSENSUS IN**

HELPTXT: Many clinicians and researchers use a clock face system to describe the location of cam morphology on radial magnetic resonance (MR) or computed tomography (CT) imaging around the axis of the femoral neck, normally 30° intervals with 12 o'clock as the superior (top) location, and 3 o'clock, 6 o'clock and 9 o'clock as the anterior, inferior (bottom) and posterior locations, respectively (when facing 'the clock').

## RESULTS: ROUND 1

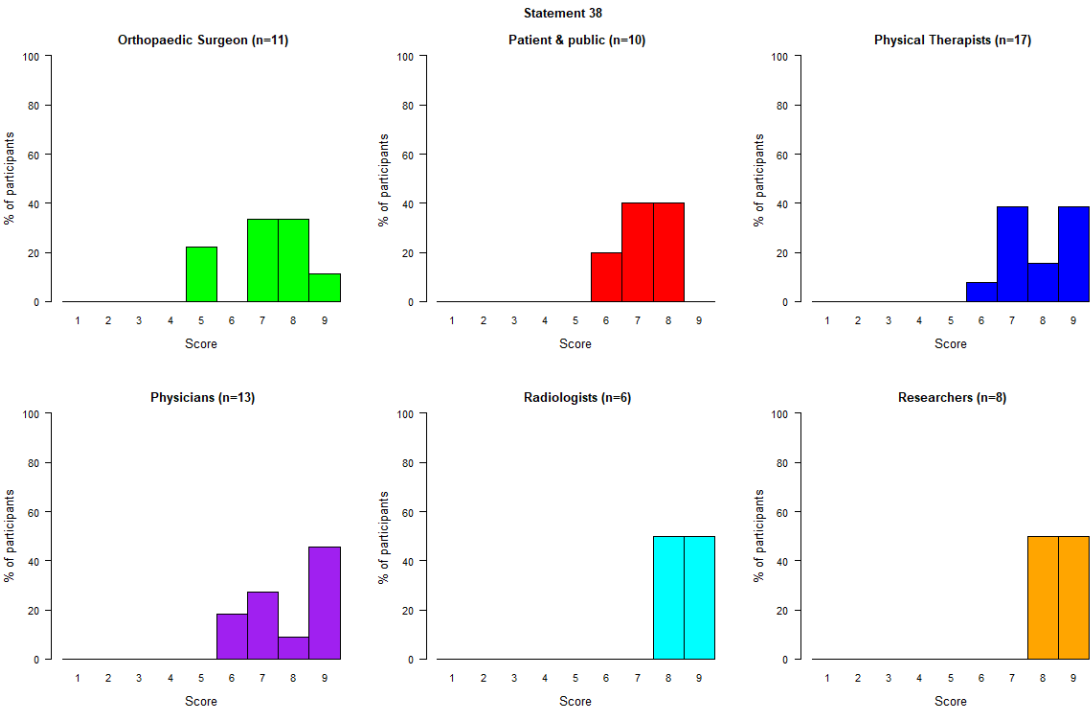


	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	5	8
Patient & Public In	7	6	8
Physical Therapists	8	6	9
Physicians	7	7	9
Radiologists	9	8	9
Researchers	9	8	9

Percentage panelists that scored the statement as critical	75%
Percentage panelists that scored the statement as not important	0%
<b>RESULT</b>	<b>CONSENSUS IN</b>



RESULTS: ROUND 2



Reasons for score boundary changes between R1 and R2

R1	R2	
6	7	Important to agree on modalities
5	7	Seems appropriate imaging modality
6	7	Seems important across the cohorts.

Median, IQR

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	5	8	7	7	8
Patient & Public In	7	6	8	7	7	8
Physical Therapists	8	6	9	8	7	9
Physicians	7	7	9	8	7	9
Radiologists	9	8	9	9	8	9
Researchers	9	8	9	9	8	9

	Round 1	Round 2
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Percentage panelists that scored the statement as critical	75%	87%
Percentage panelists that scored the statement as not important	0%	0%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>

**Statement 39:** The magnetic resonance (MR) imaging protocol for research on how primary cam morphology develops should include: (i) unilateral small field-of-view (FOV) sequences and radial images of a randomly selected or both hips, as well as (ii) femoral torsion assessment (fast axial sequences of the distal knee—femoral condyles—and proximal femoral neck), and (iii) a fluid sensitive sequence covering the whole pelvis (in axial or coronal planes, to screen for soft-tissue and bone marrow edema beyond the hip)

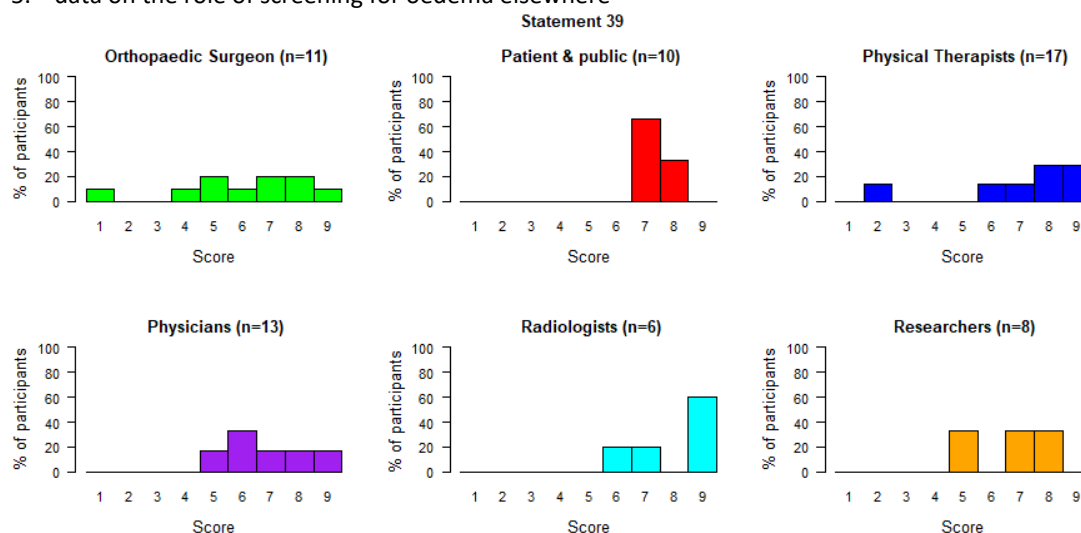
**R1: NO CONSENSUS**

**R2: CONSENSUS IN**

HELPTXT: Small field-of-view magnetic resonance (MR) imaging (of small anatomic structures like the hip) exclude unwanted surrounding tissue (that contribute to 'noise', creating artifacts). Femoral torsion is the long-axis rotation of the femoral shaft relative to its neck in the transverse plane (the orientation of the neck of the femur in relation to the femoral condyles at the level of the knee). A torsion angle of greater than 20 degrees is considered excessive femoral anteversion, whereas a torsion angle of less than 10 degrees is considered femoral retroversion.

## RESULTS: ROUND 1

1. really depends on research question; statement is too general
2. You can debate if assessment of the femoral torsion and the need for axial knee imaging.
3. Consider removing the iii) portion; because the rationale for this is to find pathological processes elsewhere besides the hip. If we want to study primary cam morphology development this might be excluded.
4. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
5. data on the role of screening for oedema elsewhere



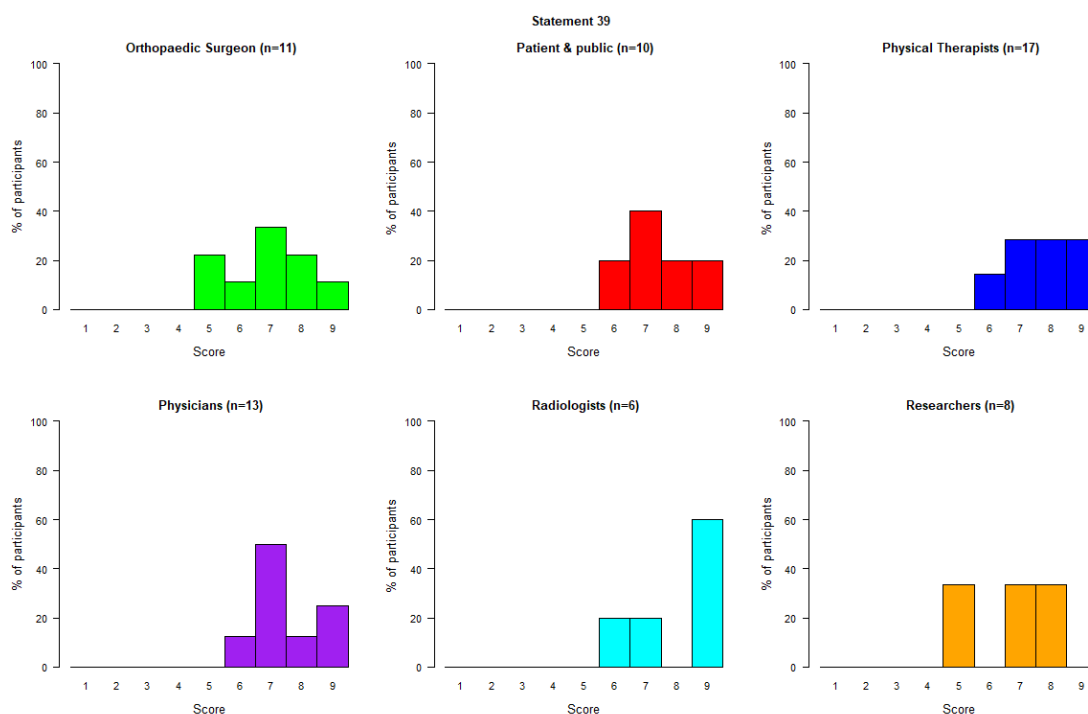
	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	5	8
Patient & Public In	7	7	8
Physical Therapists	8	6	9
Physicians	7	6	8
Radiologists	9	7	9
Researchers	7	5	8

Percentage panelists that scored the statement as critical	64.7%
Percentage panelists that scored the statement as not important	5.9%
<b>RESULT</b>	<b>NO CONSENSUS</b>

## RADIOLOGISTS

Percentage panelists that scored the statement as critical	80%
Percentage panelists that scored the statement as not important	0%
<b>RESULT</b>	<b>CONSENSUS AMONGST RADIOLOGISTS</b>

## RESULTS: ROUND 2



**Reasons for score boundary changes between R1 and R2**

R1	R2	
2	7	More attention paid to imaging
6	7	As above
10	6	Second webinar informations

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	5	8	7	6	8
Patient & Public In	7	7	8	7	7	8
Physical Therapists	8	6	9	8	7	9
Physicians	7	6	8	7	7	9
Radiologists	9	7	9	9	7	9
Researchers	7	5	8	7	5	8

	Round 1	Round 2
Percentage panelists that scored the statement as critical	64.7%	78.4%
Percentage panelists that scored the statement as not important	5.9%	0%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>CONSENSUS IN</b>

**Statement 40:** The magnetic resonance (MR) imaging for prospective research on how primary cam morphology develops should be repeated every 18 to 24 months

**R1: NO CONSENSUS**

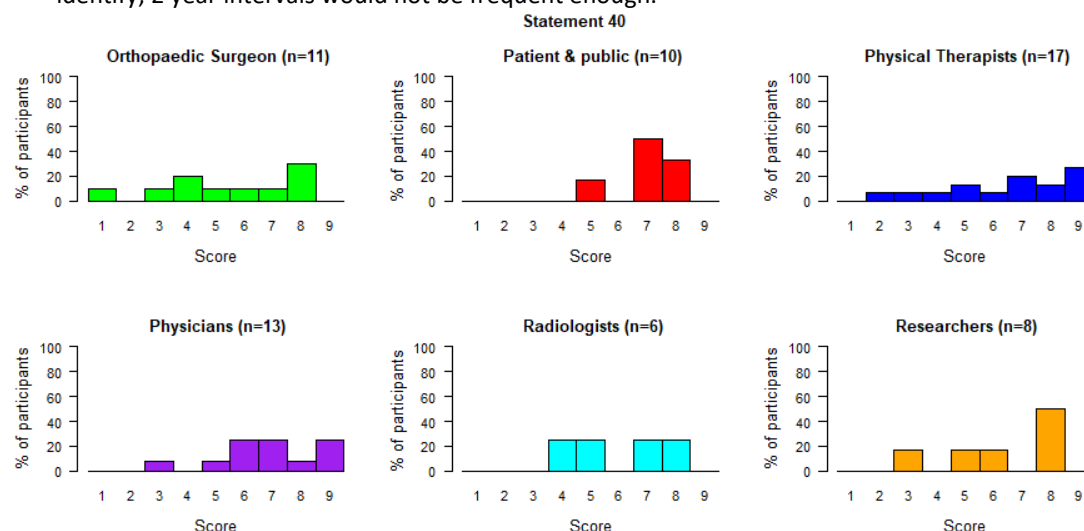
**R2: NO CONSENSUS**

HELPTXT: There is no current agreement on how often magnetic resonance (MR) imaging should be repeated in longitudinal studies to investigate how primary cam morphology develops. Longitudinal imaging studies have repeated imaging every 18 to 24 months. Consider: (1) cost, (2) logistics (including participant availability for follow-up MR imaging), (3) allowing sufficient time for morphological and other changes to occur

## RESULTS: ROUND 1

1. Not specifically continuous; therefore I answered these questions as a 4. (**? Meant for next statement?**)

2. really depends on research question; statement is too general
3. Do we know how quickly cam morphology develops/progresses?
4. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
5. Depends on phase of growth
6. This will depend on the research question. Timeline could for instance be required to be shorter.
7. evidence for "18-24 mo"?
8. What about more often? I know it will be difficult; but if there is a critical window that we want to identify; 2 year intervals would not be frequent enough.

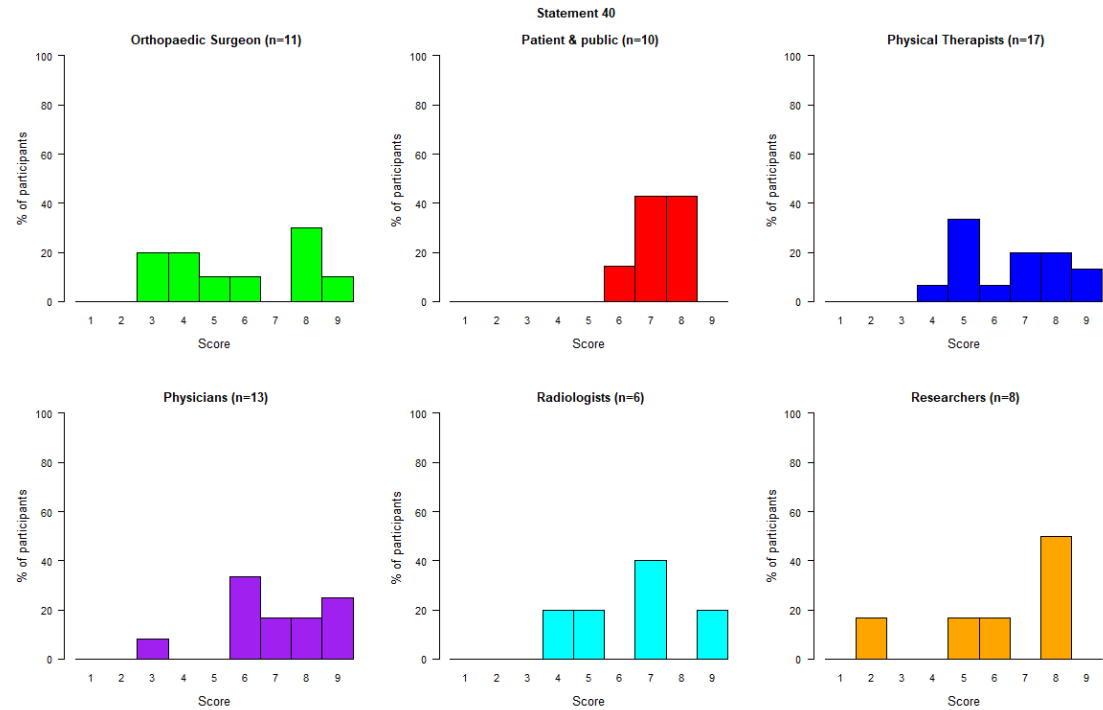


	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	6	4	8
Patient & Public In	7	7	8
Physical Therapists	7	5	9
Physicians	7	6	9
Radiologists	6	5	8

Researchers | 7 | 5 | 8 |

Percentage panelists that scored the statement as critical	56.6%
Percentage panelists that scored the statement as not important	11.3%
RESULT	NO CONSENSUS

RESULTS: ROUND 2



Reasons for score boundary changes between R1 and R1

R1	R2	
3	5	I still feel this should be more frequent - but I changed for feasibility.
2	5	More attention paid to imaging
5	7	important perspective of other colleagues (radiologists)
9	5	I reduced as I think the timeframe of the imaging is likely research methods dependent and therefore there is a risk of over investigation unless we have a really clearly defined need. This seems to have come across in others rankings too.
7	5	I do not think criteria for end point have to be so specific.

Median, IQR

	ROUND 1	ROUND 2
--	---------	---------

	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	6	4	8	6	4	8
Patient & Public In	7	7	8	7	7	8
Physical Therapists	7	5	9	7	5	8
Physicians	7	6	9	7	6	9
Radiologists	6	5	8	7	5	7
Researchers	7	5	8	7	5	8

	Round 1	Round 2
Percentage panelists that scored the statement as critical	56.6%	56.4%
Percentage panelists that scored the statement as not important	11.3%	7.3%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>



**Statement 41:** In primary cam morphology epidemiological research (e.g., when regression is being used in aetiology or prognosis research), continuous imaging outcome measures (variables), like the alpha angle, should be kept continuous

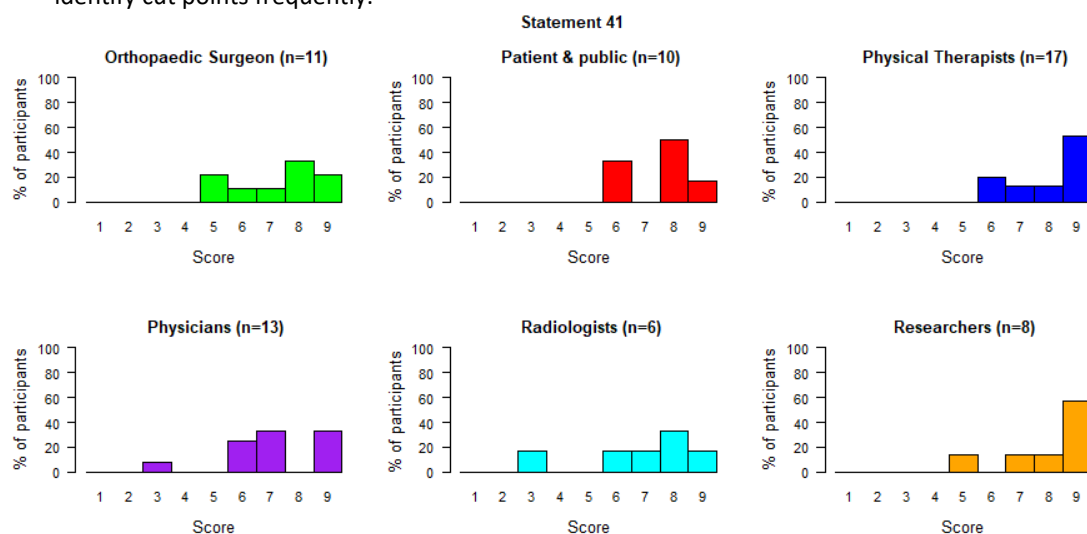
**R1: CONSENSUS IN**

**R2: CONSENSUS IN**

HELPTXT: Three problems when dichotomising continuous variables: (1) much information is lost, so the statistical power to detect a relation between the variable and patient outcome is reduced (dichotomising a variable at the median reduces power by the same amount as would discarding a third of the data). Dichotomisation may also increase the risk of a positive result being a false positive. (2) one may seriously underestimate the extent of variation in outcome between groups, such as the risk of some event, and considerable variability may be subsumed within each group. Individuals close to but on opposite sides of the cut-point are characterised as being very different rather than very similar. (3) using two groups conceals any non-linearity in the relation between the variable and outcome. (Altman et al, 2006)

## RESULTS: ROUND 1

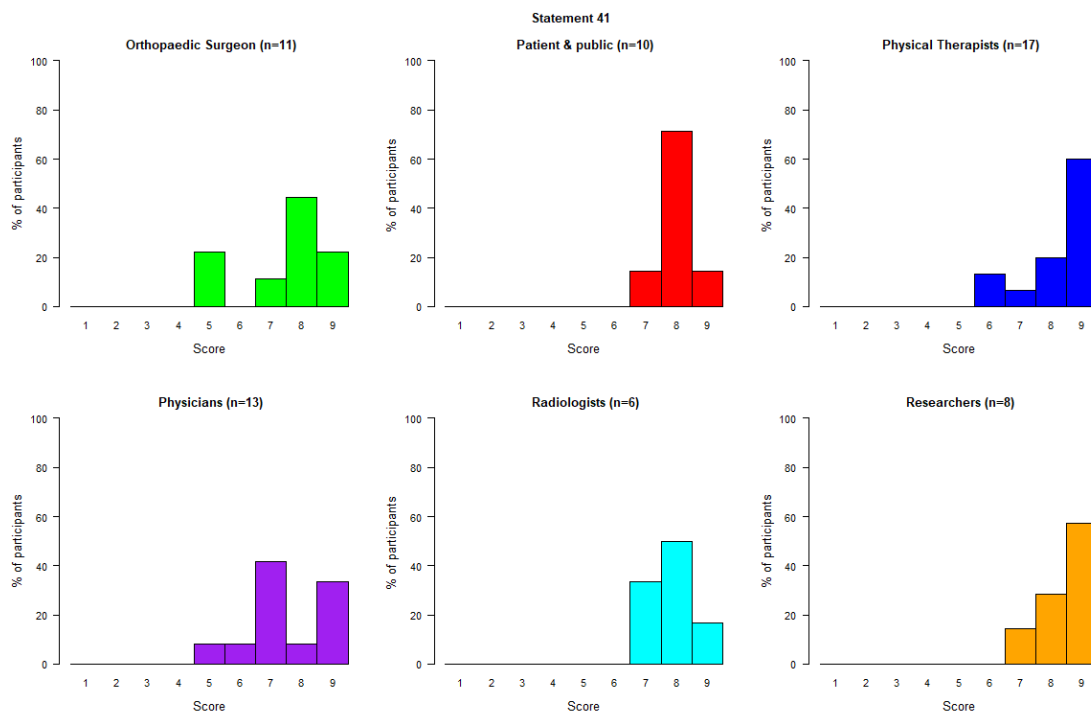
1. Not specifically continuous; therefore I answered these questions as a 4.
2. really depends on research question and audience/readers; statement is too general
3. in the end to realte back to daily practice some dichotomous reporting can also help
4. There is no consensus on optimum threshold for dichotomizing this variable. It makes comparing across studies very difficult when different thresholds are used
5. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
6. From an epidemiology standpoint; yes; you dont lose information. However; I have clinicians ask to identify cut points frequently.



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	6	8
Patient & Public In	8	6	8
Physical Therapists	9	7	9
Physicians	7	6	9
Radiologists	8	6	8
Researchers	9	7	9

Percentage panelists that scored the statement as critical	72.7%
Percentage panelists that scored the statement as not important	3.6%
<b>RESULT</b>	<b>CONSENSUS IN</b>

## RESULTS: ROUND 2



## Reasons for score boundary changes between R1 and R2

R1	R2	
3	7	Mis-read the statement initially.
6	7	Input from clinical or research opinion
5	8	Ideally; all outcomes are kept continuous
6	8	Continuous variables should be continuous
6	8	Important to ensure continuous monitoring

6	7	calibration from the other disciplines
3	5	There are some reasons to keep the alpha angle continuous; but also reasons to make it dichotomous. For me half way (score 5) fits better.
6	7	Having followed webinar; I think that it is important.

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	6	8	8	7	8
Patient & Public In	8	6	8	8	8	8
Physical Therapists	9	7	9	9	8	9
Physicians	7	6	9	7	7	9
Radiologists	8	6	8	8	7	8
Researchers	9	7	9	9	8	9

	Round 1	Round 2
Percentage panelists that scored the statement as critical	72.7%	89.3%
Percentage panelists that scored the statement as not important	3.6%	0%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>

**Statement 42:** The cam morphology magnetic resonance (MR) imaging outcome measure for research on how primary cam morphology develops (aetiology), should be the alpha angle for bone and cartilage as a continuous variable, reported for all the o'clock locations around the femoral head-neck junction, regardless of the symptomatic state of the research participant.

**R1: NO CONSENSUS**

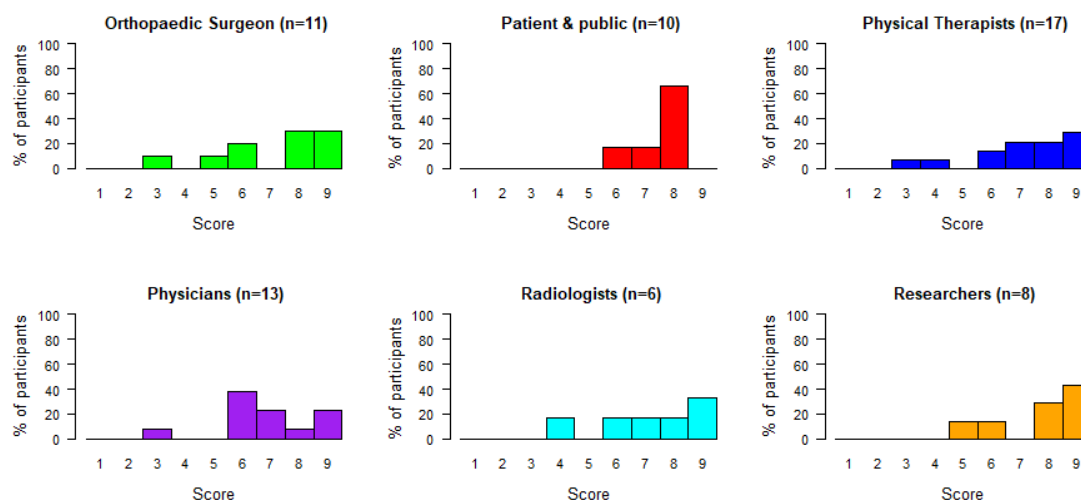
**R2: CONSENSUS IN**

**HELPTXT:** Using the MR sequence, a circle is centred over femoral head. The alpha angle is the angle between: (1) a line parallel to the femoral neck axis, and (2) a line from the centre of the femoral head to the point where the femoral head neck junction contour exceeds the head radius. Many clinicians and researchers use a clock face system to describe the location of cam morphology on radial magnetic resonance (MR) imaging or computed tomography (CT) scan sequences around the axis of the femoral neck, normally 30° intervals with 12 o'clock as the superior (top) location, and 3 o'clock, 6 o'clock and 9 o'clock as the anterior (right), inferior (bottom) and posterior (left) locations, respectively (when facing 'the clock').

