The urgent need for evidence in arthroscopic meniscal surgery;

A Systematic Review of the Evidence for Operative Management of Meniscal Tears

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ABSTRACT

Background: Arthroscopic surgery of the knee is one of the most frequently performed orthopaedic procedures. A third of these procedures are performed for meniscal pathology. It is essential that this commonly performed surgery is supported by robust evidence.

Purpose: To compare the effectiveness of arthroscopic surgery for meniscal injuries in all populations.

Design: Systematic review.

Data Sources: CENTRAL, MEDLINE, EMBASE, NHS Evidence, National Guideline Clearing House, Database of Abstracts of Reviews of Effects, Health Technology Assessment, ISRCTN, Clinicaltrials.gov, WHO trials platform (inception to April 2015).

Eligibility criteria for selecting studies: Randomised Controlled Trials (RCT) and Systematic Reviews (SR) that compared treatment options for meniscal injury. Only studies where participants were selected on the basis of meniscal pathology were included; no restrictions were placed on patient demographics. Two independent reviewers applied AMSTAR criteria for SRs and the Cochrane Collaboration's risk of bias tool for RCTs.

Results: Nine RCTs and eight SRs were included. There was no difference between arthroscopic meniscal debridement compared to non-operative management as a first line treatment strategy for patients with knee pain and a degenerative meniscal tear (mean difference in KOOS score 1.6, 95% CI –2.2 to 5.2) and visual analogue pain scores (mean difference -0.06, 95% CI -0.28 to 0.15). There is some evidence that patients, with resistant mechanical symptoms, who initially fail non-operative management may benefit from meniscal debridement. No studies compared meniscal repair with meniscal debridement or non-operative care. Initial evidence suggests meniscal transplantation might be favourable in certain patient groups.

Conclusions:

Further evidence is required to determine which patient groups do well from each intervention. Given the current widespread use of arthroscopic meniscal surgeries there is an urgent requirement for more research to support evidence-based practice in meniscal surgery, reducing the numbers of ineffective interventions and at the same time supporting potentially beneficial surgery.

KEY WORDS:

Knee
Meniscus
Meniscal Tear
Arthroscopy
Systematic Review

What is known about this subject?

Mensical tears are common and if found in association with pain or mechanical symptoms are often treated surgically, with resection/debridement, repair or replacement. Recent emerging evidence has challenged the efficacy of meniscal resection over non-operative approaches.

What this study adds to the existing evidence?

We report a systematic review of the evidence concerning the effectiveness of available management strategies for meniscal tears. Strong evidence now exists that menisectomy is not superior to non-operative therapy as the initial treatment for patients with a meniscal tear in a degenerative knee. Lower level of evidence support the use of meniscal transplantation in certain patient groups. There remains a lack of high quality studies covering the full spectrum of meniscal disease.

Introduction

Arthroscopic surgery in the knee is the commonest orthopaedic operation performed in the NHS with 150,000 performed annually[8], at an estimated direct cost of £190 million[9]. As over a third of these procedures are performed for meniscal pathology[15], it is essential that this commonly performed surgery is supported by robust evidence.

The menisci are fibrocartilage structures with an important functional roles including shock absorption and load distribution within the knee[1,25]. Loss of this function increases the risk of osteoarthritic change within the knee. The development of magnetic resonance imaging has improved our understanding of the pattern of meniscal tears. They are very common, occurring in a number of different patterns, depending on their anatomical position, orientation, complexity and size. Degenerative tears occur in middle aged patients and are associated with a change in nature of the meniscal tissue. Tears can occur in isolation but are also commonly associated with osteoarthritis[16] and anterior cruciate ligament injury[22]. Tears can be symptomatic producing painful mechanical symptoms, the most dramatic of which is the locked knee after a bucket-handle tear of the meniscus. However many tears are asymptomatic, particularly in the middle aged or elderly patients degenerative knee[10]. Arthroscopic surgical treatment of meniscal tears is divided into resection, repair or replacement of the damaged tissue. Where tissue is considered irreparable and thought to be producing symptoms it is resected, either partially or totally. Clinical practice is based on premise that resection can produce significant pain relief. However at longer-term follow-up these patients following menisectomy are at increased risk of developing osteoarthritis[19]. Avoiding the increased risk of developing OA has driven the treatment strategy of meniscal preservation through repair, particularly in the younger patient. Options for repair include direct suture or the use of other implantable fixation devices (e.g. Darts). In a similar way the threat of continued pain and osteoarthritic change following menisectomy has underpinned the more contemporary practice of meniscal replacement as the third surgical option. This can be achieved with bio-inductive scaffolds or meniscal allograft transplantation[27].