## RESULTS: ROUND 1

1. really depends on research question; statement is too general. all o'clock locations seem not necessary
2. Symptoms are important
3. Symptomatic/Asymptomatic should be a second variable
4. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
5. Although this appear to be relevant currently; new technologies - including for instance 3D reconstructions may provide outcome variables that are more relevant than the alpha angle.

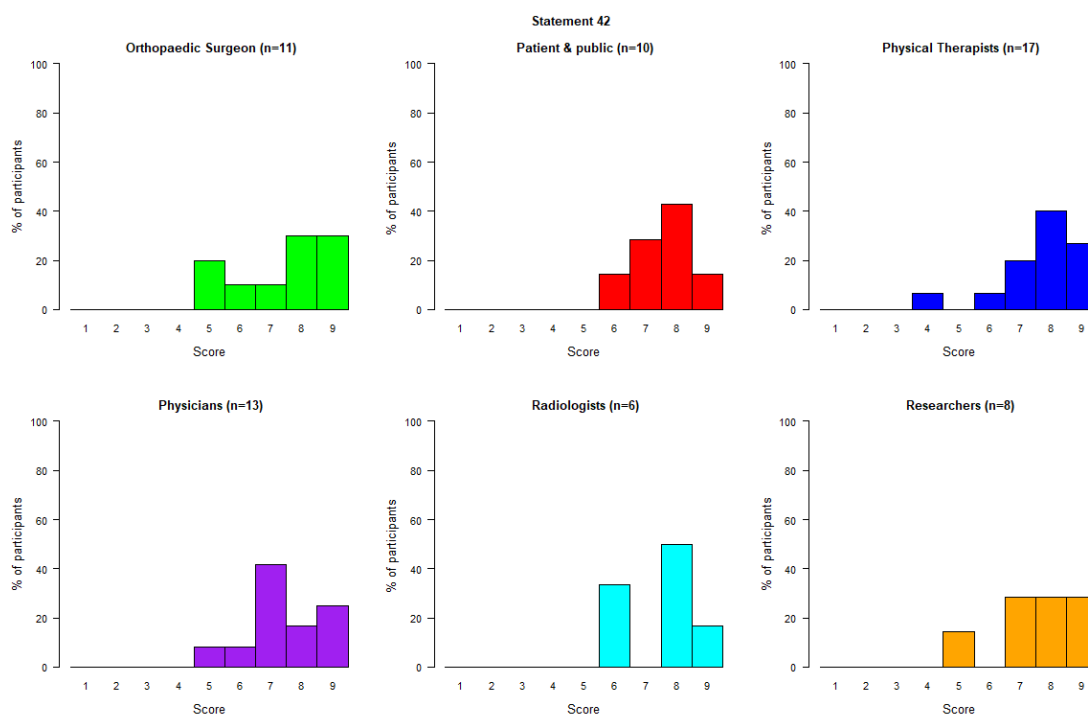
Statement 42



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	6	9
Patient & Public In	8	7	8
Physical Therapists	8	6	9
Physicians	7	6	8
Radiologists	8	6	9
Researchers	8	6	9

Percentage panelists that scored the statement as critical	66.1%
Percentage panelists that scored the statement as not important	5.4%
<b>RESULT</b>	<b>NO CONSENSUS</b>

## RESULTS: ROUND 2



## Reasons for score boundary changes between R1 and R2

R1	R2	
3	7	Current impression - Originally considered whether 3d reconstruction quantifications could be better; but this probably needs more research first.
6	7	Second webinar informations

6	7	Continuous retains better information.
6	7	Important to ensure continuous monitoring. My understanding is that sometimes pain and decrease in function does not always correlate to what is seen on a scan and this may assist to further understand this.
6	7	calibration from the other disciplines
3	5	See comment above.

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	8	6	9	8	6	9
Patient & Public In	8	7	8	8	7	8
Physical Therapists	8	6	9	8	7	9
Physicians	7	6	8	7	7	9
Radiologists	8	6	9	8	6	8
Researchers	8	6	9	8	7	9

	Round 1	Round 2
Percentage panelists that scored the statement as critical	66.1%	80.7%
Percentage panelists that scored the statement as not important	5.4%	0%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>CONSENSUS IN</b>

**Statement 43:** For research on how primary cam morphology develops it is important to quantify the epiphyseal morphology magnetic resonance (MR) imaging outcome measure using epiphyseal extension

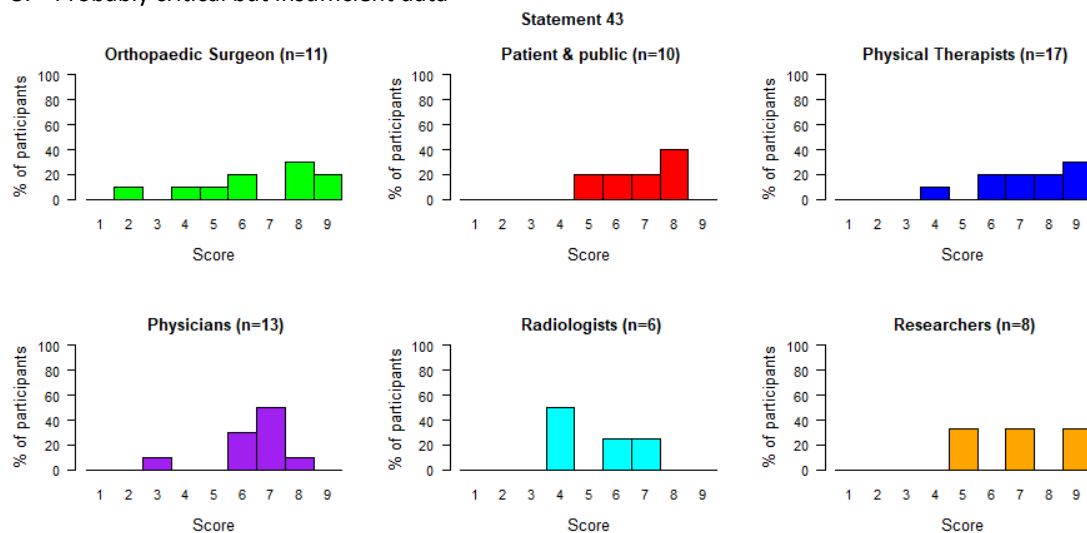
**R1: NO CONSENSUS**

**R2: NO CONSENSUS**

HELPTXT: Epiphyseal extension is the distance the epiphysis extends along the femoral neck expressed as a ratio of the femoral head diameter

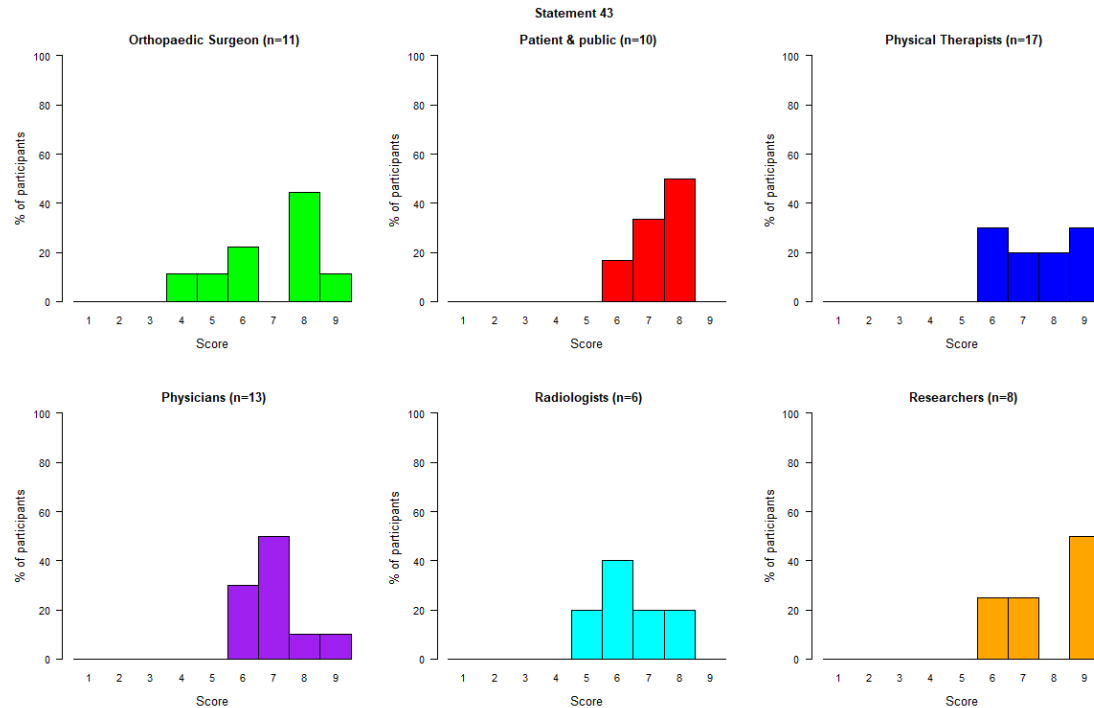
### RESULTS: ROUND 1

1. What is nice about this is that it can be quantified with minimal measurement error
2. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
3. Probably critical but insufficient data



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	5	8
Patient & Public In	7	6	8
Physical Therapists	8	6	9
Physicians	7	6	7
Radiologists	5	4	7
Researchers	7	5	9

Percentage panelists that scored the statement as critical	57.1%
Percentage panelists that scored the statement as not important	4.8%
<b>RESULT</b>	<b>NO CONSENSUS</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
3	6	I usually use the alfa angle. For me; I want to highlight that this is more important than epiphyseal extension or tilt. I said the previous time 'not important' but I think it can be important.
5	7	Seems important across the cohorts.

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	5	8	8	6	8
Patient & Public In	7	6	8	8	7	8
Physical Therapists	8	6	9	8	6	9
Physicians	7	6	7	7	6	7
Radiologists	5	4	7	6	6	7
Researchers	7	5	9	8	7	9



	Round 1	Round 2
Percentage panelists that scored the statement as critical	57.1%	65.9%
Percentage panelists that scored the statement as not important	4.8%	0%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

No outliers

**Statement 44:** For research on how primary cam morphology develops the epiphyseal morphology magnetic resonance (MR) imaging outcome measure should also be quantified using epiphyseal tilt

**R1: NO CONSENSUS**

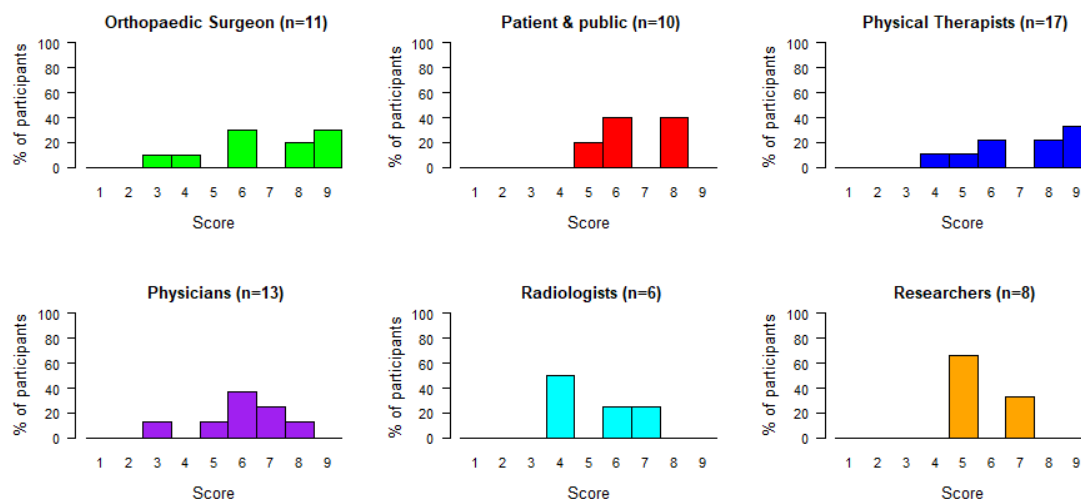
**R2: NO CONSENSUS**

HELPTXT: Epiphyseal tilt measures the ratio between epiphyseal extension on opposing sides of the femoral head

### RESULTS: ROUND 1

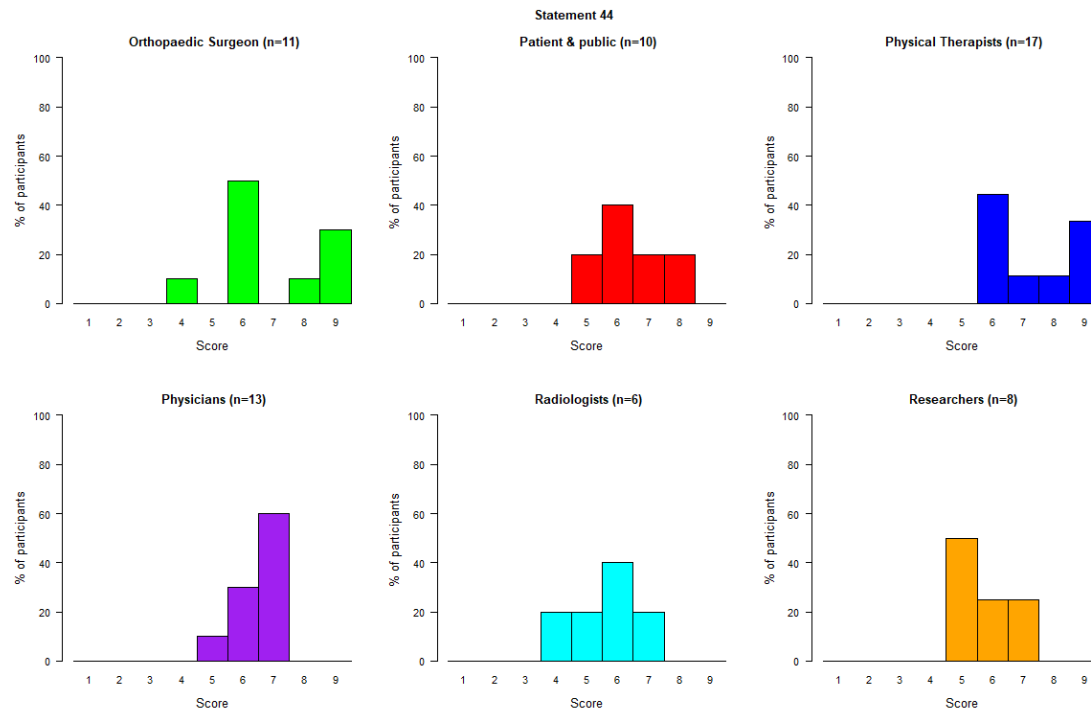
1. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
2. Possibly but again insufficient data
3. Please don't forget the genetic component in the theory of development

Statement 44



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	6	9
Patient & Public In	6	6	8
Physical Therapists	8	6	9
Physicians	6	6	7
Radiologists	5	4	7
Researchers	5	5	7

Percentage panelists that scored the statement as critical	43.6%
Percentage panelists that scored the statement as not important	5.1%
<b>RESULT</b>	<b>NO CONSENSUS</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
3	6	I usually use the alfa angle. For me; I want to highlight that this is more important than epiphyseal extension or tilt. I said the previous time 'not important' but I think it can be important.
6	7	Second webinar informations
10	6	Following the experts; in this case the radiologists

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	6	9	6	6	9
Patient & Public In	6	6	8	6	6	7
Physical Therapists	8	6	9	7	6	9
Physicians	6	6	7	7	6	7
Radiologists	5	4	7	6	5	6
Researchers	5	5	7	6	5	7

	Round 1	Round 2
Percentage panelists that scored the statement as critical	43.6%	44.2%
Percentage panelists that scored the statement as not important	5.1%	0%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

**Statement 45:** The main imaging modality for longitudinal primary cam morphology prognosis research should be anteroposterior (AP) pelvis and Dunn 45° view radiographs repeated at least every 5 years

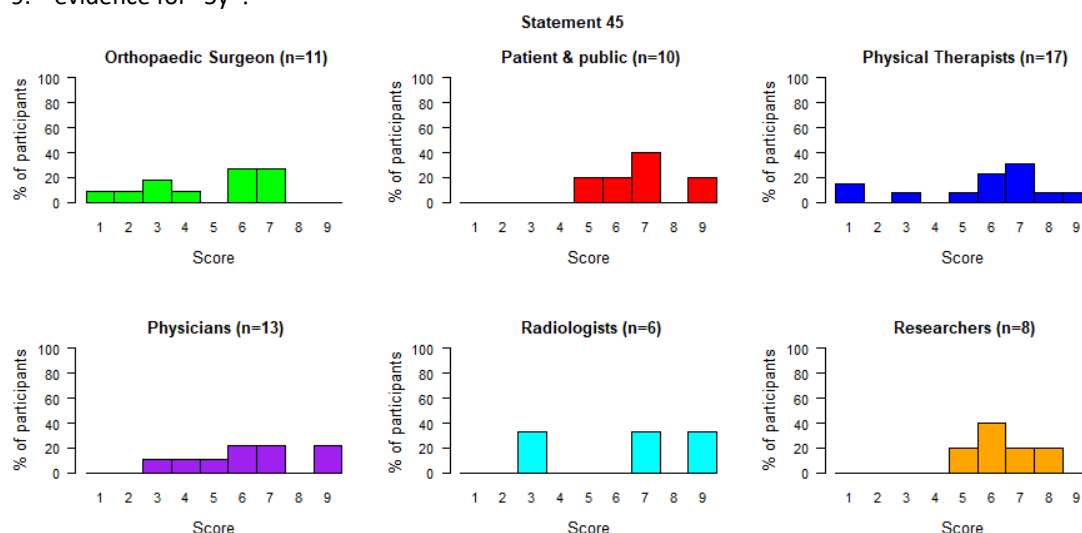
**R1: NO CONSENSUS**

**R2: NO CONSENSUS**

HELPTXT: Femoral head-neck asphericity is most often localised in the anterosuperior region, and usually best shown on a radiographic view with the hips in 45° of flexion and 20° of abduction (Dunn 45° view)

## RESULTS: ROUND 1

1. Would suggest frog-leg lateral or Dunn.
2. any lateral head-neck views; also dependent where the particular centre is familiar with
3. tough with sweeping statement - advantage of x-ray is cheap and little time costs; but radiation and less detail - so depends on exact question
4. Prefer MRI with all clock positions
5. Again; don't feel qualified to answer these statements because I don't know how MRIs are conducted --but standardizing the imaging and radiographs across research seems important
6. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
7. If after closure of growth plate; long term study -> X-Ray. Otherwise for research MRI
8. I think the evidence is already beyond such approach
9. evidence for "5y"?



	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	6	3	7
Patient & Public In	7	6	7
Physical Therapists	6	5	7
Physicians	6	5	7
Radiologists	7	3	9

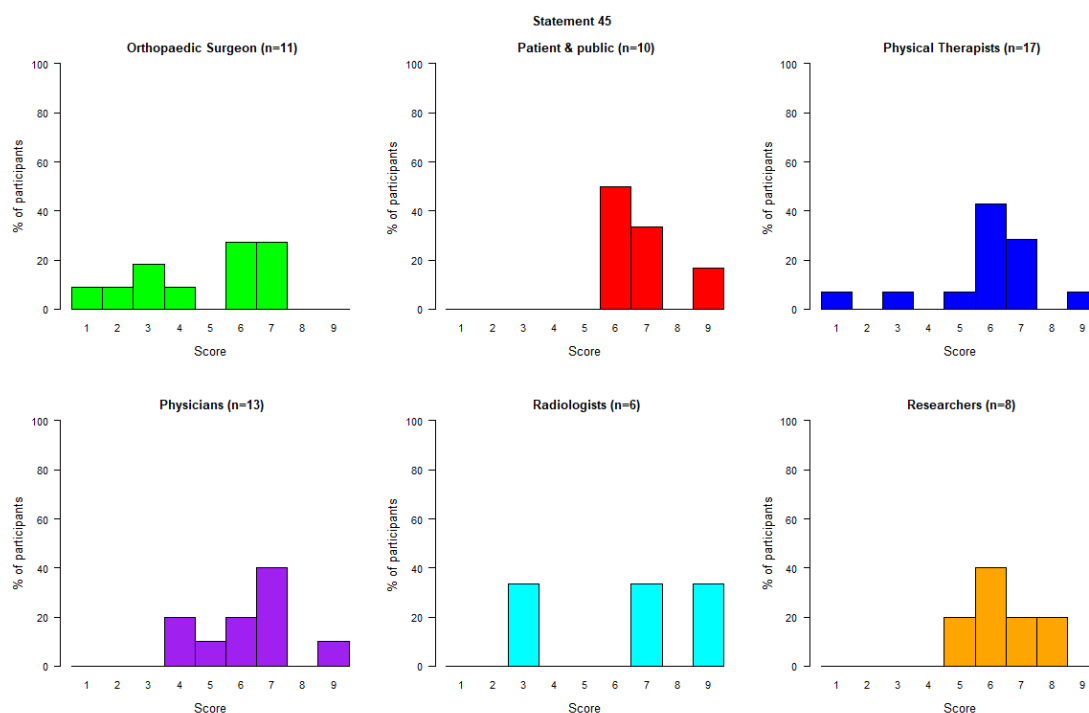
Researchers | 6 | 6 | 7 |

Percentage panelists that scored the statement as critical	44.9%
Percentage panelists that scored the statement as not important	20.4%
<b>RESULT</b>	<b>NO CONSENSUS</b>

## RADIOLOGISTS

Percentage panelists that scored the statement as critical	66.7%
Percentage panelists that scored the statement as not important	33.3%
<b>RESULT</b>	<b>NO CONSENSUS</b>

## RESULTS: ROUND 2



## Reasons for score boundary changes between R1 and R2

R1	R2	
1	6	This is a mistake - I do not think we should take radiographs every five years.
8	6	This depends on if you are talking about using radiographs to monitor joint disease progression (i.e. OA features) in young people with cam morphology. MRI would be better in this type of study;
10	6	Recognised my slight error (marked too high) in the initial scoring

**Median, IQR**

	<b>ROUND 1</b>			<b>ROUND 2</b>		
	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>	<b>Median</b>	<b>Percentile 25</b>	<b>Percentile 75</b>
<b>Orthopaedic Surgeon</b>	6	3	7	6	3	7
<b>Patient &amp; Public In</b>	7	6	7	7	6	7
<b>Physical Therapists</b>	6	5	7	6	6	7
<b>Physicians</b>	6	5	7	7	5	7
<b>Radiologists</b>	7	3	9	7	3	9
<b>Researchers</b>	6	6	7	6	6	7

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	44.9%	42.3%
Percentage panelists that scored the statement as not important	20.4%	15.4%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

**RADIOLOGISTS**

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	66.7%	66.7%
Percentage panelists that scored the statement as not important	33.3%	33.3%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

**Statement 46:** The radiographic imaging outcome measure for research on primary cam morphology prognosis should be the alpha angle as a continuous variable reported for anteroposterior (AP) pelvis and Dunn 45° view radiographs.

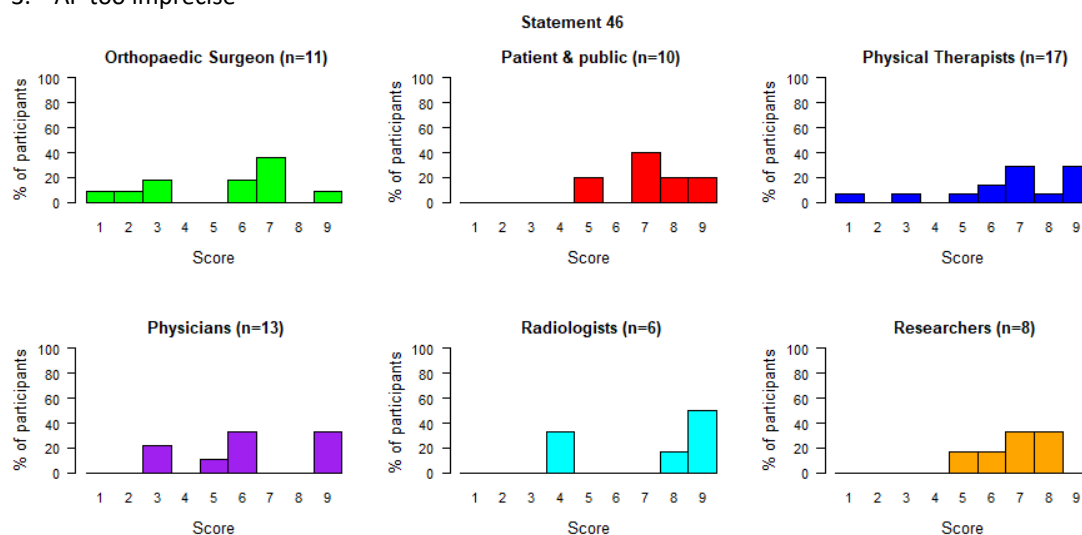
**R1: NO CONSENSUS**

**R2: NO CONSENSUS**

**HELPTXT:** Alpha angle: Using the radiographs, a circle is centred over femoral head. The alpha angle is the angle between: (1) a line parallel to the femoral neck axis, and (2) a line from the centre of the femoral head to the point where the femoral head neck junction contour exceeds the head radius

## RESULTS: ROUND 1

1. Prefer MRI with all clock positions
2. I do not agree that the concept of Primary and secondary CAM is commonly agreed and established
3. AP too imprecise



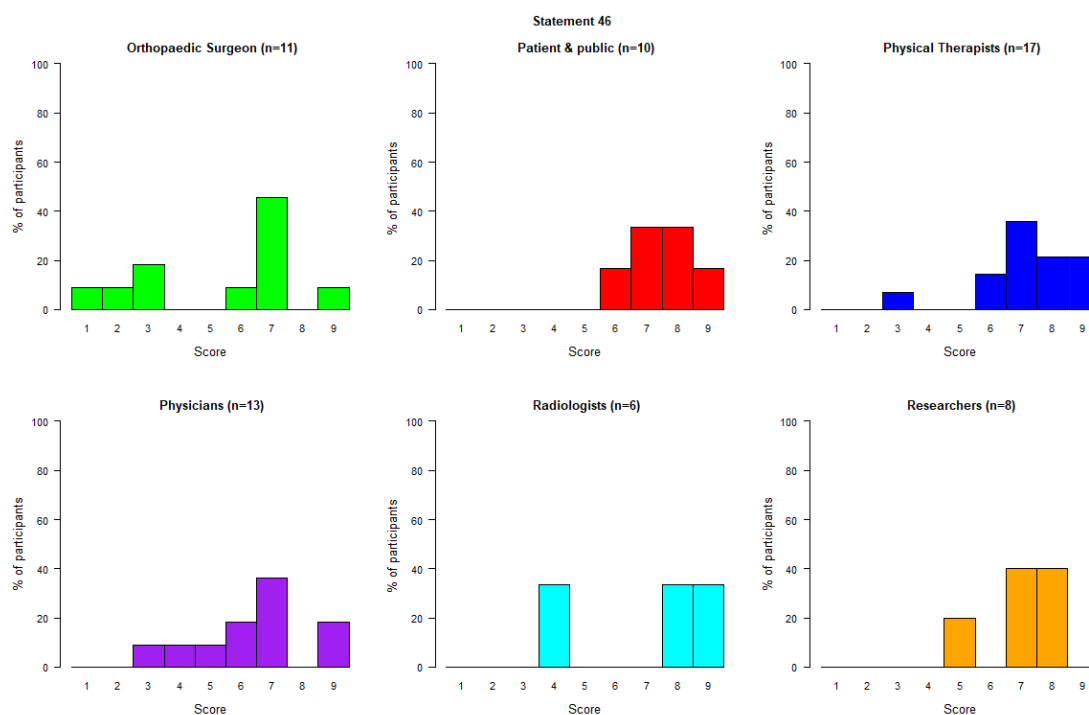
	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	6	3	7
Patient & Public In	7	7	8
Physical Therapists	7	6	9
Physicians	6	5	9
Radiologists	9	4	9
Researchers	7	6	8

Percentage panelists that scored the statement as critical	56.9%
Percentage panelists that scored the statement as not important	15.7%
<b>RESULT</b>	<b>NO CONSENSUS</b>



**RADIOLOGISTS**

Percentage panelists that scored the statement as critical	66.7%
Percentage panelists that scored the statement as not important	0%
<b>RESULT</b>	<b>NO CONSENSUS</b>

**RESULTS: ROUND 2****Reasons for score boundary changes between R1 and R2**

R1	R2	
5	7	Strength of agreement of others increased my confidence
1	6	This is a mistake - I do not think we should take radiographs in young adults.
6	8	important perspective of other colleagues (radiologists)

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	6	3	7	7	3	7

<b>Patient &amp; Public In</b>	7	7	8	8	7	8
<b>Physical Therapists</b>	7	6	9	7	7	8
<b>Physicians</b>	6	5	9	7	5	7
<b>Radiologists</b>	9	4	9	8	4	9
<b>Researchers</b>	7	6	8	7	7	8

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	56.9%	67.9% (70.6%)
Percentage panelists that scored the statement as not important	15.7%	11.3% (7.8%)
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

\* adjusted percentage after removing 2 outliers from round 2 are in brackets

#### **RADIOLOGISTS**

	<b>Round 1</b>	<b>Round 2</b>
Percentage panelists that scored the statement as critical	66.7%	66.7%
Percentage panelists that scored the statement as not important	0%	0%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>NO CONSENSUS</b>

**Statement 47:** In addition to reporting alpha angles as continuous in studies on aetiology or prognosis, the following quantitative and qualitative imaging outcome measures, to categorise cam morphology, can be useful in research or clinical practice: (i) Alpha angle  $\geq 60^\circ$  (preferred) (ii) Head-neck offset  $< 8\text{mm}$  AND head-neck offset ratio  $\leq 0.15$  usually at the anterior (3 o'clock) location around the femoral head-neck junction (in addition to (i)); Osseous or cartilage convexity of the femoral head neck junction at any location (in addition to (i) and (ii))

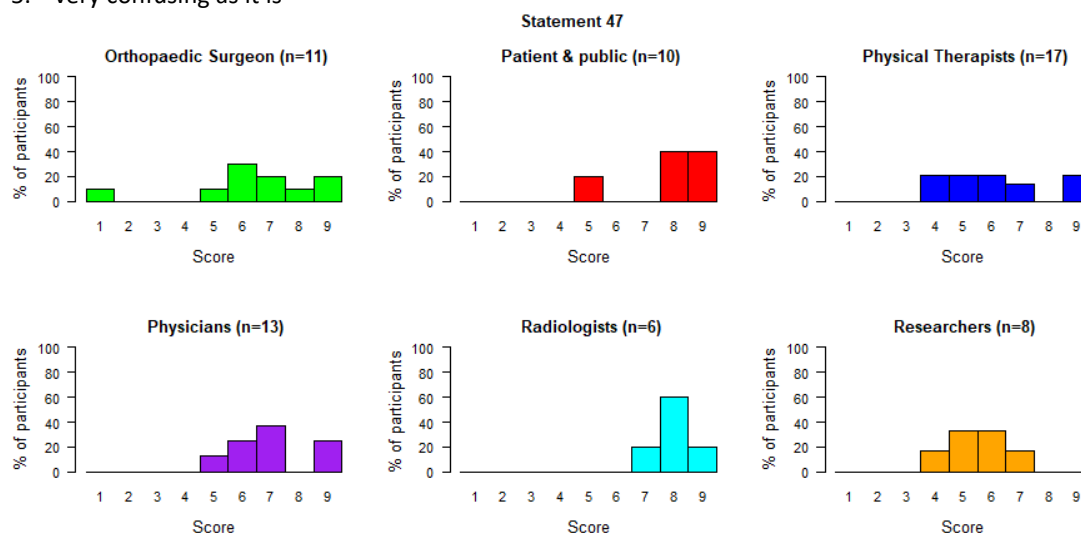
**R1: NO CONSENSUS**

**R2: CONSENSUS IN**

HELPTXT: Alpha angle: Using the hip imaging, a circle is centred over femoral head. The alpha angle is the angle between: (1) a line parallel to the femoral neck axis, and (2) a line from the centre of the femoral head to the point where the femoral head neck junction contour exceeds the head radius. Head-neck offset is the difference (o) between the femoral head radius (r) and the neck radius; the head-neck offset ratio represents the ratio of offset (o) to the femoral head radius (r). Many clinicians and researchers use a clock face system to describe the location of cam morphology on radial magnetic resonance (MR) imaging or computed tomography (CT) scan sequences around the axis of the femoral neck, normally  $30^\circ$  intervals with 12 o'clock as the superior (top) location, and 3 o'clock, 6 o'clock and 9 o'clock as the anterior (right), inferior (bottom) and posterior (left) locations, respectively (when facing 'the clock').

## RESULTS: ROUND 1

1. I would take care in allowing too many additional measurement options that may introduce confusion to the definition/taxonomy. By all means discuss them but I wonder if this needs to be tightened further to avoid potential confusion over what is/is not suggested for future research studies.
2. I would change AND to OR. Please be aware that the statements imply a lot of multiple testing with each type of measurement and each location of measurement having their uncertainty. I would advocate not using too much different measures and not too much locations.
3. perhaps more important in clinical practice to aid with decision making.
4. I would suggest that section 2 is not critical since it's not a reliable tool for assessing CAM morphology.
5. very confusing as it is

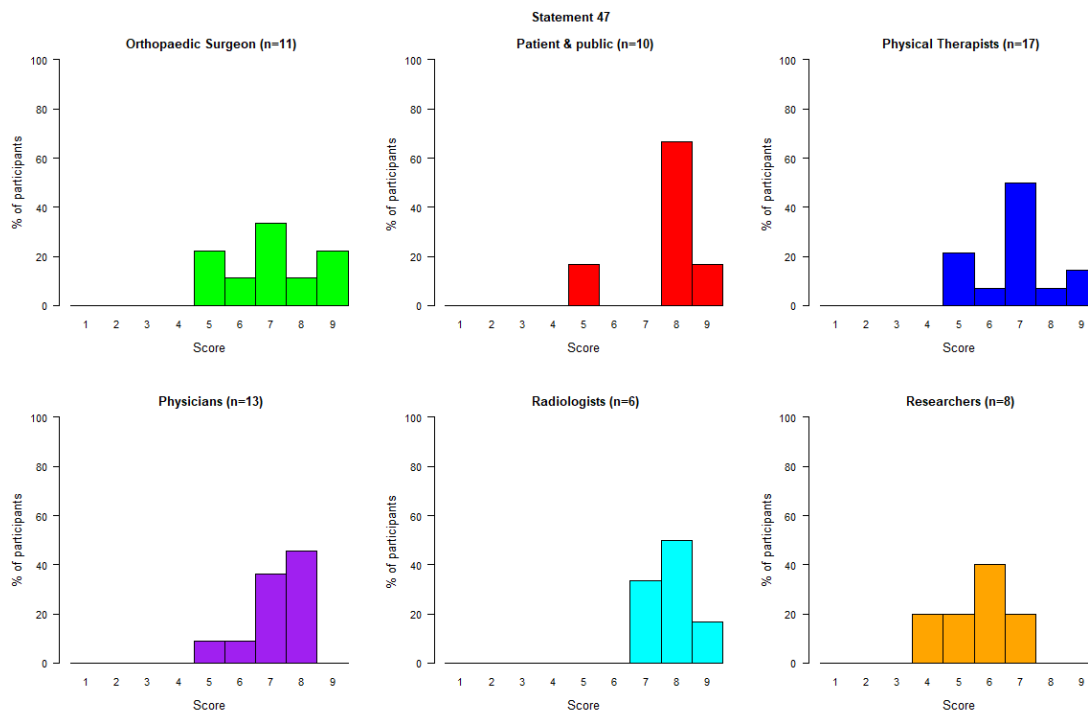


	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	6	8
Patient & Public In	8	8	9
Physical Therapists	6	5	7
Physicians	7	6	8
Radiologists	8	8	8
Researchers	6	5	6

Percentage panelists that scored the statement as critical	52.1%
Percentage panelists that scored the statement as not important	2.1%
<b>RESULT</b>	<b>NO CONSENSUS</b>

**RADIOLOGISTS**

Percentage panelists that scored the statement as critical	100%
Percentage panelists that scored the statement as not important	0%
<b>RESULT</b>	<b>CONSENSUS</b>

**RESULTS: ROUND 2**

**Reasons for score boundary changes between R1 and R2**

R1	R2	
6	7	Strength of agreement of others increased my confidence
5	10	I am uncertain on the specific research values
6	7	I scored this down in the first round due to the complexity of the statement and I still think it is too wordy; but if taken step by step I think it is more important
4	7	More attention paid to imaging
5	10	not confident that I fully understood the question
6	7	important perspective of other colleagues (radiologists)

**Median, IQR**

	ROUND 1			ROUND 2		
	Median	Percentile 25	Percentile 75	Median	Percentile 25	Percentile 75
Orthopaedic Surgeon	7	6	8	7	6	8
Patient & Public In	8	8	9	8	8	8
Physical Therapists	6	5	7	7	6	7
Physicians	7	6	8	7	7	8
Radiologists	8	8	8	8	7	8
Researchers	6	5	6	6	5	6

	Round 1	Round 2
Percentage panelists that scored the statement as critical	52.1%	72.5%
Percentage panelists that scored the statement as not important	2.1%	0%
<b>RESULT</b>	<b>NO CONSENSUS</b>	<b>CONSENSUS IN</b>

**RADIOLOGISTS**

	Round 1	Round 2
Percentage panelists that scored the statement as critical	100%	100%
Percentage panelists that scored the statement as not important	0%	0%
<b>RESULT</b>	<b>CONSENSUS IN</b>	<b>CONSENSUS IN</b>

SUPPLEMENTARY FILE 6

Qualitative analysis of individual panellists’ feedback

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Definitions – Delphi domain 1

Table SF6-1 Qualitative feedback themes for the definitions domain

Themes	Quotations, comments and recommendations
1 Cam morphology of unknown origin (statement 6)	<p><b>Quotations</b></p> <p><i>‘Disagree as the origin is not entirely ‘unknown’ - likely due to variable loading demands.’</i></p> <p><i>‘We have good knowledge about pathogenesis at this stage but may be not enough’</i></p> <p><i>‘If it’s unknown I find it hard to know if primary or secondary’</i></p> <p><i>‘Agree, at an individual level not all PCM has clear cause. Parents want to know if their children will get it.’</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"><li>➤ A primary condition/disease, per definition, includes idiopathic conditions/diseases of unknown aetiology.</li><li>➤ The aetiology of primary cam morphology in non-athletes without any known existing or pre-existing hip disease is unknown.</li><li>➤ A better-worded statement might be: “Primary cam morphology <u>also</u> includes idiopathic cam morphology (of unknown origin)”</li><li>➤ More research is needed in ethnic diverse groups</li></ul>
2 All cam morphology in young and active adults without any symptoms or history of previous hip disease is primary cam morphology until proven otherwise (statement 7)	<p><b>Quotations</b></p> <p><i>‘Could the statement possibly be modified to add “known” before history? If there is no history of disease it cannot be proven otherwise, correct? So the statement would be: “Cam morphology that develops in young and active individuals without any symptoms (e.g. hip-related pain; stiffness) or known history of previous/existing hip disease, is primary cam morphology until proven otherwise.’</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"><li>➤ Individuals with primary cam morphology might develop symptoms (including pain; stiffness) secondary to the morphology</li><li>➤ Any cam morphology, according to the agreed definition, that develops in young and active adults without any (known) hip disease, should be referred to as primary cam morphology</li><li>➤ Secondary cam morphology develops secondary to previous or existing hip disease (e.g., Perthes; SCFE)</li></ul>
3 Prevalence in asymptomatic males and females	<p><b>Quotations</b></p> <p><i>‘I don't think we know enough about females to make it categorical that it more frequently occurs in males and therefore would make this differentiation a lower priority i.e. not critical’</i></p> <p><i>‘Is this because more males are playing sports with higher loading?’</i></p> <p><i>‘Is it proportionally just as prevalent in female?’</i></p>

		<p><i>'This statement suggests PCM occurs only/mostly in males but I am not sure if that is the case. I thought it occurs in both sexes.'</i></p> <p><i>'It is common in males; but I would argue that it's mainly because we've looked at historically male sports (American football; ice hockey; wrestling)'</i></p> <p><i>'We know the prevalence in males and bilateral appearance. The only reason I cannot score this is I am not sure if I can comment on demographics and population as we do know that most of the studies include mainly male participants.'</i></p> <p><i>'Females often left out of research; From my understanding there is a paucity of research in females.'</i></p> <p><i>'I'm reacting to the suggestion that this is for "male athletes". Female athletes also have cam (and when they do have worse outcomes).'</i></p> <p><i>'I would hesitate to include gender in the definition to avoid people thinking that it is a male-only problem'</i></p> <p><i>'Use current rather than common as the number of females and specifically athletes are less known.'</i></p> <p><i>'Can we suggest based on the (limited) available literature, that the prevalence might be lower but must be explored in upcoming studies?'</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ Limited evidence in females (consider possible selection bias)</li> <li>➤ Current evidence suggests that primary cam morphology is less prevalent in females.</li> <li>➤ More research needed in female cohorts/women's sports</li> </ul>
4	Unilateral vs bilateral	<p><b>Quotations</b></p> <p><i>'Isn't it 50-50? 50% bilateral and 50% unilateral. At least that mostly comes out of our studies; not sure by hard if other studies show differently?'</i></p> <p><i>'We know the prevalence in males and bilateral appearance [of primary cam morphology]'</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ Current best evidence supports the statement that primary cam morphology is usually (but not always) bilateral while secondary cam morphology is usually (but not always unilateral). Some athletes might have unilateral primary cam morphology (refer to study in golfers: trail leg more affected)</li> </ul>
5	Primary cam morphology as a concept	<p><b>Quotation</b></p> <p><i>'I do not agree that the concept of Primary and secondary CAM is commonly agreed and established'</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ The majority Delphi panel members agreed that primary cam morphology as a concept is critical and has utility in research (e.g., prognosis), treatment, and important for classification in research.</li> <li>➤ Work is needed to convince a small but important group of stakeholders</li> </ul>
6	Primary cam morphology develops as a normal	<p><b>Quotations</b></p> <p><i>'I think the statement should remove the word 'normal'. It seems that specific types of loading influence the development of a cam morphology. As we do not know details of which loads are key in this regard; the use of normal response to load may not be accurate. I would agree with the statement: "Primary cam morphology develops during skeletal maturation as a</i></p>



	physiological response to high-load sporting activity	<p><i>physiological response to load” or “Primary cam morphology develops during skeletal maturation as a physiological response to specific types of load’</i></p> <p><i>‘I would debate the term ‘normal’; it’s a physiological reaction but normal is questionable.’</i></p> <p><i>‘While I agree that CAM appears to occur during maturation as a response to load, whether this can be considered a normal response to load is more unclear.’</i></p> <p><i>‘Primary cam morphology is not caused by previous disease, injury or an acute event. I would agree with this.’</i></p> <p><i>‘I don’t agree with a normal physiological response to ‘load’. Isn’t it overload? And can we then still call it a physiological response?’</i></p> <p><i>‘The same. I would debate the term ‘normal’; it’s a physiological reaction but normal is questionable.’</i></p> <p><i>‘Again the use of ‘normal’ response to load reduces my agreement’</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ The majority Delphi panel members agreed that primary cam morphology in athletes likely develops secondary to a <u>normal</u> physiological response of the femoral capital growth plate to high-load sporting activity.</li> <li>➤ This might constitute an ‘abnormal’ load for the individual/maturing skeleton but the cellular response is not</li> </ul>
7	Genetics as a risk factor/cause	<p><b>Quotations</b></p> <p><i>‘Would include a statement on genetic influences’</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ Important to do further research on the genetic background to primary cam morphology development</li> </ul>
8	Varying size and shape	<p><b>Quotations</b></p> <p><i>‘Varying size and probably varying shape’</i></p> <p><b>Comment and recommendation</b></p> <ul style="list-style-type: none"> <li>➤ Primary cam morphology has varying size and shape</li> </ul>
9	Any location vs anterosuperior / more common antero-superior	<p><b>Quotations</b></p> <p><i>“‘Any location” suggests equal occurrence in all locations but I understood it predominantly occurs at superior/anterior.’</i></p> <p><i>‘Primary cam morphology mainly occurs in the antero-superior quadrant, followed by anteroinferior and no morphologies in the posterosuperior or posteroinferior’</i></p> <p><i>‘Agree but see caveats above about “any location” and “males”.’</i></p> <p><b>Comment and recommendation</b></p> <ul style="list-style-type: none"> <li>➤ Primary cam morphology can develop in any location around the femoral head-neck junction but is more common in the antero-superior quadrant.</li> </ul>
10	Bump	<p><b>Quotations</b></p> <p><i>‘Consider removing ‘bump’ from the definition’</i></p> <p><b>Comment and recommendation</b></p> <ul style="list-style-type: none"> <li>➤ Although not perfect, ‘bump’ is a more patient-friendly term</li> </ul>
11		<p><b>Quotations</b></p>

	Alpha angle; Combining the conceptual and operational definition	<p><i>'Methodological issues with treating alpha angle as both dichotomised and continuous'</i></p> <p><i>'I wouldn't have the text that says 'CT scans or MR imaging, reported per hip, per person or both.' I think it distracts the reader and we know that we need to measure the alpha angle - how we achieve that I am not sure needs to be in the overall definition.'</i></p> <p><i>'I think the most common outcome measure part is better to be mentioned in taxonomy.'</i></p> <p><i>'Instead of "the most common outcome measure...", might consider something such as 'It is often diagnosed using a cartilage or bone alpha angle on radiographs, CT scans.....' Incorporation of 'outcome measure' and 'dichotomised or continuous variable' is really an operationalization of the definition.'</i></p> <p><b>Comment and recommendation</b></p> <ul style="list-style-type: none"> <li>➤ Refer to imaging outcome agreements – Statement 41: “In primary cam morphology epidemiological research (e.g.; when regression is being used in aetiology or prognosis research), continuous imaging outcome measures (variables), like the alpha angle, should be kept continuous”</li> <li>➤ The panel reached agreement on a definition that combines primary cam morphology’s 5 conceptual attributes and how the morphology is operationalised</li> </ul>
12	Existing hip disease vs pre- existing- vs known- vs previous hip disease as it relates to secondary cam morphology (Statement 3).	<p><b>Quotations</b></p> <p><i>'I think the word 'existing' should be changed to 'pre-existing'. I do not think a healed proximal femoral fracture, as in the example, classify as an existing disease; rather a disease existing prior to the cam development therefore 'pre-existing' or 'prior' or 'preceding''</i></p> <p><b>Comment and recommendation</b></p> <p>Although strong consensus, the Delphi steering committee agreed that a reworded statement might be more accurate: “Secondary cam morphology develops due to <u>existing and/or pre-existing</u> hip disease...”.</p>

## Terminology – Delphi domain 2

**Table SF6-2** Qualitative feedback themes for the terminology domain

	<b>Themes</b>	<b>Quotations, comments and recommendations</b>
1	Morphology – not deformity, lesion or abnormality	<p><b>Quotations</b></p> <p><i>'We've agreed it is a 'normal physiological response' and therefore shouldn't be called a lesion/deformity with their connotations of abnormality'</i></p> <p><i>'Abnormality is not a very optimistic term'</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ Morphology is better (less threatening) language for patients but still too scientific. Perhaps important to consider tailoring terms to different stakeholder groups</li> <li>➤ Avoid deformity, lesion, abnormality and 'pistol grip deformity'</li> </ul>
2	"Bump"	<p><b>Quotations</b></p> <p><i>'Consider replacing bump with prominence. Not every cam morphology has a 'bump'. It might have only decreased offset and that certainly does not constitute a bump'</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ Alternative to bump or prominence, consider 'thickening', 'egg-shape' - important to involve patients [in future research on this]</li> </ul>
3	Femoroacetabular impingement syndrome	<p><b>Quotations</b></p> <p>Regarding statement 26: <i>Femoroacetabular impingement (FAI) Syndrome with cam morphology is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction – 'I do not agree that you can say it is the preferred term for hip-related pain, but this is one type of pathology that may occur in the hip'</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ 'Syndrome', whilst agreed at Warwick and in this Delphi and much preferred scientifically, may require further patient-orientated research to assess whether it has negative consequences and whether femoroacetabular impingement (FAI) used in isolation may be a better term when communicating with patients." </li></ul>
4	Any location vs anterosuperior / more common antero-superior	<p><b>Quotations</b></p> <p><i>'More confident that 'any location' is a bad element'</i></p> <p><b>Comment and recommendation</b></p> <ul style="list-style-type: none"> <li>➤ Primary cam morphology can develop in any location around the femoral head-neck junction but is more common in the antero-superior quadrant.</li> </ul>

## Taxonomy – Delphi domain 3

**Table SF6-3** Qualitative feedback themes for the taxonomy domain

	<b>Themes</b>	<b>Example quotations; Online mixed stakeholder group discussions; Comments and recommendations</b>
1	Assumption that we can distinguish / difficult to distinguish in clinical practice	<b>Quotations</b> <i>'this assumes the distinction can be made!'</i> <b>Comments and recommendations</b> <ul style="list-style-type: none"> <li>➤ Easier to find relevant literature when distinguishing between PCM and SCM</li> <li>➤ PCM vs SCM can be a grey area - subclinical SCFE</li> </ul>
2	Important for diagnosis	<b>Quotations</b> <i>'I agree mainly for the diagnosis'</i> <b>Comments and recommendations</b> <ul style="list-style-type: none"> <li>➤ Distinguishing between primary and secondary cam morphology has diagnostic utility</li> </ul>
3	Important for treatment	<b>Quotations</b> <i>'from what I understand treatment is different between the two...so yes'</i> <b>Comments and recommendations</b> <ul style="list-style-type: none"> <li>➤ Distinguishing between primary and secondary cam morphology important for treatment as it is different</li> </ul>
4	Important for prognosis	<b>Quotations</b> <i>'This 100% depends on prognosis - given the presence of previous injury; it would suggest secondary CAM morphology has a poorer prognosis and therefore should be distinguished to improve treatment planning'</i> <b>Comment and recommendations</b> <ul style="list-style-type: none"> <li>➤ Prognosis for primary and secondary cam morphology is different – therefore important to distinguish</li> </ul>
5	Depends on age	<b>Quotations</b> <i>'Depends a bit on age – if someone is 30 years old – less relevant'</i> <b>Comments and recommendations</b> <ul style="list-style-type: none"> <li>➤ Might be more important and easier to make the distinction between primary and secondary cam morphology at a young age</li> </ul>
6	Mix of both types	<b>Quotation</b> <i>'Agree but I wonder if there may be cases where a patient has a mix of both types. This note applies to all my answers in this section'</i> <b>Comment and recommendation</b> <ul style="list-style-type: none"> <li>➤ Primary and secondary cam morphology might co-occur in the same patient/hip</li> </ul>

Imaging outcomes – Delphi domain 4

Table SF6-4 Qualitative feedback themes for the imaging outcomes domain

	Themes	Quotations, comments and recommendations
1	How often should MR imaging be repeated in research on how primary cam morphology develops (Statement 40)	<p><b>Quotations</b></p> <p><i>‘Really depends on research question; statement is too general’</i></p> <p><i>‘Do we know how quickly cam morphology develops/progresses?’</i></p> <p><i>‘Depends on phase of growth’</i></p> <p><i>‘This will depend on the research question. Timeline could for instance be required to be shorter’</i></p> <p><i>‘Evidence for 18-24 months?’</i></p> <p><i>‘What about more often? I know it will be difficult but if there is a critical window that we want to identify 2 year intervals would not be frequent enough’</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"><li>➤ Radiologist felt that more is better. Radial vs block imaging</li><li>➤ More frequent MR imaging in development studies - 11-16y (boys) and 9-14y (girls) – MR imaging at least every year</li><li>➤ Aetiology: Serial imaging more frequent (every 3/12 to capture periods of faster growth. Value of serial radiographs is questionable. To reduce research waste we should not use serial radiographs in aetiological research. “If you cannot do serial MRI in aetiology, don't do the study”</li></ul>
2	Quantifying epiphyseal morphology (epiphyseal extension / epiphyseal tilt) for research on how primary cam morphology develops (Statements 43 & 44)	<p><b>Quotations</b></p> <p><i>‘What is nice about this is that it can be quantified with minimal measurement error’</i></p> <p><i>‘Probably critical but insufficient data’</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"><li>➤ Epiphyseal morphology has been quantified (epiphyseal extension and epiphyseal tilt) and correlated with alpha angles in prospective MR imaging research on primary cam morphology development (Palmer <i>et al</i>; Fernquest <i>et al</i>; Hancke <i>et al</i>)</li></ul>