Over the last 10 years improvements in arthroscopic techniques and the development of new reconstructive strategies have resulted in a large increase in the amount of meniscal surgery performed. However recent emerging evidence has challenged the efficacy of meniscal resection over non-operative approaches and debate continues about defining the procedures role [7,8,28].
Contemporary surgical practice requires a critical analysis of evidence that is existing or indeed missing that may or may not affect practice.

Given the need for evidence based practice it is important to establish what supporting evidence for arthroscopic knee surgery exists. In this article, we report a systematic review of the evidence concerning the effectiveness of available management strategies for meniscal tears.

Methods

For the purposes of this overview we included reports of systematic reviews (SR) (which included both RCTs and non RCTs), and reports of randomised controlled trials (RCTs) comparing the effectiveness of different operative and / or non-operative management strategies in patients with a meniscal tears.

Inclusion and exclusion criteria

No restrictions were placed on patient ages, morphology of tear, disease or treatment stage. The following methods of meniscal tear management, singly or in combination, were included: arthroscopic and open procedures, total and partial meniscectomy, meniscal repairs, meniscal grafting, meniscal transplant, non-operative procedures and structured physiotherapy. Exclusion criteria included case-studies and cohort data, narrative reviews, imaging guidelines, diagnostic studies, rehabilitation protocols without outcome data, treatments of other knee pathology (e.g. OA or instability) where presence of meniscal tears were not a feature of all patients. 'Expert opinion' reviews and those without a formal process of identifying literature were also excluded.

Searches

We searched the Cochrane Database of Systematic Reviews, Cochrane Register of Controlled Trials, NHS Evidence, National Guideline Clearing House, The Centre for Reviews and Dissemination, Database of Abstracts of Reviews of Effects, Health Technology Assessments, ISRCTN, Clinical trials.gov, WHO trials platform, MEDLINE and EMBASE using tailored search strategies (see Appendix). Searches were undertaken in April 2015 and not limited by publication date. The search was restricted to English language publications only. Further studies were identified from the references of those found in the search, as were reports of RCTs where only the protocol was found by the search.

The title and abstract of all records retrieved by the search were independently assessed by two authors for their relevance and inclusion. Any disagreements were resolved by discussion and arbitration by a third author. After the initial screen two authors then assessed the remaining full text articles for inclusion in this overview (Figure 1).

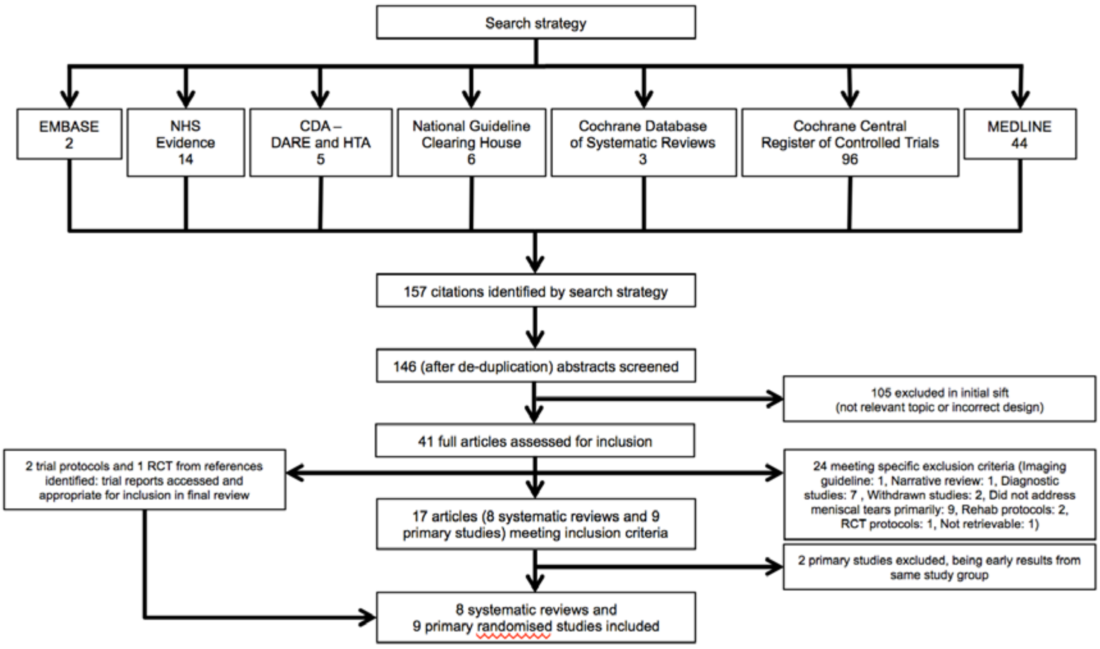

Figure 1 – Overview of Study Selection

Notes: Full search strategy and terms can be found in Supplementary Materials online, or directly via corresponding author.
Incorrect design: non-clinical studies, case reports and trial protocols without data
Inclusion criteria: arthroscopic and open procedures, total and partial meniscectomy, meniscal repairs, meniscal grafting, meniscal transplant, and structure physiotherapy. Adjuvant treatments to surgical intervention were also included. No restrictions were placed on patient ages, morphology of tear, disease or treatment stage.
Exclusion criteria: case-studies and cohort data, narrative reviews, imaging guidelines, diagnostic studies, rehabilitation protocols without outcome data, treatments of other knee pathology (e.g. OA or instability) where presence of meniscal tears were not a feature of all patients, and papers withdrawn by the authors. If two papers duplicated the same study group at different follow up points, only the longer term study was included.