3	Main imaging modality for primary cam morphology prognosis research and time interval (Statement 45)	<p><b>Quotations</b></p> <p><i>'Would suggest frog-leg lateral or Dunn'</i></p> <p><i>'Any lateral head-neck views; also dependent where the particular centre is familiar with'</i></p> <p><i>'Tough with sweeping statement - advantage of x-ray is cheap and little time costs; but radiation and less detail - so depends on exact question'</i></p> <p><i>'Prefer MRI with all clock positions'</i></p> <p><i>'Standardizing the imaging and radiographs across research seems important'</i></p> <p><i>'If after closure of growth plate; long term study -&gt; X-Ray. Otherwise for research MRI'</i></p> <p><i>'I think the evidence is already beyond such approach'</i></p> <p><i>'Evidence for 5years?'</i></p> <p><i>'Prefer MRI with all clock positions'</i></p> <p><i>'AP too imprecise'</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ Important to consider nuance of choice. MR scan refers to ideal world; many have no access, it is expensive and therefore not always feasible. Important to consider radiation exposure</li> <li>➤ Dissemination of findings: Important consideration in imaging - do athletes want to know the results? How/what do we communicate to participants/parents; Consider positive/negative response by athletes/parents</li> <li>➤ MRI vs radiographs. Ethics benefits (easier); radiographs are more practical but issue with radiation; consider economics (MR imaging expensive); logistical issues; motion artifact with young individuals;</li> <li>➤ In prognosis - degenerative; every 5 years for as long as possible; statistical issues with too high frequency - see: <a href="https://www.ncbi.nlm.nih.gov/pmc/articles/PMC280679/">https://www.ncbi.nlm.nih.gov/pmc/articles/PMC280679/</a></li> </ul>
4	Alpha angle (continuous vs dichotomous; threshold) (Statement 46)	<p><b>Quotations</b></p> <p><i>'In the end to relate back to daily practice some dichotomous reporting can also help'</i></p> <p><i>'There is no consensus on optimum threshold for dichotomizing this variable. It makes comparing across studies very difficult when different thresholds are used'</i></p> <p><i>'From an epidemiology standpoint, yes; you don't lose information. However, I have clinicians ask to identify cut points frequently'</i></p> <p><b>Comment and recommendation</b></p> <ul style="list-style-type: none"> <li>➤ The Delphi panel agreed on the continuous alpha angle as preferred primary cam morphology imaging outcome measure in aetiology or prognosis studies (statements 42 and 47). However, they failed to agree that, for prognosis studies, radiographs (AP pelvis and Dunn 45° views) should be used to calculate the alpha angle.</li> <li>➤ Panellists reminded that, to date, <i>'there is no consensus on optimum threshold for dichotomizing this [alpha angle] variable. It makes comparing across studies very difficult when different thresholds are used'</i>. Despite this, a diagnostic threshold is important for clinicians—they frequently ask <i>'to identify [alpha angle] cut points'</i>.</li> </ul>
5	Cost of MRI	<p><b>Quotations</b></p>

		<p><i>'Huge cost aspect here - depends on the research question in case'</i></p> <p><i>'Tough with sweeping statement - advantage of x-ray is cheap and little time costs; but radiation and less detail - so depends on exact question'</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ The <i>'huge cost aspect'</i> of MR imaging deprives minoritised and marginalised populations from participating in research. While radiographs are <i>'cheap and [have] little time costs'</i>, the concerns are <i>'radiation and less detail'</i></li> </ul>
6	Primary cam morphology as a concept (refer to Definitions table)	<p><b>Quotation</b></p> <p><i>'I do not agree that the concept of Primary and secondary CAM is commonly agreed and established'</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ The majority Delphi panel members agreed that primary cam morphology as a concept is critical and has utility in research (e.g., prognosis), treatment, and important for classification in research.</li> <li>➤ Work is needed to convince a small but important group of stakeholders</li> </ul>
7	Radial MR Imaging / Prefer MR vs radiographs	<p><b>Quotations</b></p> <p><i>'But qualify type of radial imaging'</i></p> <p><i>'Number of slices is not that important if you can do 3d imaging with MPR'</i></p> <p><i>'All o'clock locations seem not necessary'</i></p> <p><i>'Prefer MRI with all clock positions'</i></p> <p><i>'AP too imprecise'</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ Research should qualify the type of radial MR imaging</li> </ul>
8	Remove fluid sensitive images of pelvis (for research on primary cam morphology formation)	<p><b>Quotations</b></p> <p><i>'Consider removing the iii) portion because the rationale for this is to find pathological processes elsewhere besides the hip. If we want to study primary cam morphology development this might be excluded data on the role of screening for oedema elsewhere'</i></p> <p><b>Comments and recommendations</b></p> <ul style="list-style-type: none"> <li>➤ Fluid sensitive pelvis images, when studying primary cam morphology development are unnecessary because <i>'the rationale for this is to find pathological processes elsewhere'</i></li> </ul>
9	Research question dependent	<p><b>Quotations</b></p> <p><i>'Really depends on research question; statement is too general. all o'clock locations seem not necessary'</i> – Statement 42 <i>'This will depend on the research question. Timeline could for instance be required to be shorter'</i> (Quotation relevant to statement 40: The magnetic resonance (MR) imaging for prospective research on how primary cam morphology develops should be repeated every 18 to 24 months)</p> <p><i>'Really depends on research question and audience/readers; statement is too general'</i> (Quotation relevant to statement 41: In primary cam morphology epidemiological research (e.g. when regression is being used in aetiology or prognosis research), continuous imaging outcome measures (variables), like the alpha angle, should be kept continuous)</p>

		<b>Comment and recommendation</b> ➤ Although a continuous alpha angle should always be measured and reported, additional outcome measures (including a dichotomous alpha angle), are research question dependant
10	Alternative outcome measures / can create confusion	<b>Quotations</b> <i>'Although this appear to be relevant currently new technologies - including for instance 3D reconstructions may provide outcome variables that are more relevant than the alpha angle'</i> <i>'I would take care in allowing too many additional measurement options that may introduce confusion to the definition/taxonomy. By all means discuss them but I wonder if this needs to be tightened further to avoid potential confusion over what is/is not suggested for future research studies'</i> <i>'Relevant to statement 47: I would change AND to OR. Please be aware that the statements imply a lot of multiple testing with each type of measurement and each location of measurement having their uncertainty. I would advocate not using too much different measures and not too much locations'</i> <i>'I would suggest that section 2 [of statement47] is not critical since it's not a reliable tool for assessing CAM morphology'</i> <i>'Very confusing as it is'</i> <b>Comment and recommendation</b> ➤ Although a continuous alpha angle should always be measured and reported, additional outcome measures (including a dichotomous alpha angle), are research question dependant. Researchers should be guard against <i>'too many additional measurement options that may introduce confusion to the definition/taxonomy'</i>
11	Important to standardise imaging across research	<b>Quotations</b> <i>'Standardizing the imaging and radiographs across research seems important'</i> <b>Comment and recommendation</b> ➤ Standardising imaging across research improves rigour and provides a solid basis for meaningful collaboration and data sharing
12	Radiation	<b>Quotations</b> <i>'Tough with sweeping statement [statement 45] - advantage of x-ray is cheap and little time costs; but radiation and less detail - so depends on exact question'</i> <i>'If after closure of growth plate; long term study -&gt; X-Ray. Otherwise for research MRI'</i> <b>Comment and recommendation</b> ➤ Researchers should consider the benefits (they are cheap) and limitations (radiation and less detail) of radiographs in long-term prospective research
13	Lack of knowledge to score statement	<b>Quotations</b> <i>'As a non-clinician I don't have a strong understanding of MRI sequences and feel unqualified to answer these questions'</i> <i>'It sounds reasonable; but I do not feel qualified to provide an answer with certainty. It for instance be influenced by the specific research question'</i> <i>'Again, I don't feel qualified to answer these statements because I don't know how MRIs are conducted'</i>



**Comment and recommendation**

- The steering committee members acknowledge the technical imaging and subject-specific knowledge needed to score some of the domain 4 statements. All panellists had access to the Oxford-Aspetar-La Trobe Young Athlete's Hip Webinar Series (specifically Webinars 1 and 2 provided all the necessary background knowledge). Panellists had the option to choose "Unable to score"

## SUPPLEMENTARY FILE 7

## Primary cam morphology Delphi study – Dissent analysis Delphi domains 1 to 4

Although the main aim of the Delphi method is to structure a group communication process that might lead to consensus, we were also interested in panel dissent. To explore possible dissent, we applied *dissent analyses* including outlier analysis, bipolarity analysis, and stakeholder group analysis. In addition we performed a thematic analysis of panellists' comments, including tension and dissent, as described. [1,2]

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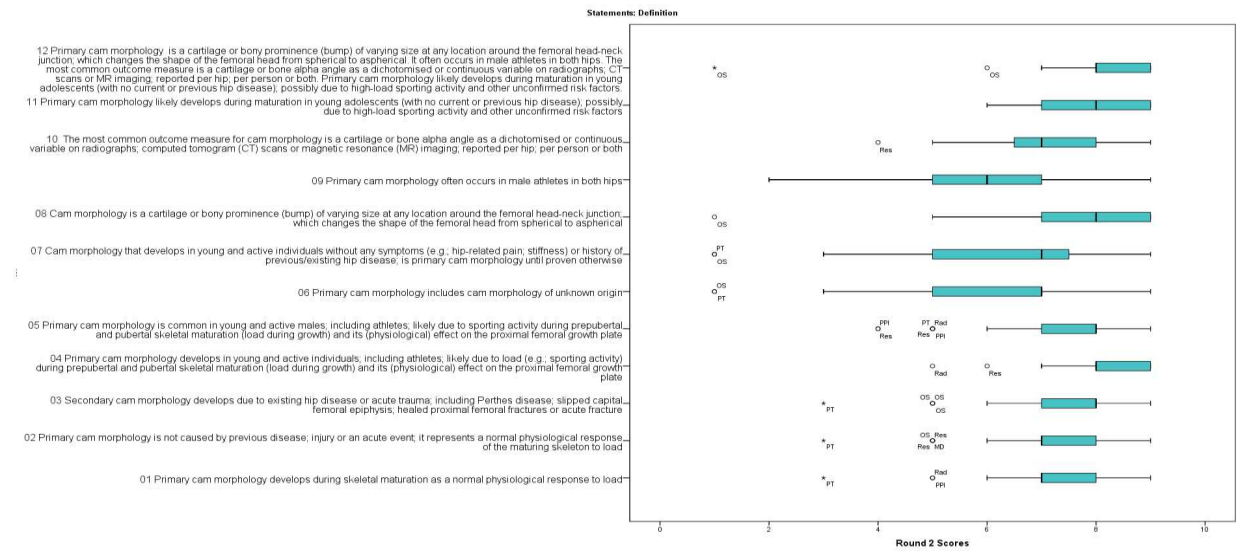
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Outlier analysis

Outliers can have a substantial effect on variables (e.g., Interquartile range), and statistical consensus. The existence of outliers is therefore an important potential explanation for dissent. We identified low outliers as data points that fall more than 1.5 times the Interquartile range below the first quartile, and high outliers as data points that fall more than 1.5 times the Interquartile range above the third quartile. In addition, we visually inspected histograms of Round 2 stakeholder group scoring for outliers. We re-analysed consensus after eliminating outliers for all statements with marginal non-consensus to test if these had an impact on the group’s consensus.

Definitions – Delphi domain 1

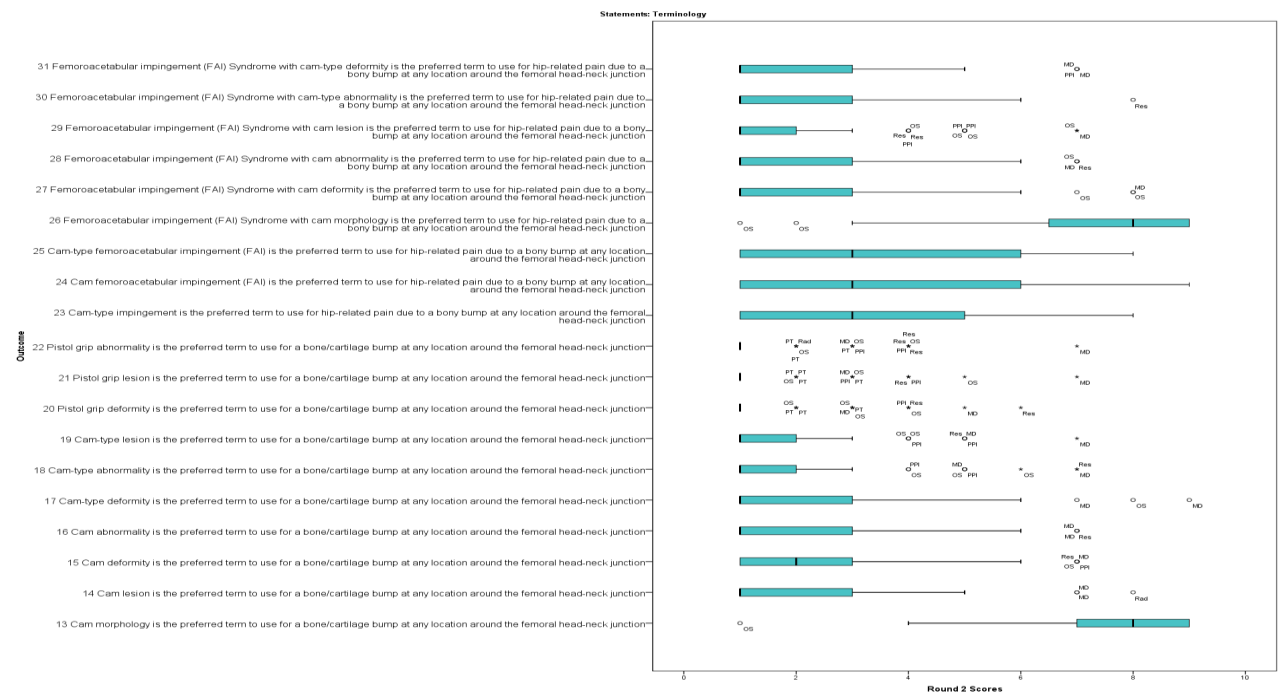
Outliers for ten of twelve definition statements in round 2, had no statistical effect on group consensus or non-consensus. (Figure 1) None of the outliers provided qualitative comments. One physical therapist chose “Unable to score” for most of the definition statements in round 1 and 2 as they *‘did not agree that the concept of primary and secondary CAM is commonly agreed and established’*.



**Figure SF7-1** Outliers for statements 1 to 12 (OS: Orthopaedic Surgeon; PPI: Patient & Public Involvement group member; MD: Physian; PT: Physical Therapist; Rad: Radiologist; Res: Researcher)

Terminology – Delphi domain 2

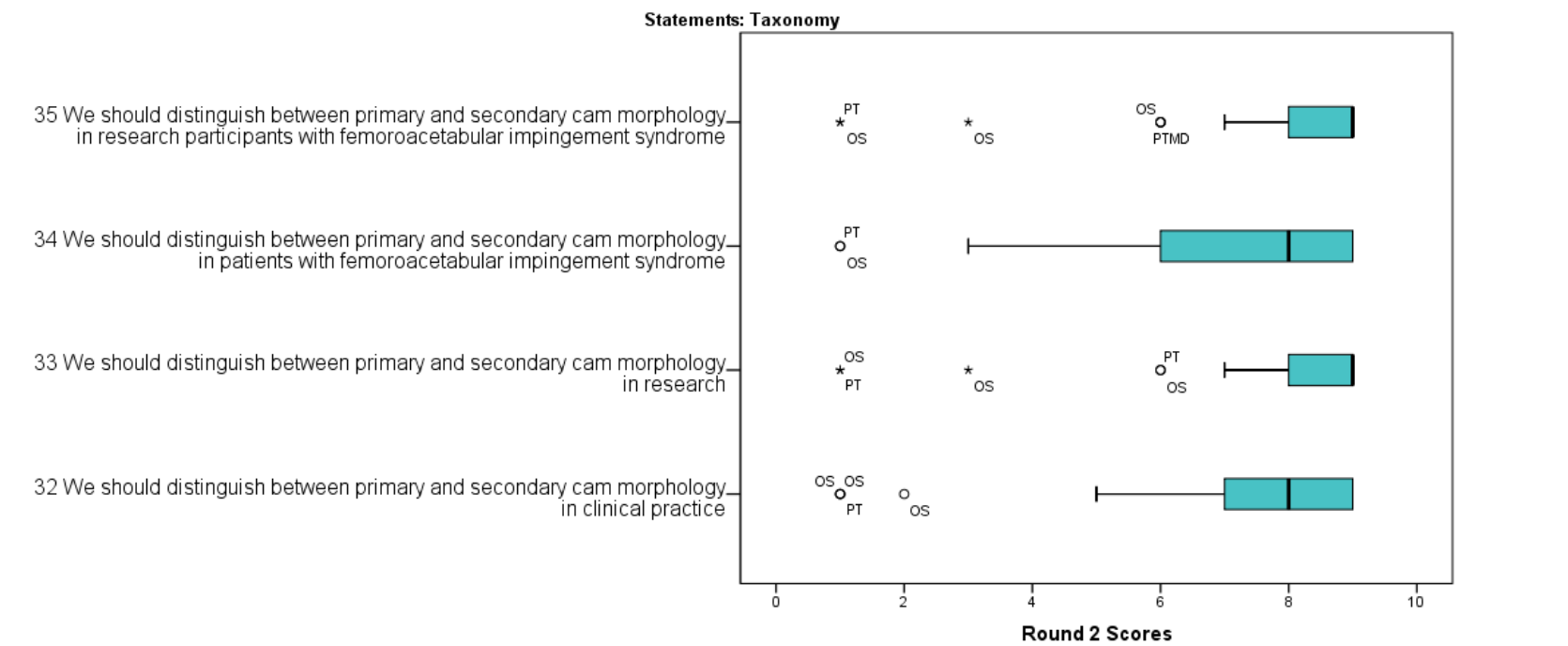
Outliers for 16 of the 19 terminology statements in round 2, had no statistical effect on group consensus or non-consensus. (Figure 2) The orthopaedic surgeon outlier for statements 13 and 26 did not agree that primary cam morphology refers to a bump “at any location” around the femoral head-neck junction. One physician chose “Unable to score” for most of the terminology statements in round 1 as they misinterpreted the statement wording. Feedback after round 1 clarified the misunderstanding.



**Figure SF7-2** Outliers for statements 13 to 31 (OS: Orthopaedic Surgeon; PPI: Patient & Public Involvement group member; MD: Physician; PT: Physical Therapist; Rad: Radiologist; Res: Researcher)

Taxonomy – Delphi domain 3

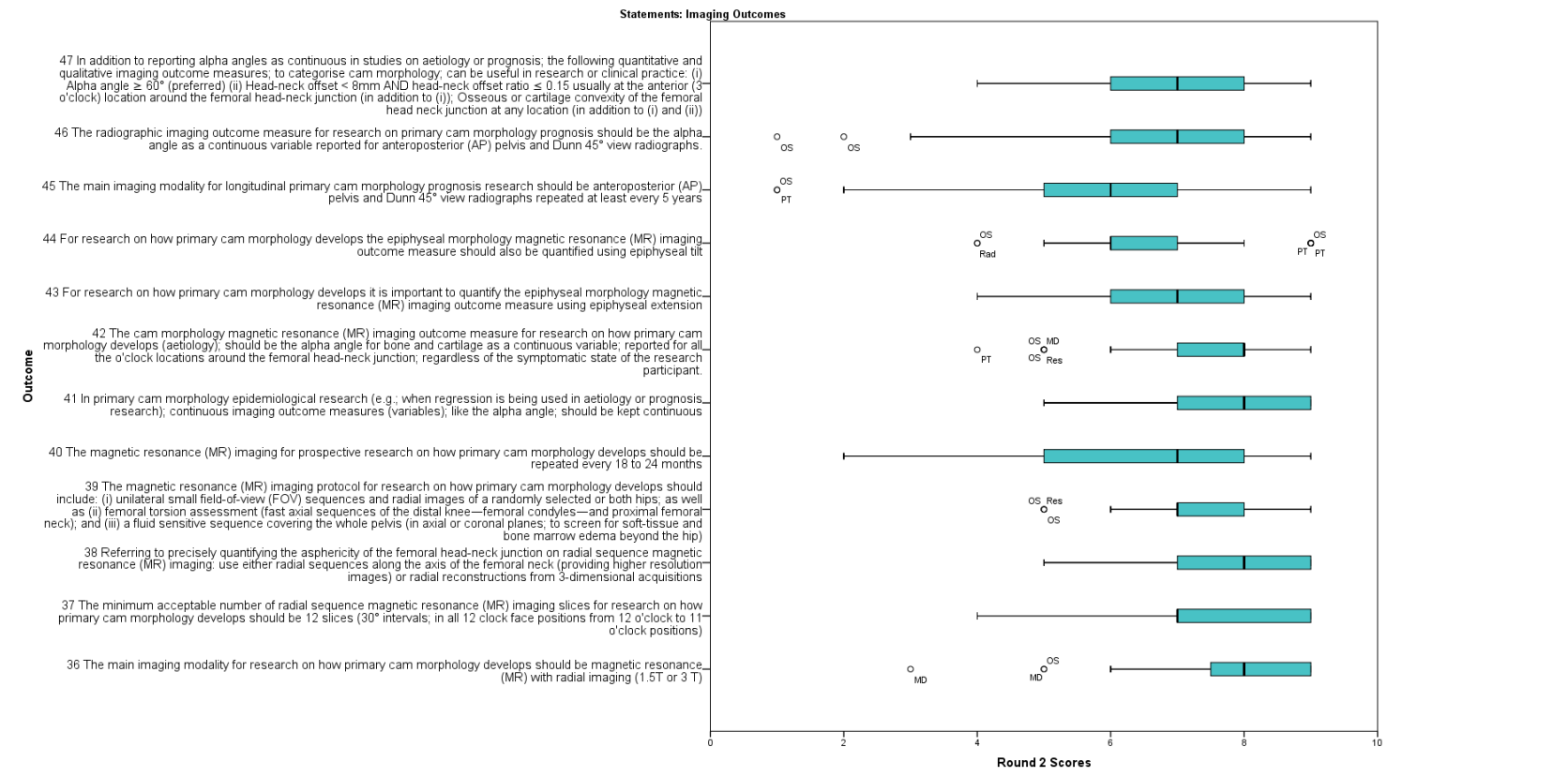
Although strong consensus was achieved for statements 32, 33 and 35, few outliers (mainly orthopaedic surgeons and a physical therapist) were not convinced (Figure 3). After removing two outliers for statement 34, the Delphi panel reached consensus on the importance of distinguishing between primary and secondary cam morphology in patients with femoroacetabular impingement syndrome.



**Figure SF7-3** Outliers for statements 32 to 35 (OS: Orthopaedic Surgeon; PPI: Patient & Public Involvement group member; MD: Physian; PT: Physical Therapist; Rad: Radiologist; Res: Researcher)

Imaging outcomes – Delphi domain 4

Six of 12 imaging outcomes statements (Statements 36, 39, 42, 44, 45, and 46) had outliers. (Figure 4). After eliminating the two orthopaedic surgeon outliers for marginally non-consensus statement 46, the Delphi panel reached consensus that the alpha angle as a continuous variable, reported for anteroposterior (AP) pelvis and Dunn 45° view radiographs, should be the radiographic imaging outcome measure for research on primary cam morphology prognosis.



**Figure SF7-4** Outliers for statements 32 to 35 (OS: Orthopaedic Surgeon; PPI: Patient & Public Involvement group member; MD: Physician; PT: Physical Therapist; Rad: Radiologist; Res: Researcher)



Bipolarity analysis

Opposing groups of experts with an important and insoluble cleft of opinion, might result in non-consensus. Bipolar data distribution is therefore a possible explanation for dissent. To test for bipolarity, we investigated potential bimodal distribution (two or more answer options had the same mode frequency) and visually inspected histograms for round 2 scores of each statement. [1]

Definitions – Delphi domain 1

There were no bimodal distribution in the overall scoring of definition statements in round 2. (Figure 5)

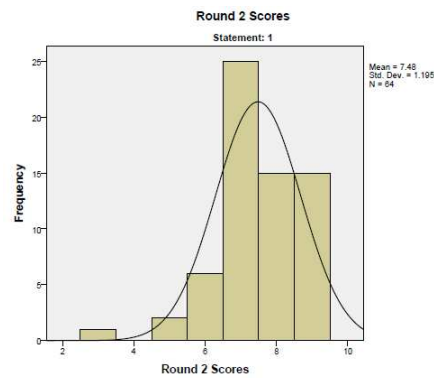


Figure 5a Statement 1

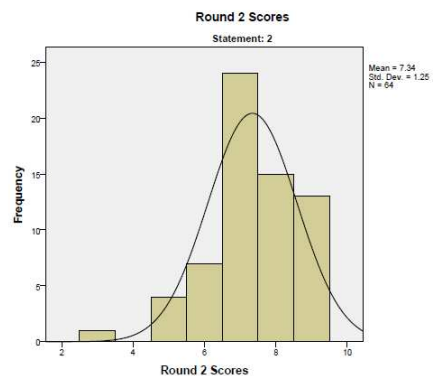


Figure 5b Statement 2

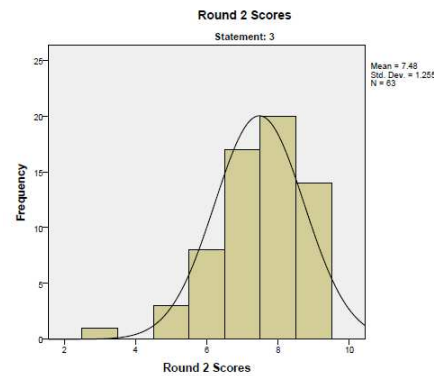


Figure 5c Statement 3

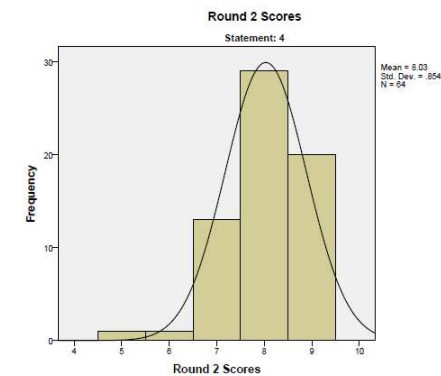
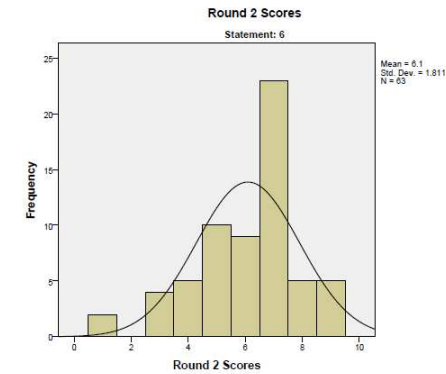
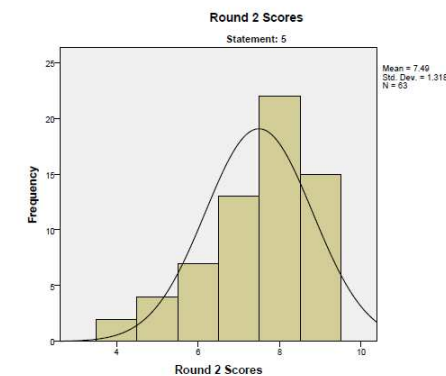
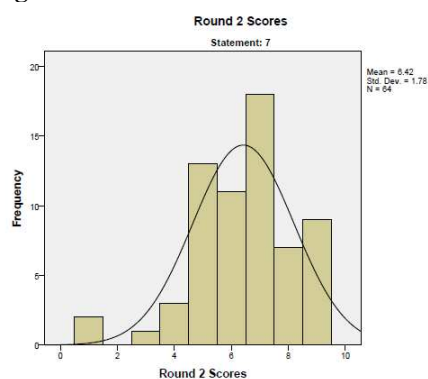
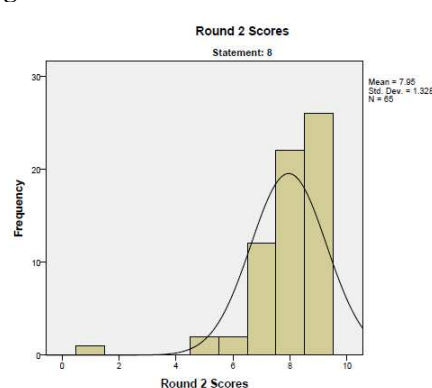
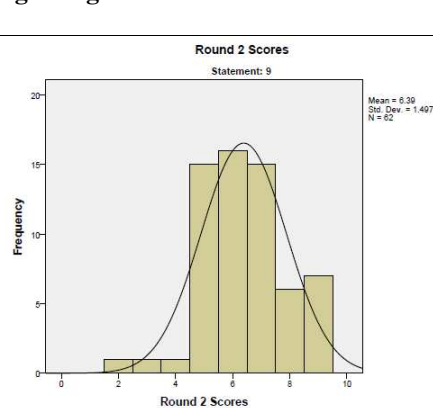
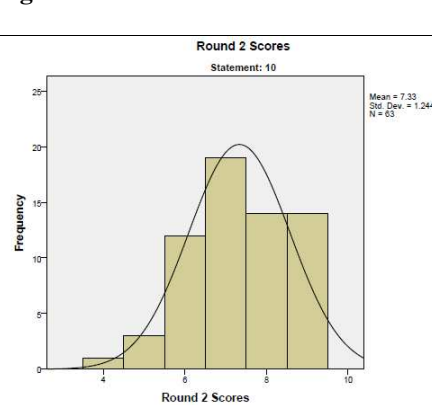
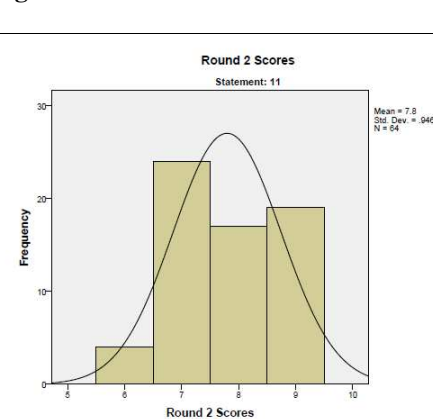
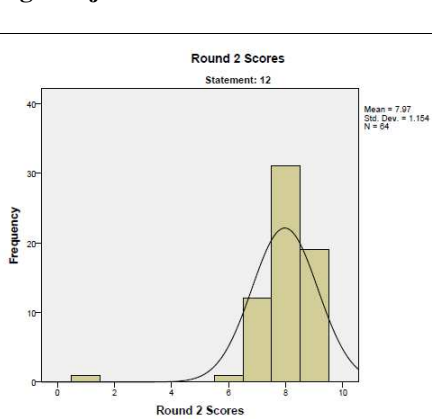
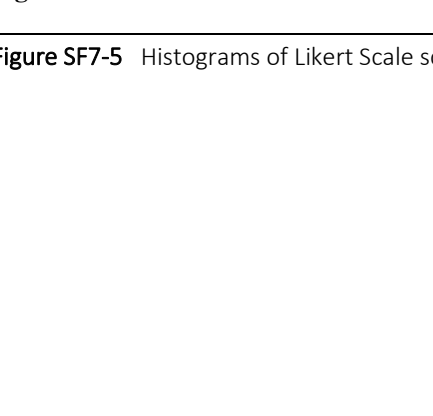
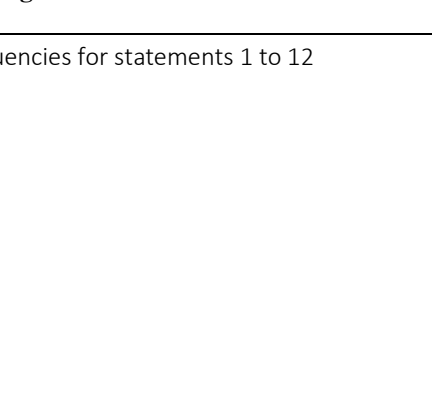


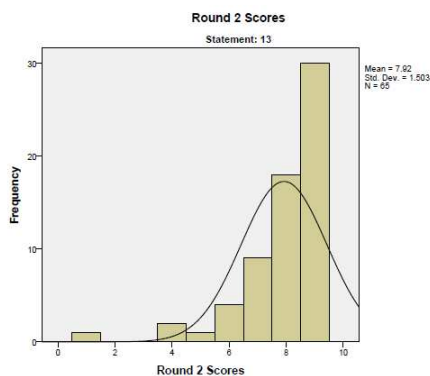
Figure 5d Statement 4



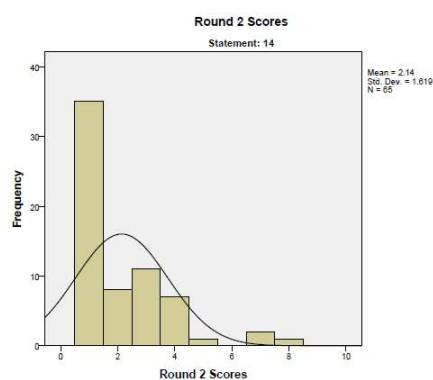
**Figure 5e** Statement 5**Figure 5f** Statement 6**Figure 5g** Statement 7**Figure 5h** Statement 8**Figure 5i** Statement 9**Figure 5j** Statement 10**Figure 5k** Statement 11**Figure 5l** Statement 12**Figure SF7-5** Histograms of Likert Scale score frequencies for statements 1 to 12

## Terminology – Delphi domain 2

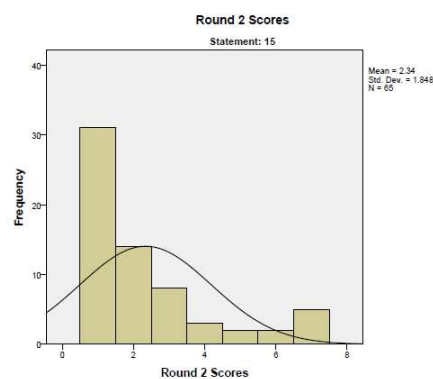
There were no bimodal distribution in the overall scoring of terminology statements in round 2. (Figure 6)



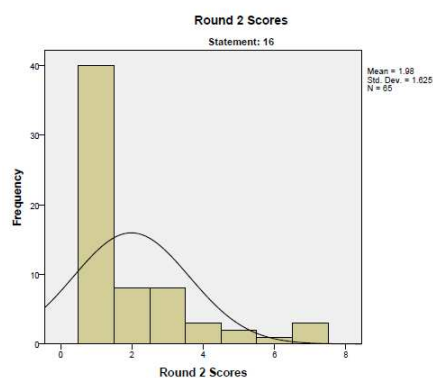
**Figure 6a** Statement 13



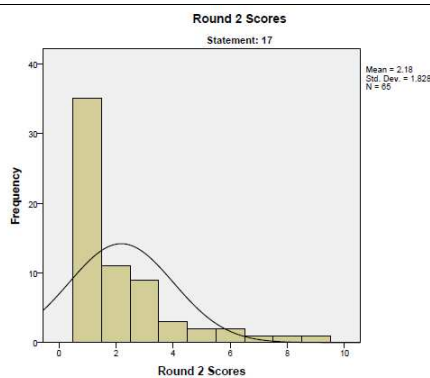
**Figure 6b** Statement 14



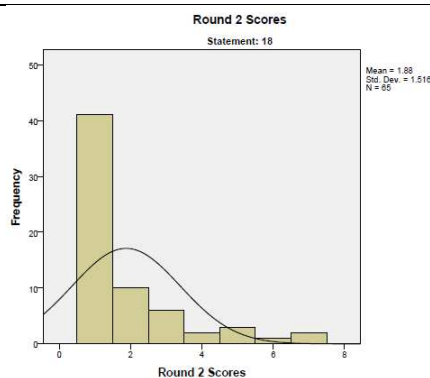
**Figure 6c** Statement 15



**Figure 6d** Statement 16



**Figure 6e** Statement 17



**Figure 6f** Statement 18

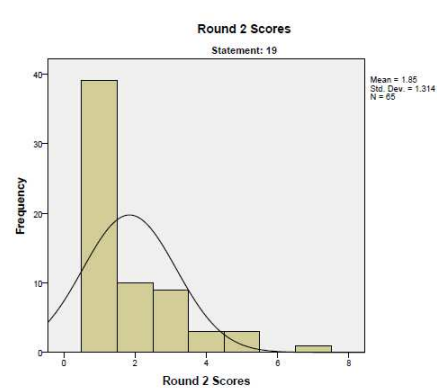


Figure 6g Statement 19

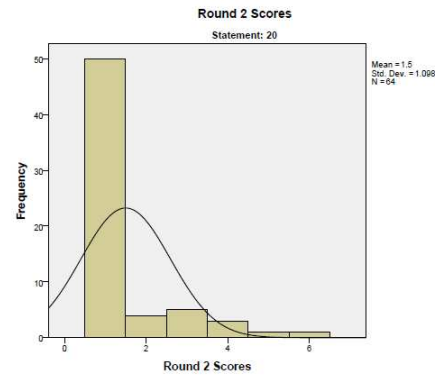


Figure 6h Statement 20

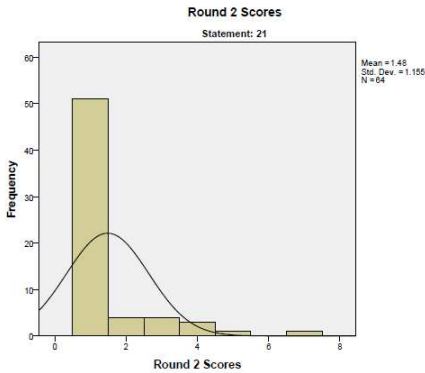


Figure 6i Statement 21

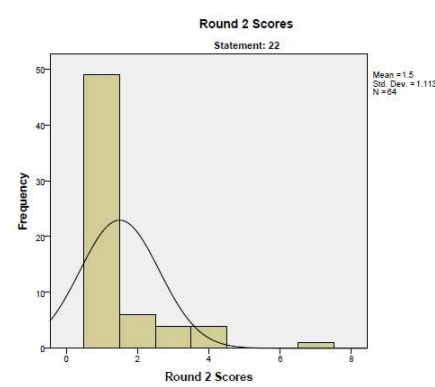


Figure 6j Statement 22

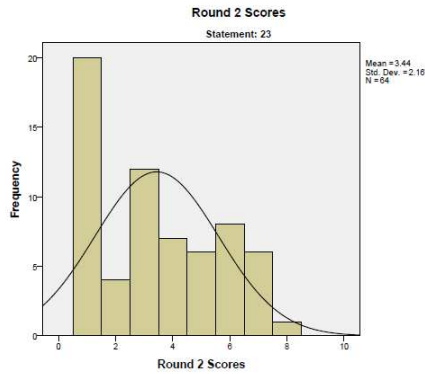


Figure 6k Statement 23

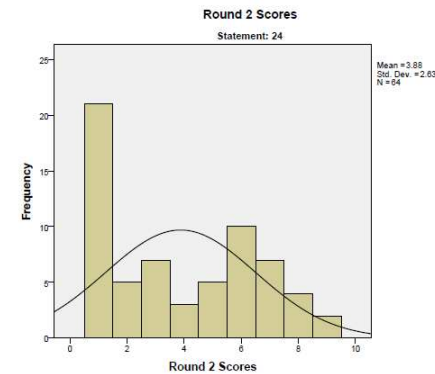


Figure 6l Statement 24

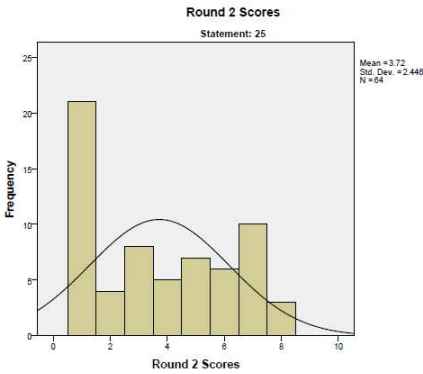


Figure 6m Statement 25

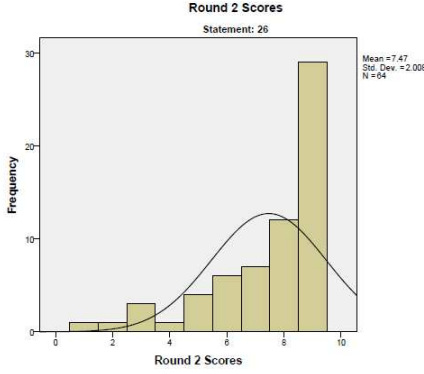


Figure 6n Statement 26

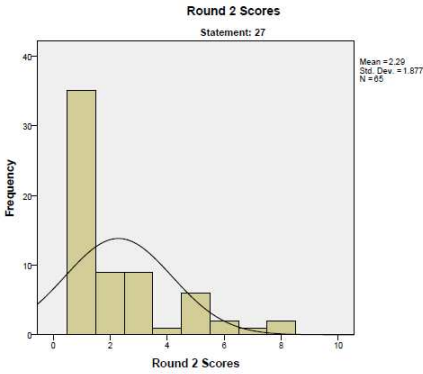


Figure 6o Statement 27

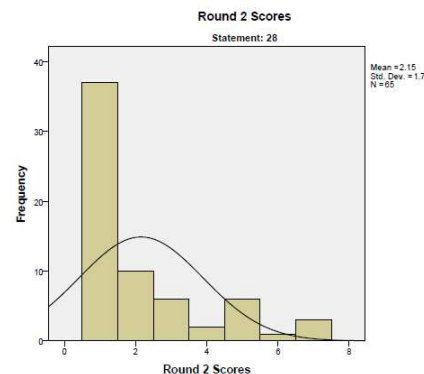


Figure 6p Statement 28

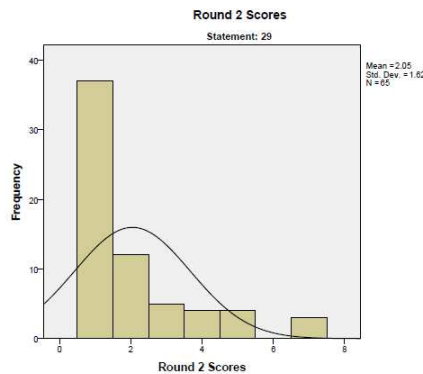


Figure 6q Statement 29

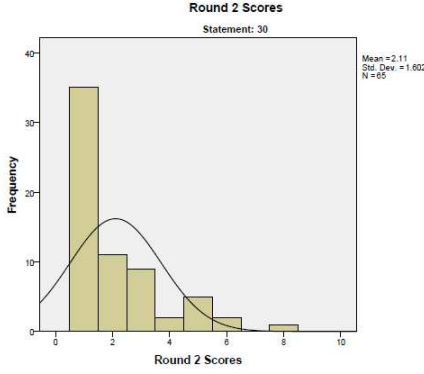


Figure 6r Statement 30

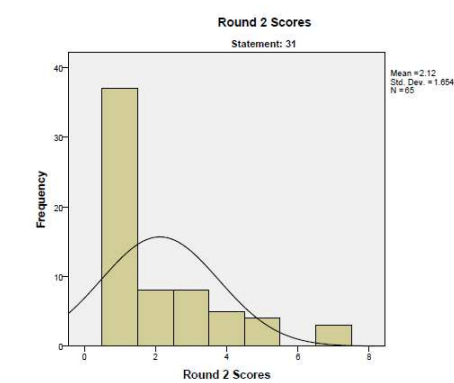


Figure 6s Statement 31

Figure SF7-6 Histograms of Likert Scale score frequencies for statements 13 to 31

Taxonomy – Delphi domain 3

There were no bimodal distribution in the overall scoring of taxonomy statements in round 2. (Figure 7)

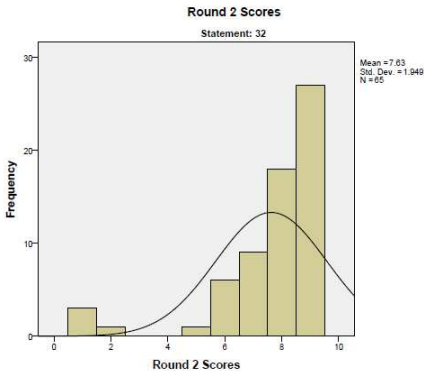


Figure 7a Statement 32

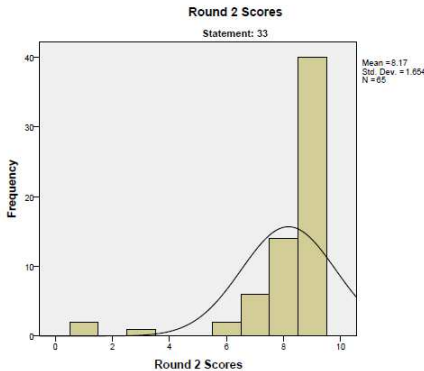


Figure 7b Statement 33

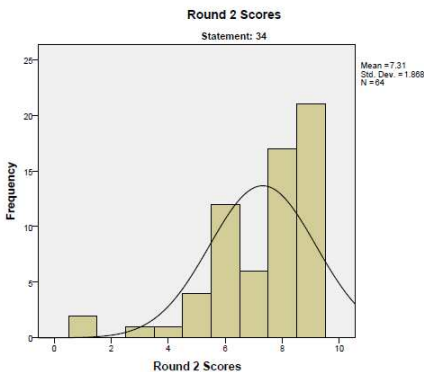


Figure 7c Statement 34

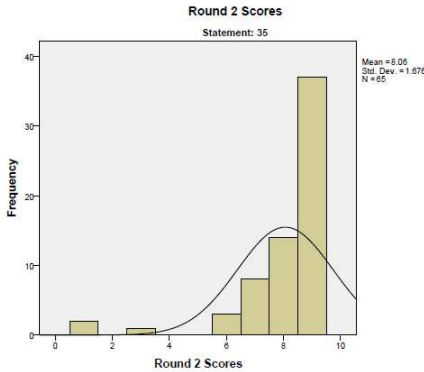
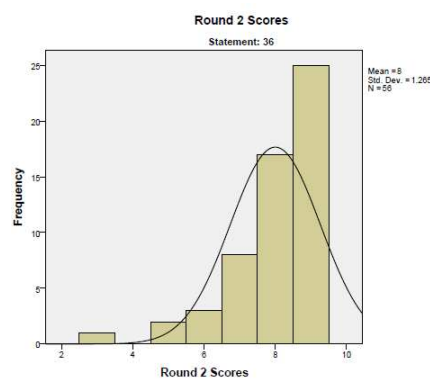


Figure 7d Statement 35

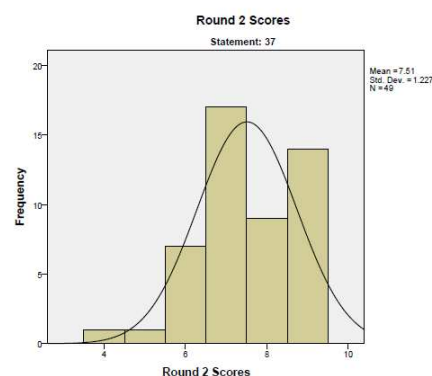
Figure SF7-7 Histograms of Likert Scale score frequencies for statements 32 to 35

## Imaging outcomes – Delphi domain 4

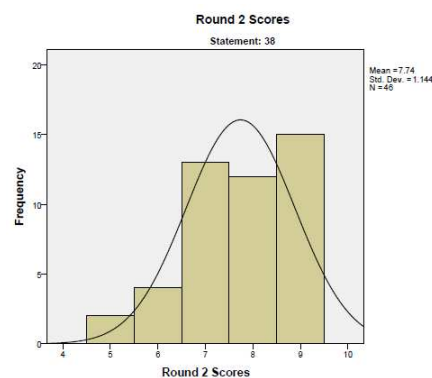
There were no bimodal distribution in the overall scoring of imaging outcomes statements in round 2. (Figure 8)



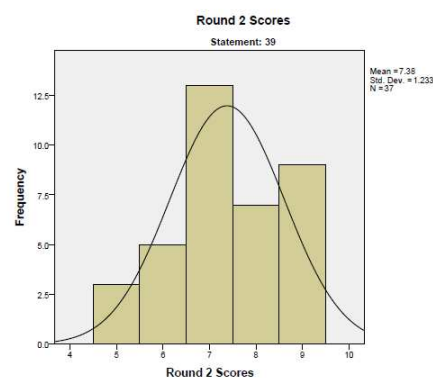
**Figure 8a** Statement 36



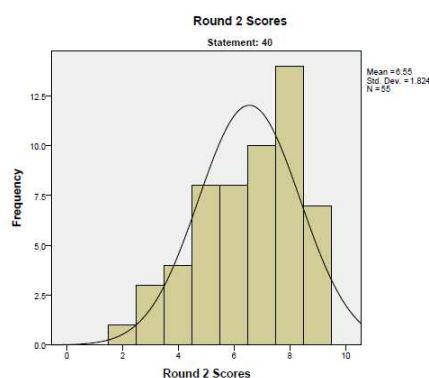
**Figure 8b** Statement 37



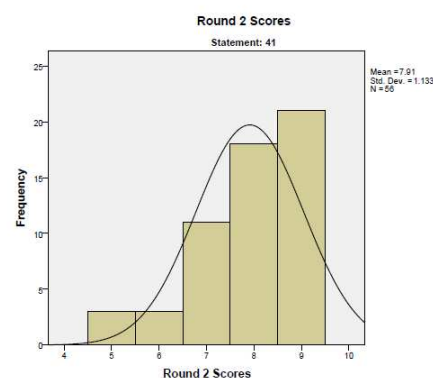
**Figure 8c** Statement 38



**Figure 8d** Statement 39



**Figure 8e** Statement 40



**Figure 8f** Statement 41



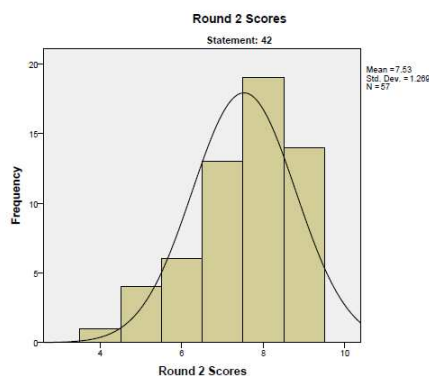


Figure 8g Statement 42

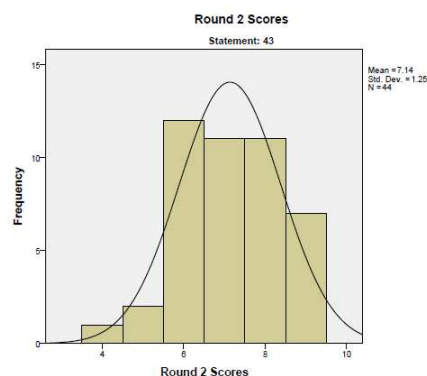


Figure 8h Statement 43

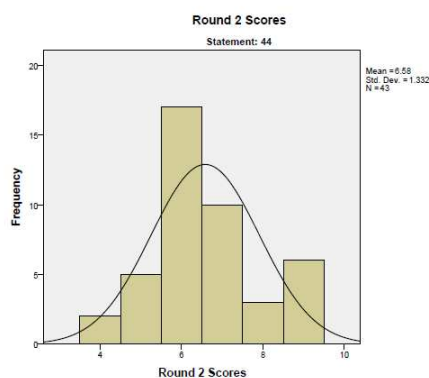


Figure 8i Statement 44

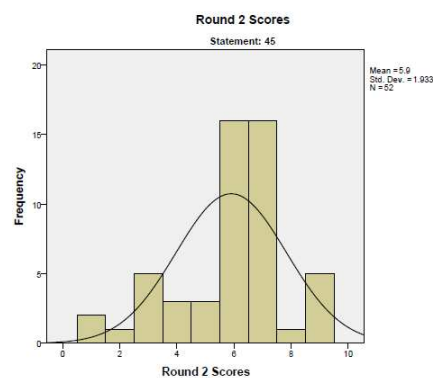


Figure 8j Statement 45

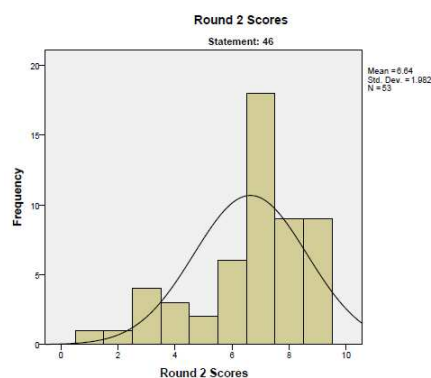


Figure 8k Statement 46

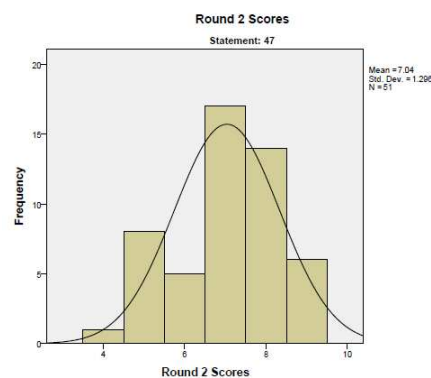


Figure 8l Statement 47

Figure SF7-8 Histograms of Likert Scale score frequencies for statements 36 to 47

Stakeholder Group analysis

Stakeholder group analysis: Stakeholder group analysis, a classical dissent analysis, is important to identify opposing views. To compare the scores from Round 2 between the six stakeholder groups, we performed non-parametric Kruskal-Wallis test (not assuming a normal distribution of the underlying data). To account for multiple post hoc comparisons, we adjusted the statistical significance threshold p-value to 0.003 according to Bonferroni method. However, agreeing with the general view that “a declaration of ‘statistical significance’ has today become meaningless”, [3] substantial stakeholder group differences (p<0.0033) prompted us to further scrutinise individual- and group opinions for the specific statement.