Quality assessment

Studies meeting our inclusion criteria were formally assessed for methodological quality using AMSTAR for the assessment of systematic reviews (AMSTAR)[23,24], and the Cochrane risk of bias tool for reports of RCTs (Tables 1 and 2). Two review authors independently performed the assessment of each included study; any disagreements were resolved by consensus or by involving a third author as necessary. Inter-rater agreement of all included studies was assessed using a kappa score.

Table 1: Randomised Control Trials

	Study Characteristics								Cochrane Collaboration's tool for assessing risk of bias						
	Study Design	Blinding	Sample Size	Participants	Intervention	Comparator	Primary Outcome	Effect size	Adequate sequence generation?	Allocation concealment?	Blinding of participants, personnel and outcome assessors?	Incomplete outcome data addressed?	Free from selective outcome reporting?	Free of other bias?	
Katz 2013 (NEJM)	RCT Multicentre	Not blinded	351	Symptomatic meniscal tear with mild-moderate OA, 45 years plus	Arthroscopic partial meniscectomy	Physical therapy	Change in Western Ontario and McMaster Universities Osteoarthritis Index at 6 months	No statistically significant difference: between group difference 2.4 points, 95% C.I. -1.8 to 6.6	Yes	Yes	No	Yes	Unclear	Yes	4
Herrlin 2013 (Knee Surg Sports Traumatol Arthrosc)	RCT Single centre	Not blinded	97	Degenerate medial meniscus tears with no/low grade OA, mean age 56 years	Arthroscopic surgery and exercise therapy	Exercise therapy alone	Knee Injury and Osteoarthritis Outcome Score at 60 months	No statistically significant difference	Unclear	Unclear	No	Yes	Unclear	Yes	2
Bryant 2007 (Am J Sports Med)	RCT Single centre	Outcome assessor blinded	100	Meniscal tear deemed equally suitable to arrow or suture repair by operating surgeon	Inside-out suturing	Bioabsorbable arrows	Repair rate	No statistically significant difference, p=0.92	Yes	Unclear	Yes	Yes	Unclear	Unclear	3
Hede 1992 (Int Orth)	RCT Single centre	Unclear	200	Meniscal tear, no other abnormality at arthroscopy	Partial meniscectomy	Total meniscectomy	Lysholm score	Negative correlation between the percentage of meniscal surface removed and knee joint function, p=0.04	Yes	Unclear	Unclear	Yes	Unclear	Yes	3
Sihvonen 2013 (NEJM)	RCT Multicentre	Subject and assessor blinded	146	Degenerative medial meniscal tear and no knee arthritis	Arthroscopic partial medial meniscectomy	Sham surgery	Changes in Lysholm score at 12 months	No statistically significant difference, between grp difference -1.6, 95% C.I. -7.2 to 4.0	Yes	Yes	Yes	Yes	Yes	Yes	6
Albrecht-Olsen 1999 (Knee Surg Sports Traumatol Arthrosc)	RCT Single centre	Not blinded	60	Bucket-handle meniscal tears	Inside-out suturing	Meniscal arrows	Healed/partially healed at re-arthroscopy after 3-4 months	No statistically significant difference found, p=0.11	Unclear	Unclear	No	Yes	Unclear	Yes	2
Yim 2013 (Am J Sports Med)	RCT Single Centre	Not blinded	108	Degenerative posterior horn medial meniscal tear on MRI, none or mild radiographic OA	Partial meniscectomy	Physiotherapy and structured home exercise programme	VAS at 2 years	No statistically significant difference, p=0.075	Unclear	Unclear	Unclear	Yes	Unclear	Yes	2
Vermesan 2013 (Eur Rev Med Pharmacol Sci)	RCT Single Centre	Not blinded	120	Atraumatic knee pain with MRI confirmed meniscal and chondral lesions medially	Partial meniscectomy	Intra-articular steroid injection	Oxford Knee Score (OKS) at 1 month and 1 year	"Marginal benefit" in OKS to surgical group of injection group at 1 month (42.8 vs 39.8, p<0.0001), which did not persist to 1 year (p=0.0641)	Unclear	Unclear	No	No	Unclear	No	0
Moseley 2002 (NEJM)	Single centre RCT	Subject and assessor blinded	180	Osteoarthritis of the knee with moderate pain despite maximal medical therapy for 6 months	Arthroscopic lavage, or arthroscopic debridement	Sham surgery	Knee Specific Pain Scale at 1 and 2 year	No statistically significant difference at 1 year (p=0.14 and p=0.51) and 2 years (p=0.64 and 0.96)	Yes	Yes	Yes	Unclear	Unclear	Yes	4
									6	8	4	1	6	1	8
									Yes	26	Unclear	22	No	6	1