Definitions – Delphi domain 1

There was no statistically significant difference in how stakeholder groups scored the definition statements in round 1 and 2.

Table SF7-1 Kruskal-Wallis test to compare Orthopaedic Surgeons vs other stakeholder groups (p-values)										
Statement	Orthopaedic surgeons vs PPI		Orthopaedic surgeons vs physical therapists		Orthopaedic surgeons vs physicians		Orthopaedic surgeons vs radiologists		Orthopaedic surgeons vs researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
01_Primary cam morphology develops during skeletal maturation as a normal physiological response to load	.694	.310	.837	.857	.629	.807	.379	.155	.103	.094
02_Primary cam morphology is not caused by previous disease, injury or an acute event; it represents a normal physiological response of the maturing skeleton to load	.666	.611	.400	.108	.678	.511	.953	.296	.285	.380
03_Secondary cam morphology develops due to existing hip disease or acute trauma; including Perthes disease; slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture	.528	.128	.396	.048	.767	.085	.708	.189	.331	.508
04_Primary cam morphology develops in young and active individuals, including athletes, likely due to load (e.g., sporting activity) during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	.572	.258	.453	.746	.265	.691	.522	.219	.016	.021

05_ Primary cam morphology is common in young and active males, including athletes, likely due to sporting activity during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	.364	.134	.624	.622	.254	.513	.019	.011	.045	.024
06_ Primary cam morphology includes cam morphology of unknown origin	.072	.290	.024	.766	.170	.158	.763	.782	.112	1.000
07_ Cam morphology that develops in young and active individuals without any symptoms (e.g., hip-related pain; stiffness) or history of previous/existing hip disease, is primary cam morphology until proven otherwise	.527	.121	.212	.110	.229	.012	.471	.825	.901	.578
08_ Cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical	.131	.028	.409	.015	.652	.028	.293	.042	.741	.832
09_ Primary cam morphology often occurs in male athletes in both hips	.891	.900	.936	.807	.899	.700	.437	.398	.162	.047
10_ The most common outcome measure for cam morphology is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, computed tomogram (CT) scans or magnetic resonance (MR) imaging, reported per hip, per person or both	.719	.913	.593	.981	.882	.719	.435	.155	.167	.059
11_ Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors	.631	.329	.514	.636	.505	.830	.231	.832	.109	.163

12_A comprehensive definition for primary cam morphology would be: Primary cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical. It often occurs in male athletes in both hips. The most common outcome measure is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, CT scans or MR imaging, reported per hip, per person or both. Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors.	.221	.205	.409	.117	.481	.308	.268	.154	.671	.926
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Table SF7-2 Kruskal-Wallis test to compare Patient & Public Involvement Group (PPI) vs other stakeholder groups (p-values)										
Statement	PPI vs Orthopaedic surgeons		PPI vs physical therapists		PPI vs physicians		PPI vs radiologists		PPI vs researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
01_Primary cam morphology develops during skeletal maturation as a normal physiological response to load	.694	.310	.767	.385	.387	.288	.193	.868	.128	.925
02_Primary cam morphology is not caused by previous disease, injury or an acute event; it represents a normal physiological response of the maturing skeleton to load	.666	.611	.677	.284	.561	.898	.533	.574	.353	.215
03_Secondary cam morphology develops due to existing hip disease or acute trauma; including Perthes disease; slipped	.528	.128	.952	.680	.368	.869	.756	1.000	.165	.314

capital femoral epiphysis, healed proximal femoral fractures or acute fracture										
04_Primary cam morphology develops in young and active individuals, including athletes, likely due to load (e.g., sporting activity) during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	.572	.258	.234	.112	.615	.211	.759	.725	.098	.087
05_Primary cam morphology is common in young and active males, including athletes, likely due to sporting activity during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	.364	.134	.502	.243	.655	.161	.646	.435	.722	.494
06_Primary cam morphology includes cam morphology of unknown origin	.072	.290	.931	.328	.563	.653	.245	.134	.583	.262
07_Cam morphology that develops in young and active individuals without any symptoms (e.g., hip-related pain; stiffness) or history of previous/existing hip disease, is primary cam morphology until proven otherwise	.527	.121	.419	.918	.540	.254	.231	.122	.468	.291
08_Cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical	.131	.028	.363	.955	.175	.679	.687	.855	.037	.022
09_Primary cam morphology often occurs in male athletes in both hips	.891	.900	.877	.885	.912	.835	.738	.498	.185	.062
10_The most common outcome measure for cam morphology is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs,	.719	.913	.353	.755	.769	.389	.305	.039	.266	.016

computed tomogram (CT) scans or magnetic resonance (MR) imaging, reported per hip, per person or both										
11_ Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors	.631	.329	.836	.606	.944	.184	.431	.242	.226	.326
12_A comprehensive definition for primary cam morphology would be: Primary cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical. It often occurs in male athletes in both hips. The most common outcome measure is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, CT scans or MR imaging, reported per hip, per person or both. Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors.	.221	.205	.592	.865	.465	.689	.953	.811	.123	.167

**Table SF7-3** Kruskal-Wallis test to compare Physical Therapists vs other stakeholder groups (p-values)

Statement	Physical Therapists vs Orthopaedic surgeons		Physical therapists vs PPI		Physical Therapists vs physicians		Physical Therapists vs radiologists		Physical Therapists vs researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
01_ Primary cam morphology develops during skeletal maturation as a normal physiological response to load	.837	.857	.767	.385	.487	.982	.343	.234	.087	.152
02_ Primary cam morphology is not caused by previous disease, injury or an acute event; it represents a normal physiological response of the maturing skeleton to load	.400	.108	.677	.284	.186	.225	.550	.485	.050	.008
03_ Secondary cam morphology develops due to existing hip disease or acute trauma; including Perthes disease; slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture	.396	.048	.952	.680	.371	.663	.787	.490	.097	.213
04_ Primary cam morphology develops in young and active individuals, including athletes, likely due to load (e.g., sporting activity) during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	.453	.746	.234	.112	.055	.371	.231	.112	.006	.007
05_ Primary cam morphology is common in young and active males, including athletes, likely due to sporting activity during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	.624	.622	.502	.243	.855	.926	.101	.031	.142	.048
06_ Primary cam morphology includes cam morphology of unknown origin	.024	.766	.931	.328	.583	.192	.293	.366	.545	.800
07_ Cam morphology that develops in young and active individuals without any	.212	.110	.419	.918	.804	.324	.093	.080	.198	.280

symptoms (e.g., hip-related pain; stiffness) or history of previous/existing hip disease, is primary cam morphology until proven otherwise

08_ Cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical	.409	.015	.363	.955	.690	.647	.647	.906	.243	.021
09_Primary cam morphology often occurs in male athletes in both hips	.936	.807	.877	.885	.964	.680	.475	.404	.214	.038
10_The most common outcome measure for cam morphology is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, computed tomogram (CT) scans or magnetic resonance (MR) imaging, reported per hip, per person or both	.593	.981	.353	.755	.400	.863	.562	.120	.041	.032
11_ Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors	.514	.636	.836	.606	.928	.595	.568	.669	.386	.211
12_A comprehensive definition for primary cam morphology would be: Primary cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical. It often occurs in male athletes in both hips. The most common outcome measure is a cartilage or bone alpha angle as a dichotomised or continuous variable	.409	.117	.592	.865	.889	.525	.609	.936	.249	.095



on radiographs, CT scans or MR imaging, reported per hip, per person or both. Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors.

Table SF7-4 Kruskal-Wallis test to compare Physicians vs other stakeholder groups (p-values)

Statement	Physicians vs Orthopaedic surgeons		Physicians vs PPI		Physicians vs Physical Therapists		Physicians vs radiologists		Physicians vs researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
01_Primary cam morphology develops during skeletal maturation as a normal physiological response to load	.629	.807	.387	.288	.487	.982	.716	.186	.196	.069
02_Primary cam morphology is not caused by previous disease, injury or an acute event; it represents a normal physiological response of the maturing skeleton to load	.678	.511	.561	.898	.186	.225	.412	.574	.318	.059
03_Secondary cam morphology develops due to existing hip disease or acute trauma; including Perthes disease; slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture	.767	.085	.368	.869	.371	.663	.340	.924	.251	.216
04_Primary cam morphology develops in young and active individuals, including athletes, likely due to load (e.g., sporting activity) during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	.265	.691	.615	.211	.055	.371	.775	.181	.174	.005
05_Primary cam morphology is common in young and active males, including	.254	.513	.655	.161	.855	.926	.039	.004	.064	.015

athletes, likely due to sporting activity during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate

06_Primary cam morphology includes cam morphology of unknown origin	.170	.158	.563	.653	.583	.192	.740	.140	.869	.151
07_Cam morphology that develops in young and active individuals without any symptoms (e.g., hip-related pain; stiffness) or history of previous/existing hip disease, is primary cam morphology until proven otherwise	.229	.012	.540	.254	.804	.324	.074	.031	.175	.049
08_Cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical	.652	.028	.175	.679	.690	.647	.378	.552	.194	.019
09_Primary cam morphology often occurs in male athletes in both hips	.899	.700	.912	.835	.964	.680	.422	.311	.149	.016
10_The most common outcome measure for cam morphology is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, computed tomogram (CT) scans or magnetic resonance (MR) imaging, reported per hip, per person or both	.882	.719	.769	.389	.400	.863	.235	.079	.101	.006
11_Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors	.505	.830	.944	.184	.928	.595	.465	1.000	.174	.081
12_A comprehensive definition for primary cam morphology would be:	.481	.308	.465	.689	.889	.525	.480	.498	.254	.291

Primary cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical. It often occurs in male athletes in both hips. The most common outcome measure is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, CT scans or MR imaging, reported per hip, per person or both. Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors.

Table SF7-5 Kruskal-Wallis test to compare Radiologists vs other stakeholder groups (p-values)

	Radiologists vs Orthopaedic surgeons		Radiologists vs PPI		Radiologists vs Physical Therapists		Radiologists vs Physicians		Radiologists vs Researchers	
Statement	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
01_Primary cam morphology develops during skeletal maturation as a normal physiological response to load	.379	.155	.193	.868	.343	.234	.716	.186	.499	.763
02_Primary cam morphology is not caused by previous disease, injury or an acute event; it represents a normal physiological response of the maturing skeleton to load	.953	.296	.533	.574	.550	.485	.412	.574	.071	.009
03_Secondary cam morphology develops due to existing hip disease or acute trauma; including Perthes disease; slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture	.708	.189	.756	1.000	.787	.490	.340	.924	.101	.361

04_ Primary cam morphology develops in young and active individuals, including athletes, likely due to load (e.g., sporting activity) during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	.522	.219	.759	.725	.231	.112	.775	.181	.463	.376
05_ Primary cam morphology is common in young and active males, including athletes, likely due to sporting activity during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	.019	.011	.646	.435	.101	.031	.039	.004	.881	1.000
06_ Primary cam morphology includes cam morphology of unknown origin	.763	.782	.245	.134	.293	.366	.740	.140	.709	.690
07_ Cam morphology that develops in young and active individuals without any symptoms (e.g., hip-related pain; stiffness) or history of previous/existing hip disease, is primary cam morphology until proven otherwise	.471	.825	.231	.122	.093	.080	.074	.031	.458	.202
08_ Cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical	.293	.042	.687	.855	.647	.906	.378	.552	.065	.026
09_ Primary cam morphology often occurs in male athletes in both hips	.437	.398	.738	.498	.475	.404	.422	.311	.683	.367
10_ The most common outcome measure for cam morphology is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, computed tomogram (CT) scans or	.435	.155	.305	.039	.562	.120	.235	.079	.059	.006

magnetic resonance (MR) imaging, reported per hip, per person or both										
11_Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors	.231	.832	.431	.242	.568	.669	.465	1.000	.715	.139
12_A comprehensive definition for primary cam morphology would be: Primary cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical. It often occurs in male athletes in both hips. The most common outcome measure is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, CT scans or MR imaging, reported per hip, per person or both. Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors.	.268	.154	.953	.811	.609	.936	.480	.498	.154	.052

Table SF7-6 Kruskal-Wallis test to compare Researchers vs other stakeholder groups (p-values)										
	Researchers vs Orthopaedic surgeons		Researchers vs PPI		Researchers vs Physical Therapists		Researchers vs Physicians		Researchers vs Radiologists	
Statement	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
01_Primary cam morphology develops during skeletal maturation as a normal physiological response to load	.103	.094	.128	.925	.087	.152	.196	.069	.499	.763

02_ Primary cam morphology is not caused by previous disease, injury or an acute event; it represents a normal physiological response of the maturing skeleton to load	.285	.380	.353	.215	.050	.008	.318	.059	.071	.009
03_ Secondary cam morphology develops due to existing hip disease or acute trauma; including Perthes disease; slipped capital femoral epiphysis, healed proximal femoral fractures or acute fracture	.331	.508	.165	.314	.097	.213	.251	.216	.101	.361
04_ Primary cam morphology develops in young and active individuals, including athletes, likely due to load (e.g., sporting activity) during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	.016	.021	.098	.087	.006	.007	.174	.005	.463	.376
05_ Primary cam morphology is common in young and active males, including athletes, likely due to sporting activity during prepubertal and pubertal skeletal maturation (load during growth) and its (physiological) effect on the proximal femoral growth plate	.045	.024	.722	.494	.142	.048	.064	.015	.881	1.000
06_ Primary cam morphology includes cam morphology of unknown origin	.112	1.000	.583	.262	.545	.800	.869	.151	.709	.690
07_ Cam morphology that develops in young and active individuals without any symptoms (e.g., hip-related pain; stiffness) or history of previous/existing hip disease, is primary cam morphology until proven otherwise	.901	.578	.468	.291	.198	.280	.175	.049	.458	.202
08_ Cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of	.741	.832	.037	.022	.243	.021	.194	.019	.065	.026

the femoral head from spherical to aspherical										
09_Primary cam morphology often occurs in male athletes in both hips	.162	.047	.185	.062	.214	.038	.149	.016	.683	.367
10_The most common outcome measure for cam morphology is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, computed tomogram (CT) scans or magnetic resonance (MR) imaging, reported per hip, per person or both	.167	.059	.266	.016	.041	.032	.101	.006	.059	.006
11_Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors	.109	.163	.226	.326	.386	.211	.174	.081	.715	.139
12_A comprehensive definition for primary cam morphology would be: Primary cam morphology is a cartilage or bony prominence (bump) of varying size at any location around the femoral head-neck junction, which changes the shape of the femoral head from spherical to aspherical. It often occurs in male athletes in both hips. The most common outcome measure is a cartilage or bone alpha angle as a dichotomised or continuous variable on radiographs, CT scans or MR imaging, reported per hip, per person or both. Primary cam morphology likely develops during maturation in young adolescents (with no current or previous hip disease), possibly due to high-load sporting activity and other unconfirmed risk factors.	.671	.926	.123	.167	.249	.095	.254	.291	.154	.052

## Terminology – Delphi domain 2

The average scores for some of the terminology statements were statistically significant different for the physical therapist stakeholder group compared to the researcher stakeholder group (Statement 23, round 1,  $p<0.0033$ ; Statement 24, round 1,  $p<0.001$  and round 2,  $p<0.002$ ), and for the radiologist stakeholder group compared to the researcher stakeholder group (Statement 24, round 2,  $p<0.0033$ ).

**Table SF7-7** Kruskal-Wallis test to compare Orthopaedic Surgeons vs other stakeholder groups (p-values)

Statement	Orthopaedic surgeons vs PPI		Orthopaedic surgeons vs physical therapists		Orthopaedic surgeons vs physicians		Orthopaedic surgeons vs radiologists		Orthopaedic surgeons vs researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
13_Cam morphology is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.022	.004	.005	.001	.025	.004	.044	.014	.117	.065
14_Cam lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.969	.797	.030	.014	.287	.291	.271	.190	.925	.637
15_Cam deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.248	.350	.003	.028	.042	.119	.100	.009	.337	.967
16_Cam abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.401	.388	.110	.059	.327	.228	.064	.018	.853	.764
17_Cam-type deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.576	.512	.216	.099	.464	.195	.301	.018	.781	.832
18_Cam-type abnormality is the preferred term to use for a bone/cartilage bump at any location	.515	.369	.434	.035	.695	.205	.383	.018	.814	.698



around the femoral head-neck junction										
19_Cam-type lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.496	.399	.069	.007	.253	.119	.057	.008	.926	.437
20_Pistol grip deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.858	.507	.957	.329	.913	.321	.533	.105	.156	.957
21_Pistol grip lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.929	.741	.830	.687	.971	.568	.906	.174	.141	.863
22_Pistol grip abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.858	.536	.915	.239	.726	.341	.768	.348	.156	.641
23_Cam-type impingement is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.106	.369	.006	.022	.247	.217	.058	.033	.713	.646
24_Cam femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.416	.353	.463	.611	.610	.953	.675	.081	.019	.081
25_Cam-type femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to	.638	.665	.789	.628	.545	.658	.959	.276	.613	.890

a bony bump at any location around the femoral head-neck junction

26_Femoroacetabular impingement (FAI) Syndrome with cam morphology is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.276	.077	.250	.009	.028	.003	.063	.021	.271	.119
27_Femoroacetabular impingement (FAI) Syndrome with cam deformity is the preferred term to use for hip-related pain due	.183	.227	.018	.010	.255	.155	.174	.009	.270	.129
28_Femoroacetabular impingement (FAI) Syndrome with cam abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.386	.268	.081	.030	.704	.275	.295	.009	.889	.522
29_Femoroacetabular impingement (FAI) Syndrome with cam lesion is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.667	.512	.052	.006	.658	.159	.295	.009	.963	.445
30_Femoroacetabular impingement (FAI) Syndrome with cam-type abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.756	.913	.129	.022	.705	.312	.296	.009	.963	.639
31_Femoroacetabular impingement (FAI) Syndrome with cam-type deformity is the preferred term to use	.507	.660	.041	.006	.468	.312	.210	.009	.614	.525

for hip-related pain due to a bony bump at any location around the femoral head-neck junction

**Table SF7-8** Kruskal-Wallis test to compare Patient & Public Involvement Group (PPI) vs other stakeholder groups (p-values)

Statement	PPI vs Orthopaedic surgeons		PPI vs physical therapists		PPI vs physicians		PPI vs radiologists		PPI vs researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
13_Cam morphology is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.022	.004	.507	.673	.835	.514	1.000	.853	.342	.037
14_Cam lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.969	.797	.126	.022	.538	.347	.480	.230	.869	.539
15_Cam deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.248	.350	.161	.093	.345	.246	.418	.011	.665	.290
16_Cam abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.401	.388	.616	.472	.937	.770	.231	.087	.372	.317
17_Cam-type deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.576	.512	.449	.208	.787	.408	.561	.024	.224	.610
18_Cam-type abnormality is the preferred term to use for a bone/cartilage bump at any location	.515	.369	.837	.352	.817	.743	.738	.087	.537	.732

around the femoral head-neck junction										
19_Cam-type lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.496	.399	.416	.170	.723	.503	.205	.048	.441	.962
20_Pistol grip deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.858	.507	.829	.972	1.000	.814	.462	.258	.159	.555
21_Pistol grip lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.929	.741	.829	.972	.966	.814	.833	.258	.158	.598
22_Pistol grip abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.858	.536	.781	.739	.597	.814	.888	.750	.158	.331
23_Cam-type impingement is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.106	.369	.091	.171	.512	.706	.326	.104	.046	.459
24_Cam femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.416	.353	.029	.019	.242	.376	.206	.017	.052	.236
25_Cam-type femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to	.638	.665	.302	.243	.185	.241	.507	.178	.667	.428

a bony bump at any location around the femoral head-neck junction

26_Femoroacetabular impingement (FAI) Syndrome with cam morphology is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.276	.077	.934	.592	.133	.168	.261	.382	.626	.879
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27_Femoroacetabular impingement (FAI) Syndrome with cam deformity is the preferred term to use for hip-related pain due	.183	.227	.175	.192	.940	.762	.477	.047	.869	.674
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28_Femoroacetabular impingement (FAI) Syndrome with cam abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.386	.268	.509	.486	.623	.837	.739	.086	.542	.695
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29_Femoroacetabular impingement (FAI) Syndrome with cam lesion is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.667	.512	.125	.081	.882	.537	.480	.047	.829	.888
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30_Femoroacetabular impingement (FAI) Syndrome with cam-type abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.756	.913	.236	.040	.971	.373	.418	.012	.871	.712
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31_Femoroacetabular impingement (FAI) Syndrome with cam-type deformity is the preferred term to use	.507	.660	.186	.092	.911	.655	.442	.048	.957	1.000
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for hip-related pain due to a bony bump at any location around the femoral head-neck junction

Table SF7-9 Kruskal-Wallis test to compare Physical Therapists vs other stakeholder groups

	Physical Therapists vs Orthopaedic surgeons		Physical therapists vs PPI		Physical Therapists vs physicians		Physical Therapists vs radiologists		Physical Therapists vs researchers	
Statement	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
13_Cam morphology is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.005	.001	.507	.673	.339	.251	.450	.532	.075	.012
14_Cam lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.030	.014	.126	.022	.619	.277	.968	.884	.013	.000
15_Cam deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.003	.028	.161	.093	.770	.849	.907	.069	.045	.010
16_Cam abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.110	.059	.616	.472	.789	.737	.263	.145	.113	.070
17_Cam-type deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.216	.099	.449	.208	.789	.981	.907	.069	.027	.065
18_Cam-type abnormality is the preferred term to use for a	.434	.035	.837	.352	.666	.679	.756	.144	.265	.172

bone/cartilage bump at any location around the femoral head-neck junction										
19_Cam-type lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.069	.007	.416	.170	.673	.679	.320	.144	.028	.172
20_Pistol grip deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.957	.329	.829	.972	.899	.742	.436	.203	.069	.558
21_Pistol grip lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.830	.687	.829	.972	.899	.742	.968	.203	.074	.558
22_Pistol grip abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.915	.239	.781	.739	.728	1.000	.689	.915	.103	.143
23_Cam-type impingement is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.006	.022	.091	.171	.089	.331	.759	.389	.003	.033
24_Cam femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.463	.611	.029	.019	.489	.183	.825	.109	.000	.001
25_Cam-type femoroacetabular impingement (FAI) is the preferred	.789	.628	.302	.243	.853	.730	.913	.441	.191	.672

term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

26_Femoroacetabular impingement (FAI) Syndrome with cam morphology is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.250	.009	.934	.592	.104	.328	.124	.569	.974	.349
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26\_Femoroacetabular impingement (FAI) Syndrome with cam morphology is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

27_Femoroacetabular impingement (FAI) Syndrome with cam deformity is the preferred term to use for hip-related pain due	.018	.010	.175	.192	.180	.308	.968	.101	.138	.217
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27\_Femoroacetabular impingement (FAI) Syndrome with cam deformity is the preferred term to use for hip-related pain due

28_Femoroacetabular impingement (FAI) Syndrome with cam abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.081	.030	.509	.486	.180	.433	.968	.102	.183	.306
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28\_Femoroacetabular impingement (FAI) Syndrome with cam abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

29_Femoroacetabular impingement (FAI) Syndrome with cam lesion is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.052	.006	.125	.081	.144	.378	.901	.142	.048	.045
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29\_Femoroacetabular impingement (FAI) Syndrome with cam lesion is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

30_Femoroacetabular impingement (FAI) Syndrome with cam-type abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.129	.022	.236	.040	.261	.451	.905	.101	.232	.261
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30\_Femoroacetabular impingement (FAI) Syndrome with cam-type abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction

31_Femoroacetabular impingement (FAI) Syndrome with cam-type	.041	.006	.186	.092	.196	.282	.968	.144	.064	.054
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31\_Femoroacetabular impingement (FAI) Syndrome with cam-type



deformity is the preferred term to use  
for hip-related pain due to a bony  
bump at any location around the  
femoral head-neck junction

**Table SF7-10** Kruskal-Wallis test to compare Physicians vs other stakeholder groups (p-values)

	Physicians vs Orthopaedic surgeons		Physicians vs PPI		Physicians vs Physical Therapists		Physicians vs radiologists		Physicians vs researchers	
Statement	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
13_Cam morphology is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.025	.004	.835	.514	.339	.251	.884	.663	.413	.089
14_Cam lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.287	.291	.538	.347	.619	.277	.873	.523	.231	.045
15_Cam deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.042	.119	.345	.246	.770	.849	.873	.089	.171	.062
16_Cam abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.327	.228	.937	.770	.789	.737	.264	.140	.282	.227
17_Cam-type deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.464	.195	.787	.408	.789	.981	.709	.140	.200	.207

18_Cam-type abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.695	.205	.817	.743	.666	.679	.571	.140	.564	.455
19_Cam-type lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.253	.119	.723	.503	.673	.679	.264	.140	.158	.506
20_Pistol grip deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.913	.321	1.000	.814	.899	.742	.455	.324	.110	.428
21_Pistol grip lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.971	.568	.966	.814	.899	.742	.867	.324	.148	.496
22_Pistol grip abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.726	.341	.597	.814	.728	1.000	.522	.945	.366	.231
23_Cam-type impingement is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.247	.217	.512	.706	.089	.331	.265	.156	.213	.351
24_Cam femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.610	.953	.242	.376	.489	.183	.731	.036	.003	.023

25_Cam-type femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.545	.658	.185	.241	.853	.730	.961	.366	.275	.777
26_Femoroacetabular impingement (FAI) Syndrome with cam morphology is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.028	.003	.133	.168	.104	.328	.883	.760	.179	.098
27_Femoroacetabular impingement (FAI) Syndrome with cam deformity is the preferred term to use for hip-related pain due	.255	.155	.940	.762	.180	.308	.451	.055	1.000	.908
28_Femoroacetabular impingement (FAI) Syndrome with cam abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.704	.275	.623	.837	.180	.433	.482	.055	.862	.783
29_Femoroacetabular impingement (FAI) Syndrome with cam lesion is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.658	.159	.882	.537	.144	.378	.452	.089	.729	.409
30_Femoroacetabular impingement (FAI) Syndrome with cam-type abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.705	.312	.971	.373	.261	.451	.482	.088	.828	.658

31_Femoroacetabular impingement (FAI) Syndrome with cam-type deformity is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.468	.312	.911	.655	.196	.282	.421	.089	.729	.555
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Table SF7-11 Kruskal-Wallis test to compare Radiologists vs other stakeholder groups (p-values)										
Statement	Radiologists vs Orthopaedic surgeons		Radiologists vs PPI		Radiologists vs Physical Therapists		Radiologists vs Physicians		Radiologists vs Researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
13_Cam morphology is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.044	.014	1.000	.853	.450	.532	.884	.663	.335	.059
14_Cam lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.271	.190	.480	.230	.968	.884	.873	.523	.172	.058
15_Cam deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.100	.009	.418	.011	.907	.069	.873	.089	.236	.004
16_Cam abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.064	.018	.231	.087	.263	.145	.264	.140	.061	.024
17_Cam-type deformity is the preferred term to use for a bone/cartilage bump at any location	.301	.018	.561	.024	.907	.069	.709	.140	.157	.010

around the femoral head-neck  
junction

18_Cam-type abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.383	.018	.738	.087	.756	.144	.571	.140	.321	.052
19_Cam-type lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.057	.008	.205	.048	.320	.144	.264	.140	.022	.052
20_Pistol grip deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.533	.105	.462	.258	.436	.203	.455	.324	.451	.173
21_Pistol grip lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.906	.174	.833	.258	.968	.203	.867	.324	.345	.171
22_Pistol grip abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.768	.348	.888	.750	.689	.915	.522	.945	.103	.255
23_Cam-type impingement is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.058	.033	.326	.104	.759	.389	.265	.156	.029	.038
24_Cam femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to	.675	.081	.206	.017	.825	.109	.731	.036	.011	.003

a bony bump at any location around the femoral head-neck junction										
25_Cam-type femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.959	.276	.507	.178	.913	.441	.961	.366	.385	.162
26_Femoroacetabular impingement (FAI) Syndrome with cam morphology is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.063	.021	.261	.382	.124	.569	.883	.760	.067	.173
27_Femoroacetabular impingement (FAI) Syndrome with cam deformity is the preferred term to use for hip-related pain due	.174	.009	.477	.047	.968	.101	.451	.055	.298	.023
28_Femoroacetabular impingement (FAI) Syndrome with cam abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.295	.009	.739	.086	.968	.102	.482	.055	.365	.052
29_Femoroacetabular impingement (FAI) Syndrome with cam lesion is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.295	.009	.480	.047	.901	.142	.452	.089	.208	.024
30_Femoroacetabular impingement (FAI) Syndrome with cam-type abnormality is the preferred term to use for hip-related pain due to a bony	.296	.009	.418	.012	.905	.101	.482	.088	.327	.052

bump at any location around the femoral head-neck junction										
31_Femoroacetabular impingement (FAI) Syndrome with cam-type deformity is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.210	.009	.442	.048	.968	.144	.421	.089	.208	.023

**Table SF7-12** Kruskal-Wallis test to compare Researchers vs other stakeholder groups (p-values)

Statement	Researchers vs Orthopaedic surgeons		Researchers vs PPI		Researchers vs Physical Therapists		Researchers vs Physicians		Researchers vs Radiologists	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
13_Cam morphology is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.117	.065	.342	.037	.075	.012	.413	.089	.335	.059
14_Cam lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.925	.637	.869	.539	.013	.000	.231	.045	.172	.058
15_Cam deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.337	.967	.665	.290	.045	.010	.171	.062	.236	.004
16_Cam abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.853	.764	.372	.317	.113	.070	.282	.227	.061	.024
17_Cam-type deformity is the preferred term to use for a	.781	.832	.224	.610	.027	.065	.200	.207	.157	.010

bone/cartilage bump at any location around the femoral head-neck junction										
18_Cam-type abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.814	.698	.537	.732	.265	.172	.564	.455	.321	.052
19_Cam-type lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.926	.437	.441	.962	.028	.172	.158	.506	.022	.052
20_Pistol grip deformity is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.156	.957	.159	.555	.069	.558	.110	.428	.451	.173
21_Pistol grip lesion is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.141	.863	.158	.598	.074	.558	.148	.496	.345	.171
22_Pistol grip abnormality is the preferred term to use for a bone/cartilage bump at any location around the femoral head-neck junction	.156	.641	.158	.331	.103	.143	.366	.231	.103	.255
23_Cam-type impingement is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.713	.646	.046	.459	.003	.033	.213	.351	.029	.038
24_Cam femoroacetabular impingement (FAI) is the preferred	.019	.081	.052	.236	.000	.001	.003	.023	.011	.003



term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction										
25_Cam-type femoroacetabular impingement (FAI) is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.613	.890	.667	.428	.191	.672	.275	.777	.385	.162
26_Femoroacetabular impingement (FAI) Syndrome with cam morphology is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.271	.119	.626	.879	.974	.349	.179	.098	.067	.173
27_Femoroacetabular impingement (FAI) Syndrome with cam deformity is the preferred term to use for hip-related pain due	.270	.129	.869	.674	.138	.217	1.000	.908	.298	.023
28_Femoroacetabular impingement (FAI) Syndrome with cam abnormality is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.889	.522	.542	.695	.183	.306	.862	.783	.365	.052
29_Femoroacetabular impingement (FAI) Syndrome with cam lesion is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.963	.445	.829	.888	.048	.045	.729	.409	.208	.024
30_Femoroacetabular impingement (FAI) Syndrome with cam-type abnormality is the preferred term to	.963	.639	.871	.712	.232	.261	.828	.658	.327	.052

use for hip-related pain due to a bony bump at any location around the femoral head-neck junction										
31_Femoroacetabular impingement (FAI) Syndrome with cam-type deformity is the preferred term to use for hip-related pain due to a bony bump at any location around the femoral head-neck junction	.614	.525	.957	1.000	.064	.054	.729	.555	.208	.023

### Taxonomy - Delphi domain 3

Stakeholder group analysis indicated the average scores for taxonomy statement 32 were statistically significant different for PPI group compared to the: (1) Orthopaedic Surgeon stakeholder group (round 2,  $p < 0.005$ ); (2) Physical Therapist stakeholder group (round 1 and 2,  $p < 0.002$ ); (3) Radiologist stakeholder group (round 1,  $p < 0.003$ ; round 2,  $p < 0.002$ ), and (4) Researcher stakeholder group (round 2,  $p < 0.002$ ). The difference in how the PPI stakeholder group compared to the Physical Therapist stakeholder group scored statement 34, was statistically significant (round 1,  $p < 0.005$ ; round 2,  $p < 0.003$ ).

**Table SF7-13** Kruskal-Wallis test to compare Orthopaedic Surgeons vs other stakeholder groups (p-values)

Statement	Orthopaedic surgeons vs PPI		Orthopaedic surgeons vs physical therapists		Orthopaedic surgeons vs physicians		Orthopaedic surgeons vs radiologists		Orthopaedic surgeons vs researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
32_We should distinguish between primary and secondary cam morphology in clinical practice	.011	.003	.847	.772	.526	.293	.918	.469	.564	.326
33_We should distinguish between primary and secondary cam morphology in research	.637	.144	.509	.590	.346	1.000	.516	1.000	.325	.473
34_We should distinguish between primary and secondary cam morphology in patients with femoroacetabular impingement syndrome	.030	.007	.829	.631	.324	.222	.325	.227	.721	.854
35_We should distinguish between primary and secondary cam morphology in research participants with femoroacetabular impingement syndrome	.178	.032	.810	.250	.922	.351	.955	.336	.450	.698

**Table SF7-14** Kruskal Wallis test to compare Patient & Public Involvement Group (PPI) vs other stakeholder groups

Statement	PPI vs Orthopaedic surgeons		PPI vs physical therapists		PPI vs physicians		PPI vs radiologists		PPI vs researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
32_We should distinguish between primary and secondary cam morphology in clinical practice	.011	.003	.001	.001	.005	.003	.002	.001	.006	.001

33_We should distinguish between primary and secondary cam morphology in research	.637	.144	.279	.255	.156	.084	.290	.133	.219	.017
34_We should distinguish between primary and secondary cam morphology in patients with femoroacetabular impingement syndrome	.030	.007	.003	.002	.031	.012	.122	.017	.024	.004
35_We should distinguish between primary and secondary cam morphology in research participants with femoroacetabular impingement syndrome	.178	.032	.114	.161	.089	.086	.150	.133	.025	.016

Table SF7-15 Kruskal-Wallis test to compare Physical Therapists vs other stakeholder groups (p-values)

	Physical Therapists vs Orthopaedic surgeons		Physical therapists vs PPI		Physical Therapists vs physicians		Physical Therapists vs radiologists		Physical Therapists vs researchers	
Statement	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
32_We should distinguish between primary and secondary cam morphology in clinical practice	.847	.772	.001	.001	.175	.299	.695	.446	.123	.275
33_We should distinguish between primary and secondary cam morphology in research	.509	.590	.279	.255	.714	.451	.938	.619	.899	.150
34_We should distinguish between primary and secondary cam morphology in patients with femoroacetabular impingement syndrome	.829	.631	.003	.002	.070	.242	.070	.084	.286	.948
35_We should distinguish between primary and secondary cam morphology in research participants with femoroacetabular impingement syndrome	.810	.250	.114	.161	.981	.722	.907	.904	.553	.279

**Table SF7-16** Kruskal-Wallis test to compare Physicians vs other stakeholder groups (p-values)

Statement	Physicians vs Orthopaedic surgeons		Physicians vs PPI		Physicians vs Physical Therapists		Physicians vs radiologists		Physicians vs researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
32_We should distinguish between primary and secondary cam morphology in clinical practice	.526	.293	.005	.003	.175	.299	.496	.852	.646	.908
33_We should distinguish between primary and secondary cam morphology in research	.346	1.000	.156	.084	.714	.451	.814	.665	.668	.815
34_We should distinguish between primary and secondary cam morphology in patients with femoroacetabular impingement syndrome	.324	.222	.031	.012	.070	.242	.580	.510	.651	.349
35_We should distinguish between primary and secondary cam morphology in research participants with femoroacetabular impingement syndrome	.922	.351	.089	.086	.981	.722	.774	.772	.729	.508

**Table SF7-17** Kruskal-Wallis test to compare Radiologists vs other stakeholder groups (p-values)

Statement	Radiologists vs Orthopaedic surgeons		Radiologists vs PPI		Radiologists vs Physical Therapists		Radiologists vs Physicians		Radiologists vs Researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
32_We should distinguish between primary and secondary cam morphology in clinical practice	.918	.469	.002	.001	.695	.446	.496	.852	.343	.705
33_We should distinguish between primary and secondary cam morphology in research	.516	1.000	.290	.133	.938	.619	.814	.665	.942	.352
34_We should distinguish between primary and secondary cam morphology in patients with femoroacetabular impingement syndrome	.325	.227	.122	.017	.070	.084	.580	.510	.315	.102

35_We should distinguish between primary and secondary cam morphology in research participants with femoroacetabular impingement syndrome	.955	.336	.150	.133	.907	.904	.774	.772	.524	.270
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Table SF7-18 Kruskal-Wallis test to compare Researchers vs other stakeholder groups (p-values)										
Statement	Researchers vs Orthopaedic surgeons		Researchers vs PPI		Researchers vs Physical Therapists		Researchers vs Physicians		Researchers vs Radiologists	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
32_We should distinguish between primary and secondary cam morphology in clinical practice	.564	.326	.006	.001	.123	.275	.646	.908	.343	.705
33_We should distinguish between primary and secondary cam morphology in research	.325	.473	.219	.017	.899	.150	.668	.815	.942	.352
34_We should distinguish between primary and secondary cam morphology in patients with femoroacetabular impingement syndrome	.721	.854	.024	.004	.286	.948	.651	.349	.315	.102
35_We should distinguish between primary and secondary cam morphology in research participants with femoroacetabular impingement syndrome	.450	.698	.025	.016	.553	.279	.729	.508	.524	.270

### Imaging outcomes – Delphi domain 4

There was no statistically significant difference in how stakeholder groups scored the imaging outcomes statements in round 1 and 2 (stakeholder group analysis).

**Table SF7-19** Kruskal-Wallis test to compare Orthopaedic Surgeons vs other stakeholder groups (p-values)

Statement	Orthopaedic surgeons vs PPI		Orthopaedic surgeons vs physical therapists		Orthopaedic surgeons vs physicians		Orthopaedic surgeons vs radiologists		Orthopaedic surgeons vs researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
36_ The main imaging modality for research on how primary cam morphology develops should be magnetic resonance (MR) with radial imaging (1.5T or 3 T)	.958	.553	1.000	.502	.787	.305	.713	1.000	.490	.883
37_ The minimum acceptable number of radial sequence magnetic resonance (MR) imaging slices for research on how primary cam morphology develops should be 12 slices (30° intervals, in all 12 clock face positions from 12 o'clock to 11 o'clock positions)	.755	.390	.656	.426	.749	.174	.437	.177	.381	.208
38_ Referring to precisely quantifying the asphericity of the femoral head-neck junction on radial sequence magnetic resonance (MR) imaging: use either radial sequences along the axis of the femoral neck (providing higher resolution images) or radial reconstructions from 3-dimensional acquisitions	.705	.944	.133	.251	.441	.272	.034	.026	.117	.142
39_ The magnetic resonance (MR) imaging protocol for research on how primary cam morphology develops	.388	.536	.256	.232	.546	.394	.082	.171	.731	.849

should include: (i) unilateral small field-of-view (FOV) sequences and radial images of a randomly selected or both hips, as well as (ii) femoral torsion assessment (fast axial sequences of the distal knee—femoral condyles—and proximal femoral neck), and (iii) a fluid sensitive sequence covering the whole pelvis (in axial or coronal planes, to screen for soft-tissue and bone marrow edema beyond the hip)										
40_The magnetic resonance (MR) imaging for prospective research on how primary cam morphology develops should be repeated every 18 to 24 months	.222	.270	.228	.382	.172	.215	.719	.620	.434	.780
41_In primary cam morphology epidemiological research (e.g.; when regression is being used in aetiology or prognosis research), continuous imaging outcome measures (variables), like the alpha angle, should be kept continuous	.759	.639	.170	.098	.971	.912	.809	.900	.248	.146
42_The cam morphology magnetic resonance (MR) imaging outcome measure for research on how primary cam morphology develops (aetiology), should be the alpha angle for bone and cartilage as a continuous variable, reported for all the o'clock locations around the femoral head-neck junction, regardless of the	.909	.960	1.000	.773	.679	.865	.956	1.000	.543	.920



symptomatic state of the research  
participant

43_ For research on how primary cam morphology develops it is important to quantify the epiphyseal morphology magnetic resonance (MR) imaging outcome measure using epiphyseal extension	.950	.803	.464	.424	.672	.900	.251	.490	.797	.342
44_ For research on how primary cam morphology develops the epiphyseal morphology magnetic resonance (MR) imaging outcome measure should also be quantified using epiphyseal tilt	.613	.559	.801	.538	.317	.843	.219	.173	.304	.208
45_ The main imaging modality for longitudinal primary cam morphology prognosis research should be anteroposterior (AP) pelvis and Dunn 45° view radiographs repeated at least every 5 years	.104	.086	.314	.268	.189	.129	.150	.150	.202	.202
46_ The radiographic imaging outcome measure for research on primary cam morphology prognosis should be the alpha angle as a continuous variable reported for anteroposterior (AP) pelvis and Dunn 45° view radiographs.	.130	.076	.170	.053	.588	.474	.093	.102	.216	.173
47_ In addition to reporting alpha angles as continuous in studies on aetiology or prognosis, the following quantitative and qualitative imaging outcome measures, to categorise cam morphology, can be useful in research or clinical practice: (i) Alpha angle $\geq 60^\circ$ (preferred) (ii) Head-neck offset <	.236	.332	.439	.816	.681	.723	.118	.248	.150	.102

8mm AND head-neck offset ratio  $\leq$  0.15 usually at the anterior (3 o'clock) location around the femoral head-neck junction (in addition to (i));  
Osseous or cartilage convexity of the femoral head neck junction at any location (in addition to (i) and (ii))

Table SF7-20 Kruskal-Wallis test to compare Patient & Public Involvement Group (PPI) vs other stakeholder groups										
Statement	PPI vs Orthopaedic surgeons		PPI vs physical therapists		PPI vs physicians		PPI vs radiologists		PPI vs researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
36_The main imaging modality for research on how primary cam morphology develops should be magnetic resonance (MR) with radial imaging (1.5T or 3 T)	.958	.553	.733	.625	.557	.503	.652	.447	.489	.916
37_The minimum acceptable number of radial sequence magnetic resonance (MR) imaging slices for research on how primary cam morphology develops should be 12 slices (30° intervals, in all 12 clock face positions from 12 o'clock to 11 o'clock positions)	.755	.390	1.000	.820	.940	.588	.456	.407	.439	.502
38_Referring to precisely quantifying the asphericity of the femoral head-neck junction on radial sequence magnetic resonance (MR) imaging: use either radial sequences along the axis of the femoral neck (providing higher resolution images) or radial	.705	.944	.443	.256	.714	.318	.081	.020	.139	.105

reconstructions from 3-dimensional acquisitions

39_ The magnetic resonance (MR) imaging protocol for research on how primary cam morphology develops should include: (i) unilateral small field-of-view (FOV) sequences and radial images of a randomly selected or both hips, as well as (ii) femoral torsion assessment (fast axial sequences of the distal knee—femoral condyles—and proximal femoral neck), and (iii) a fluid sensitive sequence covering the whole pelvis (in axial or coronal planes, to screen for soft-tissue and bone marrow edema beyond the hip)	.388	.536	.725	.614	.508	.877	.433	.443	.637	.539
40_ The magnetic resonance (MR) imaging for prospective research on how primary cam morphology develops should be repeated every 18 to 24 months	.222	.270	.905	.311	.848	.794	.371	.351	.801	.545
41_ In primary cam morphology epidemiological research (e.g.; when regression is being used in aetiology or prognosis research), continuous imaging outcome measures (variables), like the alpha angle, should be kept continuous	.759	.639	.285	.196	.772	.379	.675	.622	.332	.207
42_ The cam morphology magnetic resonance (MR) imaging outcome measure for research on how primary cam morphology develops (aetiology),	.909	.960	.966	.605	.366	.792	1.000	1.000	.405	.842

should be the alpha angle for bone and cartilage as a continuous variable, reported for all the o'clock locations around the femoral head-neck junction, regardless of the symptomatic state of the research participant

43_ For research on how primary cam morphology develops it is important to quantify the epiphyseal morphology magnetic resonance (MR) imaging outcome measure using epiphyseal extension	.950	.803	.453	.779	.608	.357	.135	.153	.879	.582
44_ For research on how primary cam morphology develops the epiphyseal morphology magnetic resonance (MR) imaging outcome measure should also be quantified using epiphyseal tilt	.613	.559	.493	.235	.595	.742	.209	.329	.279	.373
45_ The main imaging modality for longitudinal primary cam morphology prognosis research should be anteroposterior (AP) pelvis and Dunn 45° view radiographs repeated at least every 5 years	.104	.086	.479	.313	.586	.533	1.000	.868	.667	.562
46_ The radiographic imaging outcome measure for research on primary cam morphology prognosis should be the alpha angle as a continuous variable reported for anteroposterior (AP) pelvis and Dunn 45° view radiographs.	.130	.076	.776	.831	.455	.179	.707	.869	.636	.566
47_ In addition to reporting alpha angles as continuous in studies on aetiology or prognosis, the following	.236	.332	.120	.114	.330	.170	.735	.788	.041	.031

quantitative and qualitative imaging outcome measures, to categorise cam morphology, can be useful in research or clinical practice: (i) Alpha angle  $\geq 60^\circ$  (preferred) (ii) Head-neck offset  $< 8\text{mm}$  AND head-neck offset ratio  $\leq 0.15$  usually at the anterior (3 o'clock) location around the femoral head-neck junction (in addition to (i)); Osseous or cartilage convexity of the femoral head neck junction at any location (in addition to (i) and (ii))

Table SF7-21 Kruskal-Wallis test to compare Physical Therapists vs other stakeholder groups (-values)										
	Physical Therapists vs Orthopaedic surgeons		Physical therapists vs PPI		Physical Therapists vs physicians		Physical Therapists vs radiologists		Physical Therapists vs researchers	
Statement	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
36_The main imaging modality for research on how primary cam morphology develops should be magnetic resonance (MR) with radial imaging (1.5T or 3 T)	1.000	.502	.733	.625	.841	.630	.522	.319	.348	.672
37_The minimum acceptable number of radial sequence magnetic resonance (MR) imaging slices for research on how primary cam morphology develops should be 12 slices (30° intervals, in all 12 clock face positions from 12 o'clock to 11 o'clock positions)	.656	.426	1.000	.820	.940	.365	.784	.258	.360	.364

38_ Referring to precisely quantifying the asphericity of the femoral head-neck junction on radial sequence magnetic resonance (MR) imaging: use either radial sequences along the axis of the femoral neck (providing higher resolution images) or radial reconstructions from 3-dimensional acquisitions	.133	.251	.443	.256	.711	.975	.289	.210	.423	.419
39_ The magnetic resonance (MR) imaging protocol for research on how primary cam morphology develops should include: (i) unilateral small field-of-view (FOV) sequences and radial images of a randomly selected or both hips, as well as (ii) femoral torsion assessment (fast axial sequences of the distal knee—femoral condyles—and proximal femoral neck), and (iii) a fluid sensitive sequence covering the whole pelvis (in axial or coronal planes, to screen for soft-tissue and bone marrow edema beyond the hip)	.256	.232	.725	.614	.513	.671	.446	.609	.486	.292
40_ The magnetic resonance (MR) imaging for prospective research on how primary cam morphology develops should be repeated every 18 to 24 months	.228	.382	.905	.311	.862	.372	.543	.823	.752	.968
41_ In primary cam morphology epidemiological research (e.g.; when regression is being used in aetiology or prognosis research), continuous	.170	.098	.285	.196	.187	.117	.177	.181	.908	.936

imaging outcome measures (variables), like the alpha angle, should be kept continuous										
42_The cam morphology magnetic resonance (MR) imaging outcome measure for research on how primary cam morphology develops (aetiology), should be the alpha angle for bone and cartilage as a continuous variable, reported for all the o'clock locations around the femoral head-neck junction, regardless of the symptomatic state of the research participant	1.000	.773	.966	.605	.471	.448	.966	.682	.490	.854
43_For research on how primary cam morphology develops it is important to quantify the epiphyseal morphology magnetic resonance (MR) imaging outcome measure using epiphyseal extension	.464	.424	.453	.779	.160	.386	.061	.130	.795	.713
44_ For research on how primary cam morphology develops the epiphyseal morphology magnetic resonance (MR) imaging outcome measure should also be quantified using epiphyseal tilt	.801	.538	.493	.235	.220	.301	.116	.051	.221	.066
45_The main imaging modality for longitudinal primary cam morphology prognosis research should be anteroposterior (AP) pelvis and Dunn 45° view radiographs repeated at least every 5 years	.314	.268	.479	.313	.760	.715	.420	.395	.801	.734
46_The radiographic imaging outcome measure for research on primary cam	.170	.053	.776	.831	.540	.185	.525	.735	.833	.701

morphology prognosis should be the alpha angle as a continuous variable reported for anteroposterior (AP) pelvis and Dunn 45° view radiographs.

47_In addition to reporting alpha angles as continuous in studies on aetiology or prognosis, the following quantitative and qualitative imaging outcome measures, to categorise cam morphology, can be useful in research or clinical practice: (i) Alpha angle ≥ 60° (preferred) (ii) Head-neck offset < 8mm AND head-neck offset ratio ≤ 0.15 usually at the anterior (3 o'clock) location around the femoral head-neck junction (in addition to (i)); Osseous or cartilage convexity of the femoral head neck junction at any location (in addition to (i) and (ii))	.439	.816	.120	.114	.197	.370	.054	.074	.584	.066
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Table SF7-22 Kruskal-Wallis test to compare Physicians vs other stakeholder groups (p-values)

Statement	Physicians vs Orthopaedic surgeons		Physicians vs PPI		Physicians vs Physical Therapists		Physicians vs radiologists		Physicians vs researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
36_The main imaging modality for research on how primary cam morphology develops should be magnetic resonance (MR) with radial imaging (1.5T or 3 T)	.787	.305	.557	.503	.841	.630	.391	.266	.290	.515
37_The minimum acceptable number of radial sequence magnetic	.749	.174	.940	.588	.940	.365	.642	.726	.386	.817



resonance (MR) imaging slices for research on how primary cam morphology develops should be 12 slices (30° intervals, in all 12 clock face positions from 12 o'clock to 11 o'clock positions)										
38_ Referring to precisely quantifying the asphericity of the femoral head-neck junction on radial sequence magnetic resonance (MR) imaging: use either radial sequences along the axis of the femoral neck (providing higher resolution images) or radial reconstructions from 3-dimensional acquisitions	.441	.272	.714	.318	.711	.975	.129	.335	.213	.530
39_ The magnetic resonance (MR) imaging protocol for research on how primary cam morphology develops should include: (i) unilateral small field-of-view (FOV) sequences and radial images of a randomly selected or both hips, as well as (ii) femoral torsion assessment (fast axial sequences of the distal knee—femoral condyles—and proximal femoral neck), and (iii) a fluid sensitive sequence covering the whole pelvis (in axial or coronal planes, to screen for soft-tissue and bone marrow edema beyond the hip)	.546	.394	.508	.877	.513	.671	.186	.484	.896	.451
40_ The magnetic resonance (MR) imaging for prospective research on how primary cam morphology	.172	.215	.848	.794	.862	.372	.424	.554	.634	.443

develops should be repeated every 18 to 24 months

41_In primary cam morphology epidemiological research (e.g.; when regression is being used in aetiology or prognosis research), continuous imaging outcome measures (variables), like the alpha angle, should be kept continuous	.971	.912	.772	.379	.187	.117	.923	.589	.248	.117
42_The cam morphology magnetic resonance (MR) imaging outcome measure for research on how primary cam morphology develops (aetiology), should be the alpha angle for bone and cartilage as a continuous variable, reported for all the o'clock locations around the femoral head-neck junction, regardless of the symptomatic state of the research participant	.679	.865	.366	.792	.471	.448	.619	.885	.307	.692
43_For research on how primary cam morphology develops it is important to quantify the epiphyseal morphology magnetic resonance (MR) imaging outcome measure using epiphyseal extension	.672	.900	.608	.357	.160	.386	.179	.302	.655	.369
44_ For research on how primary cam morphology develops the epiphyseal morphology magnetic resonance (MR) imaging outcome measure should also be quantified using epiphyseal tilt	.317	.843	.595	.742	.220	.301	.432	.099	.529	.144
45_The main imaging modality for longitudinal primary cam morphology	.189	.129	.586	.533	.760	.715	.809	.737	.892	.850

prognosis research should be anteroposterior (AP) pelvis and Dunn 45° view radiographs repeated at least every 5 years										
46_The radiographic imaging outcome measure for research on primary cam morphology prognosis should be the alpha angle as a continuous variable reported for anteroposterior (AP) pelvis and Dunn 45° view radiographs.	.588	.474	.455	.179	.540	.185	.501	.414	.632	.414
47_In addition to reporting alpha angles as continuous in studies on aetiology or prognosis, the following quantitative and qualitative imaging outcome measures, to categorise cam morphology, can be useful in research or clinical practice: (i) Alpha angle ≥ 60° (preferred) (ii) Head-neck offset < 8mm AND head-neck offset ratio ≤ 0.15 usually at the anterior (3 o'clock) location around the femoral head-neck junction (in addition to (i)); Osseous or cartilage convexity of the femoral head neck junction at any location (in addition to (i) and (ii))	.681	.723	.330	.170	.197	.370	.153	.211	.054	.019

Table SF7-23 Kruskal-Wallis test to compare Radiologists vs other stakeholder groups (p-values)										
Statement	Radiologists vs Orthopaedic surgeons		Radiologists vs PPI		Radiologists vs Physical Therapists		Radiologists vs Physicians		Radiologists vs Researchers	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2

36_The main imaging modality for research on how primary cam morphology develops should be magnetic resonance (MR) with radial imaging (1.5T or 3 T)	.713	1.000	.652	.447	.522	.319	.391	.266	.733	.724
37_The minimum acceptable number of radial sequence magnetic resonance (MR) imaging slices for research on how primary cam morphology develops should be 12 slices (30° intervals, in all 12 clock face positions from 12 o'clock to 11 o'clock positions)	.437	.177	.456	.407	.784	.258	.642	.726	.892	.892
38_Referring to precisely quantifying the asphericity of the femoral head-neck junction on radial sequence magnetic resonance (MR) imaging: use either radial sequences along the axis of the femoral neck (providing higher resolution images) or radial reconstructions from 3-dimensional acquisitions	.034	.026	.081	.020	.289	.210	.129	.335	.855	1.000
39_The magnetic resonance (MR) imaging protocol for research on how primary cam morphology develops should include: (i) unilateral small field-of-view (FOV) sequences and radial images of a randomly selected or both hips, as well as (ii) femoral torsion assessment (fast axial sequences of the distal knee—femoral condyles—and proximal femoral neck), and (iii) a fluid sensitive	.082	.171	.433	.443	.446	.609	.186	.484	.219	.219

sequence covering the whole pelvis (in axial or coronal planes, to screen for soft-tissue and bone marrow edema beyond the hip)										
40_The magnetic resonance (MR) imaging for prospective research on how primary cam morphology develops should be repeated every 18 to 24 months	.719	.620	.371	.351	.543	.823	.424	.554	.659	.926
41_In primary cam morphology epidemiological research (e.g.; when regression is being used in aetiology or prognosis research), continuous imaging outcome measures (variables), like the alpha angle, should be kept continuous	.809	.900	.675	.622	.177	.181	.923	.589	.208	.170
42_The cam morphology magnetic resonance (MR) imaging outcome measure for research on how primary cam morphology develops (aetiology), should be the alpha angle for bone and cartilage as a continuous variable, reported for all the o'clock locations around the femoral head-neck junction, regardless of the symptomatic state of the research participant	.956	1.000	1.000	1.000	.966	.682	.619	.885	.604	.882
43_For research on how primary cam morphology develops it is important to quantify the epiphyseal morphology magnetic resonance (MR) imaging outcome measure using epiphyseal extension	.251	.490	.135	.153	.061	.130	.179	.302	.208	.167

44_ For research on how primary cam morphology develops the epiphyseal morphology magnetic resonance (MR) imaging outcome measure should also be quantified using epiphyseal tilt	.219	.173	.209	.329	.116	.051	.432	.099	.586	.899
45_ The main imaging modality for longitudinal primary cam morphology prognosis research should be anteroposterior (AP) pelvis and Dunn 45° view radiographs repeated at least every 5 years	.150	.150	1.000	.868	.420	.395	.809	.737	.711	.711
46_ The radiographic imaging outcome measure for research on primary cam morphology prognosis should be the alpha angle as a continuous variable reported for anteroposterior (AP) pelvis and Dunn 45° view radiographs.	.093	.102	.707	.869	.525	.735	.501	.414	.415	.572
47_ In addition to reporting alpha angles as continuous in studies on aetiology or prognosis, the following quantitative and qualitative imaging outcome measures, to categorise cam morphology, can be useful in research or clinical practice: (i) Alpha angle $\geq 60^\circ$ (preferred) (ii) Head-neck offset $< 8\text{mm}$ AND head-neck offset ratio $\leq 0.15$ usually at the anterior (3 o'clock) location around the femoral head-neck junction (in addition to (i)); Osseous or cartilage convexity of the femoral head neck junction at any location (in addition to (i) and (ii))	.118	.248	.735	.788	.054	.074	.153	.211	.007	.009

**Table SF7-24** Kruskal-Wallis test to compare Researchers vs other stakeholder groups (p-values)

Statement	Researchers vs Orthopaedic surgeons		Researchers vs PPI		Researchers vs Physical Therapists		Researchers vs Physicians		Researchers vs Radiologists	
	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2	Round 1	Round 2
36_The main imaging modality for research on how primary cam morphology develops should be magnetic resonance (MR) with radial imaging (1.5T or 3 T)	.490	.883	.489	.916	.348	.672	.290	.515	.733	.724
37_The minimum acceptable number of radial sequence magnetic resonance (MR) imaging slices for research on how primary cam morphology develops should be 12 slices (30° intervals, in all 12 clock face positions from 12 o'clock to 11 o'clock positions)	.381	.208	.439	.502	.360	.364	.386	.817	.892	.892
38_Referring to precisely quantifying the asphericity of the femoral head-neck junction on radial sequence magnetic resonance (MR) imaging: use either radial sequences along the axis of the femoral neck (providing higher resolution images) or radial reconstructions from 3-dimensional acquisitions	.117	.142	.139	.105	.423	.419	.213	.530	.855	1.000
39_The magnetic resonance (MR) imaging protocol for research on how primary cam morphology develops should include: (i) unilateral small field-of-view (FOV) sequences and radial images of a randomly selected	.731	.849	.637	.539	.486	.292	.896	.451	.219	.219

or both hips, as well as (ii) femoral torsion assessment (fast axial sequences of the distal knee—femoral condyles—and proximal femoral neck), and (iii) a fluid sensitive sequence covering the whole pelvis (in axial or coronal planes, to screen for soft-tissue and bone marrow edema beyond the hip)										
40_The magnetic resonance (MR) imaging for prospective research on how primary cam morphology develops should be repeated every 18 to 24 months	.434	.780	.801	.545	.752	.968	.634	.443	.659	.926
41_In primary cam morphology epidemiological research (e.g.; when regression is being used in aetiology or prognosis research), continuous imaging outcome measures (variables), like the alpha angle, should be kept continuous	.248	.146	.332	.207	.908	.936	.248	.117	.208	.170
42_The cam morphology magnetic resonance (MR) imaging outcome measure for research on how primary cam morphology develops (aetiology), should be the alpha angle for bone and cartilage as a continuous variable, reported for all the o'clock locations around the femoral head-neck junction, regardless of the symptomatic state of the research participant	.543	.920	.405	.842	.490	.854	.307	.692	.604	.882



43_ For research on how primary cam morphology develops it is important to quantify the epiphyseal morphology magnetic resonance (MR) imaging outcome measure using epiphyseal extension	.797	.342	.879	.582	.795	.713	.655	.369	.208	.167
44_ For research on how primary cam morphology develops the epiphyseal morphology magnetic resonance (MR) imaging outcome measure should also be quantified using epiphyseal tilt	.304	.208	.279	.373	.221	.066	.529	.144	.586	.899
45_ The main imaging modality for longitudinal primary cam morphology prognosis research should be anteroposterior (AP) pelvis and Dunn 45° view radiographs repeated at least every 5 years	.202	.202	.667	.562	.801	.734	.892	.850	.711	.711
46_ The radiographic imaging outcome measure for research on primary cam morphology prognosis should be the alpha angle as a continuous variable reported for anteroposterior (AP) pelvis and Dunn 45° view radiographs.	.216	.173	.636	.566	.833	.701	.632	.414	.415	.572
47_ In addition to reporting alpha angles as continuous in studies on aetiology or prognosis, the following quantitative and qualitative imaging outcome measures, to categorise cam morphology, can be useful in research or clinical practice: (i) Alpha angle $\geq 60^\circ$ (preferred) (ii) Head-neck offset $< 8\text{mm}$ AND head-neck offset ratio $\leq 0.15$ usually at the anterior (3 o'clock)	.150	.102	.041	.031	.584	.066	.054	.019	.007	.009

location around the femoral head-neck junction (in addition to (i));  
Osseous or cartilage convexity of the femoral head neck junction at any location (in addition to (i) and (ii))

## References

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## SUPPLEMENTARY FILE 8

## Interacting Group Process – Delphi exercise domain 1 to 4. Mixed stakeholder group online Zoom meeting: 22 September 2021

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## Agenda



### Young Athlete's Hip Research (YAHiR) Collaboration

**Towards an international agreement on primary cam morphology research to increase value and reduce waste**

**#OxfordHip2021**

#### Overall Objectives

The purpose of this consensus is to:

1. ascertain level of agreement between experts on taxonomy, terminology, and definitions for primary cam morphology (including imaging outcome measures for research on primary cam morphology)
2. work towards agreement on a set of research priorities on conditions affecting the young person's hip (focussing on primary cam morphology and its consequences in athletes)

VERSION: September 2021 (2)

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#### WEBINAR 10 - WEBINAR REGISTRATION LINK:

[https://medsci.zoom.us/webinar/register/WN\\_m2UedGjiRUuVb5oPJtagRw](https://medsci.zoom.us/webinar/register/WN_m2UedGjiRUuVb5oPJtagRw)

#### 22 September consensus discussion - Zoom meeting link:

<https://medsci.zoom.us/j/92697337840?pwd=WEEdMY2pOUkdEZG54M1h3VXhkWDk2UT09>

#### WEBINAR 11 – WEBINAR 11 REGISTRATION LINK:

[https://medsci.zoom.us/webinar/register/WN\\_mdKVnM7rReaQg-M1QziSrA](https://medsci.zoom.us/webinar/register/WN_mdKVnM7rReaQg-M1QziSrA)

#### 23 September consensus discussion - Zoom meeting link:

<https://medsci.zoom.us/j/97928325865?pwd=S2RNV3N6RHIDa3ZLQkZ5VU45ZDIJQT09>

Objectives – To:	Type of consensus meeting	Date
1. ascertain level of agreement between experts on taxonomy, terminology, and definitions for primary cam morphology (including imaging outcome measures for research on primary cam morphology)	Virtual consensus meeting (Zoom)	22 September 2021 12-4pm BST
2. work towards agreement on a set of research priorities on conditions affecting the young person's hip (focussing on primary cam morphology and its consequences in athletes)	Virtual consensus meeting (Zoom)	23 September 2021 12-4.30pm BST

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Wednesday 22 September 2021 - Online (Zoom)		
<b>Webinar 10: Sharing results of the YAHIR Collaboration's Delphi exercise on primary cam morphology terminology, definitions, and imaging outcome measures</b>		
<b>WEBINAR REGISTRATION LINK:</b> <a href="https://medsci.zoom.us/webinar/register/WN_m2UedGjjRUuVb5oPJtagRw">https://medsci.zoom.us/webinar/register/WN_m2UedGjjRUuVb5oPJtagRw</a>		
<b>Faculty: Clare Ardern, Paul Dijkstra, Eugene McNally, Siôn Glyn-Jones, Joanne Kemp</b>		
<b>Objectives</b> Following this session participants will be able to: <ol style="list-style-type: none"> <li>1. Apply a standard taxonomy, terminology, and definition for primary cam morphology and femoroacetabular syndrome</li> <li>2. Discuss the consensus on imaging outcomes for studies on how primary cam morphology develops</li> <li>3. Consider the benefits to stakeholders of applying consistent terminology and definitions for primary cam morphology</li> </ol>		
12.00	Introduction - Delphi study on primary cam morphology	Paul Dijkstra, Clare Ardern and Joanne Kemp
12.10	Consensus definition for primary cam morphology – results of the Delphi Study	Paul Dijkstra
12.25	Consensus taxonomy and terminology for primary cam morphology and femoroacetabular impingement syndrome	Clare Ardern
12.40	Consensus on imaging outcomes for studies on how primary cam morphology develops	Eugene McNally
13.00	Panel discussion	All with Siôn Glyn-Jones
13.30 Tea break (end of Webinar 10)		
Online mixed stakeholder group discussion and feedback		
<b>Zoom meeting link:</b> <a href="https://medsci.zoom.us/j/92697337840?pwd=WEEdMY2pOUkdEZG54M1h3VXhkWDk2UT09">https://medsci.zoom.us/j/92697337840?pwd=WEEdMY2pOUkdEZG54M1h3VXhkWDk2UT09</a>		
14.00	<b>Consensus group refining discussion: 4-6 groups of 6-8 individuals representing each of the 6 Delphi Study stakeholder groups)</b>  <i>Discussion: Delphi exercise domain 1-4 results and areas of tension and dissent</i>	Chairs: Paul Dijkstra, Clare Ardern and Karim Khan Stakeholder group leads: Group 1: Andrea Mosler & Amy Price Group 2: Joanne Kemp & Siôn Glyn-Jones Group 3: Karim Khan & Dawn Richards Group 4: Sean McAuliffe & Eugene McNally Group 5: Paul Blazey & Rich Willy Group 6: Andreas Serner & Mike Clarke
15.00	Feedback: 5 min per group Summary, closing remarks and next steps	Paul Dijkstra, Clare Ardern and Karim Khan



## Discussion topics

# Primary Cam Morphology (PCM)

## Definition

- Despite strong consensus on the importance of **PCM as a concept**, some panelists are not convinced
- PCM is more common in **asymptomatic males**. Yes, but we **need more research in female cohorts**
- PCM often **occurs in both hips** (unlike secondary cam morphology)
- PCM also includes cam morphology of unknown origin (cause). Consider role of **genetics**
- PCM likely develops during skeletal maturation in young adolescents (with no current or previous hip disease), as a **normal physiological response due to high-load sporting activity** and other unconfirmed risk factors

## Terminology

- Let's validate the patient. It's a **morphology** (not: "lesion", "deformity", "abnormality")
- Is **'bump'** patient/athlete friendly language? What about 'prominence'?
- Let's validate the patient. It's **FAI Syndrome** (not: 'symptomatic FAI', 'cam-type', 'FAI cam FAI')

## Taxonomy

- Is it difficult to distinguish between PCM and secondary cam morphology in **patients** with femoroacetabular impingement syndrome?

## Imaging Outcomes

- What is the ideal time interval for **serial imaging** (MR imaging) in **studies** on PCM **aetiology**? Early adolescent cohorts (9 to 16y)
- MR imaging vs radiographs (AP and lateral) for **long-term prospective studies** on PCM (and FAI syndrome) prognosis (likely decades)

## Results

### Definitions – Delphi domain 1

#### **Box 1** Interacting Group Process: mixed stakeholder group Definition domain discussion topics and results

**Topic 1 – Primary cam morphology as a concept:** Despite strong consensus on the importance of primary cam morphology as a concept, some panellists are not convinced

The Delphi panel, and mixed stakeholder groups, agreed on the importance of primary cam morphology as a concept. This taxonomy, differentiating between primary and secondary cam morphology, offers a number of advantages that offset its drawbacks—*‘their origins are important to distinguish’*, and *‘it has utility in research, prognosis, and treatment’*. In research the taxonomy is *‘important for classification’*, while the prognosis is often worse for secondary cam morphology. Treatment maybe distinctly different as the majority of individuals with primary cam morphology will never present with any symptoms. The panel contended more work is needed to authentically engage a small group that is not yet convinced that *primary* cam morphology is an important concept.

**Topic 2 – Prevalence of primary cam morphology in males vs females:** Primary cam morphology is more common in asymptomatic males. Yes, but we need more research in female cohorts.

Although there is agreement, albeit *‘based on the (limited) available literature’*, that primary cam morphology is more common in males and mostly asymptomatic, it is important to note that female athletes also develop this morphology and that *‘longer term consequences of PCM seem to affect women as much as men.’* More inclusive research is needed involving minoritised female cohorts.

**Topic 3 – Primary cam morphology often occurs in both hips:** Primary cam morphology often occurs in both hips (unlike secondary cam morphology)

Although there is agreement that primary cam morphology, unlike secondary cam morphology, often occurs bilaterally, and this distinction *‘is the defining element for PCM vs SCM, and important for patients’*, this is not always the case. Some patients might have unilateral primary cam morphology while others might present with a combination of primary- and secondary cam morphology.

**Topic 4 – Primary cam morphology’s unknown origin and the role of genetics:** Primary cam morphology also includes cam morphology of unknown origin (cause). Consider role of genetics

The mixed stakeholder groups agreed that primary cam morphology also include the group where no clear aetiology *‘at an individual level’* exists. It is likely that a *‘complex relationship’* between primary cam morphology and *‘a genetic susceptibility’* exists. Genetics as risk factor, and *‘the*

*interplay between genetic risk and load relationship*’ should therefore be considered and researched.

**Topic 5 – Primary cam morphology develops as a normal physiological response to load:**

Primary cam morphology likely develops during skeletal maturation in young adolescents (with no current or previous hip disease), as a normal physiological response due to high-load sporting activity and other unconfirmed risk factors

Despite strong consensus that primary cam morphology develops during skeletal maturation “as a normal physiological response to load” (Statement 1) further qualified as “high-load sporting activity” (Statement 11), some panellists, during the online discussions, felt “normal” is *‘potentially problematic’*. However, the high prevalence of primary cam morphology in largely asymptomatic professional athletes—*‘several studies showed >80% prevalence’*—begs the question: *‘when does it [physiological response] become abnormal? ...when it’s very painful?’* Furthermore, high-load sporting activity for one athlete might be normal-load sporting activity for another; load type (*‘torsion, varus/valgus’*) and *skeletal maturation* status are both important variables to consider in clinical practice and research.

## Terminology – Delphi domain 2

**Box 2** Interacting Group Process: Mixed stakeholder group terminology domain discussion topics and results

**Topic 1 – Morphology:** Let's validate the patient. It's a morphology (not: 'lesion', 'deformity', 'abnormality')

The Delphi panel achieved strong consensus on using the term “morphology” and to abandon “lesion”, “deformity” and “abnormality”: *'large foreign words set the tone for fear, unknown, not in control, especially about [the] outcome.'* Although the majority agreed, some felt that *'language didn't necessarily change things for patients'*, and that the consequences (*'the pathology part'*) of primary cam morphology *'is the bigger problem and needs to be part of the file, but the patient doesn't necessarily need to know about this [wording]'*. Others thought that *'morphology should be avoided in patient consultations as it's unfriendly, not well understood and likely medical "jargon"'*. A further problem is that “morphology” doesn't always translate well into other languages.

**Topic 2 – “Bump” or “prominence”:** Is 'bump' patient/athlete friendly language? What about 'prominence'?

Although “bump” is easy for patients to understand and visualise (*'I use "bump" to make it easy for patients'*), some felt primary cam morphology is *'likely more complex than "bump"'*. *Morphology and syndrome sound more scientific. Bump totally not'*. Another group warned about the possible *'nociceptive response in patients'* caused by associating the term “bump” with *'bumping bones'*, or of *'things hitting'*. *'Therefore we may need to take care with using this term [bump] too.'* One mixed stakeholder group concluded that the *'language we use in patient-facing consultations should be tailored to the person'* and mentioned alternatives like *'bumpy-shape'* and *'egg-shape'*. There was agreement to use *'less threatening'* language supported by visual aids *'images/figures'*. While it might be appropriate to *'tailor terms to three different target audiences: researchers, clinicians and patients and public'*, stakeholder groups suggested that Patient and Public Involvement group should inform further research on this.

**Topic 3 – FAI syndrome:** Let's validate the patient. It's FAI syndrome (not: 'symptomatic FAI', 'cam-type FAI' or 'cam FAI').

Validating the Warwick Agreement, the Delphi panel achieved strong consensus on using the *'much preferred scientifically'* term, “Femoroacetabular Impingement (FAI) Syndrome” for FAI in patients with symptoms (pain/stiffness etc). However, some felt that “syndrome” sounds *'too serious'*. Arguing that *'words matter'* panellists discussed the importance to *'tailor language to the individual'* and distinguish between a *'research discussion vs talking with patients'*. Commenting on the 2016 Warwick Agreement, a member of that panel mentioned *'we considered whether 'syndrome' might apply a negative label to patients, but the expert patient member of the panel did not feel this would be the case, but could be good to bounce this off more patients too.'* We therefore need *'further patient-orientated research to assess whether it [syndrome] has negative consequences and whether femoroacetabular impingement (FAI) used in isolation may be a better term when communicating with patients'*.

## Taxonomy – Delphi domain 3

**Box 3** Interacting Group Process: Mixed stakeholder group taxonomy domain discussion topics and results**Topic 1 – Distinguishing between primary- and secondary cam morphology in patients with FAI syndrome (Statement 34):** Is it difficult to distinguish between primary cam morphology and secondary cam morphology in patients with femoroacetabular impingement syndrome?

The general agreement was that it is important (and not necessarily difficult) to distinguish between primary and secondary cam morphology in clinical practice and in research: *‘Where we can, we should make the differential diagnosis as it affects the prognosis and therefore the management of the problem’*. A librarian panellist emphasised the benefit of *‘consistent terminology’* when reviewing the literature: *‘using primary vs secondary allowed searching the literature more clear’*.

Although most panellists felt that *‘history is key’* to distinguish between primary and secondary cam morphology, others felt that *‘obtaining a detailed history and discussion with patient is more important than a label of primary and secondary’*.

It can be clinically challenging when a combination of primary and secondary cam morphology exists in the same patient as *‘there are some cases where primary cam morphology exists prior to a secondary injury (e.g. SCE), and these cases can be a little more difficult to diagnose but are less commonly observed’*.

A small number of panellists felt that *‘the inclusion of “primary” in the term in the Delphi [statements] influenced responses to the specific questions in the Delphi rounds’*. Some were not convinced that “secondary cam morphology” exists: *‘There is no secondary CAM, it is another diagnosis. Secondary CAM is in a different position than primary cam and looks different (on radiology and in arthroscopy) and should not be considered CAM’*.

One panellist commented that *‘primary and secondary is a causal statement’* and that *‘the terms are not necessary, but they are not a problem either’*. Another was concerned that a disease taxonomy is used for an asymptomatic morphology: *‘The differentiation of primary and secondary CAM morphology is not related to current symptoms or disease, but because it is taken from disease taxonomy, it may sound like a disease, thus using the terms primary or secondary CAM morphology might make a CAM finding in an asymptomatic person seem to be a more serious negative issue.’*

## Imaging outcomes – Delphi domain 4

**Box 4** Interacting Group Process: Mixed stakeholder group imaging outcomes domain discussion topics and results**Topic 1 – Time interval for serial imaging in studies on primary cam morphology**

**aetiology:** What is the ideal time interval for serial imaging (MR imaging) in studies on primary cam morphology aetiology? Early adolescent cohorts (9 to 16y)

While commenting on the *'obvious ethical consideration for the amount or frequency of imaging'*, a radiologist in one of the mixed stakeholder groups felt *'the more the better in terms of insight'*, and also raised the possible benefit of radial vs block imaging – *'block images may allow you to evaluate the images later through the use of novel techniques such as AI [artificial intelligence]'*.

While one group felt that yearly MR imaging is appropriate when investigating how primary cam morphology develops in boys (from 11 to 16 years) and girls (from 9 to 14 years), another commented that *'the time interval should be much shorter if it is to be truly 'ideal' (e.g. every 3 months). This would capture periods of considerably faster growth or considerable changes in load'*, while *'more frequent imaging will help in periods of rapid growth but it is also important to have frequent serial imaging even in periods without rapid growth to assess the influence of growth spurts.'* However, one panellist questioned the value of serial imaging as, for example, *'positions [of primary cam morphology] might vary making it impossible to use them to track changes over time'*. One group felt that the use of serial radiographs to investigate primary cam morphology aetiology constitutes research waste: *'if you can't do serial MRIs at short enough intervals, don't waste time and money, don't do the study.'*

**Topic 2 – MR imaging vs radiographs for long-term prognosis studies:** MR imaging vs radiographs (AP and lateral) for long-term prospective studies on primary cam morphology (and FAI syndrome) prognosis (likely decades)

MR imaging trumps radiography and *'should be the investigation of choice where at all possible in adolescent populations'*. The quality of imaging is better, it better quantifies cartilaginous progression in adolescents where *'the use of alpha-angle on x-ray can be misleading and therefore inaccurate'*, and, as it does not pose a (cumulative) radiation risk *'ethics committees are more likely to accept MRI based studies'*. One panellist commented on the possible benefit of low dose 2D/3D imaging that *'may reduce the barrier to x-rays with improved 3D modelling and reduced radiation'*.

However there are at least 3 issues with MR imaging: cost, availability (equipment and expert radiologists), and the burden of procedure (time, claustrophobia etc). MR imaging is challenging in young adolescents *'due to difficulty remaining still, i.e. movement artefact'*.

The group agreed that further work is needed to develop and refine consensus on the specific and standardised imaging protocol: *'If x-rays are utilised then it has to be reinforced on the views that are valuable and this message should be repeated in order to support this becoming routine practice; not all facilities are skilled with specific radiograph images e.g., Dunn'*.

It is further important to consider dissemination of findings: *‘Do athletes want to know the results? How, what, and when do we communicate imaging results to participants or parents? Do we consider positive/negative response by athletes/parents, and provide them with the “opt in” opportunity not to be informed of their individual imaging results?’* Group members raised four important points from the athlete/parent’s perspective. First, parents *‘were not comfortable’* with cumulative radiation exposure associated with serial radiographs. Radiation exposure is an *‘ethical dilemma in this area’* with *‘a need to be up front and transparent with information so parents are aware’*. Second, sharing of imaging results is a *‘hugely important area’* and research teams should carefully consider the possibility that *‘parents may pick up the information or interpret it differently than health care practitioners’*. Third, research teams should consider *‘an “opt in” option for participants and parents where, except if there is an issue with an imaging finding, they will not be informed of the results’*. Last, research teams should carefully consider how they communicate periodic imaging results and suggested a *‘common approach to dissemination of results/imaging is needed’*.