Table 2: Systematic Reviews

	Study Characteristics							A measurement tool to assess systematic reviews (AMSTAR)											
	Study Design	Sample Size	Participants	Intervention	Comparator	Primary Outcome	Effect size	1. Was a priori design provided?	2. Was there duplicate study selection and data extraction?	3. Was a comprehensive literature search performed?	4. Was the status of publication (i.e. grey literature) used as an inclusion criterion?	5. Was a list of studies (included and excluded) provided?	6. Were the characteristics of the included studies provided?	7. Was the scientific quality of the included studies assessed and documented?	8. Was the scientific quality of the included studies used appropriately in formulating conclusions?	9. Were the methods used to combine the findings of studies appropriate?	10. Was the likelihood of publication bias assessed?	11. Was the conflict of interest included?	Yes responses
Grant 2012 (Am J Sport Med)	Systematic review of RCT, retrospective cohort and case series	311	Arthroscopic meniscal repairs	Inside-out meniscal repair	All-inside meniscal repair	Clinical failure rate	No statistically significant difference: Pooled odds ratio 0.80 (95% C.I. 0.45 – 1.40)	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	8
Ayeni 2011 (J Knee Surg)	Systematic review of RCTs and retrospective & prospective cohort studies	398	Arthroscopic meniscal repairs	Suture repair	Arrow repair	Failure	Meta-analysis not possible due to heterogeneous study design	Yes	Yes	Can't Answer	Yes	No	No	Yes	Yes	Not applicable	No	No	5
Noyes 2014 (Knee Surg Sports Traumatol Arthrosc)	Systematic review of Level I to IV studies	814	Medial and lateral meniscal tears	Meniscal allograft transplantation	-	Meniscal extrusion on MRI	Meta-analysis not possible due to heterogeneous study design	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Not applicable	No	No	7
Barber-Westin 2014 (Arthroscopy)	Systematic review of Level I to IV studies	767	Red-White (Central third) meniscal tears	Arthroscopic suture-based repairs	-	Clinical healing rate	83% clinically healed (at 1.1 to 16.8 years average follow up)	Yes	Can't Answer	Yes	Yes	No	Yes	Yes	No	No	No	No	5
Kurzweil 2014 (Arthroscopy)	Systematic review of 9 studies	98	Horizontal cleavage tears	Meniscal repair by any method	-	Re-operation as criterion for failure of repair	21.4% failure of repair, at mean follow up 70 months	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	No	No	No	7
Khan 2014 (CMAJ)	Systematic review and metaanalysis of RCTs	805	Degenerative meniscal tears with mild or no concurrent osteoarthritis	Arthroscopic debridement	Non-operative treatment	Minimally important difference (MID) in Knee Injury and Osteoarthritis Outcome score (10 points)	Estimated KOOS mean difference 5.6 (95% C.I. 0.45 to 10.8) failed to exceed threshold of MID	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	8
Smith 2015 (Knee Surg Sports Traumatol Arthrosc)	Systematic reviews and metaanalysis fo case series	1374	Meniscal allograft transplantation, any indication	Meniscal allograft transplantation	-	PROM measurement at ≥1 year	Mean pre- vs post op scores: Lysholm 55.7 vs 81.3; IKDC 47.6 vs 70; Tegner 3.1 vs 4.7	Yes	Yes	Yes	Yes	No	No	Yes	Yes	No	No	Yes	7
Xu 2015 (Knee Surg Sports Traumatol Arthrosc)	Systematic review and metaanalysis of Level I to III studies	367	Meniscal tears undergoing surgical intervention	Meniscal repair (open suture and arthroscopic inside-out procedures)	Meniscectomy (partial or total)	IKDC	No statistically significant difference of Odds Ratio for IKDC score outcomes	Yes	Yes	Yes	Can't Answer	No	Yes	Yes	Yes	Yes	No	No	7
								8	6	6	1	6	2	8	1	4	7	5	0

Data extraction

Two authors independently extracted data from each included study using a standardized data extraction form. Any disagreements were resolved by discussion or by involving a third author if necessary. Data was extracted on all of the relevant variables for the study, including details of methods, participants, setting, interventions, outcomes, results and funding sources. Specific outcomes considered for this overview included: Pain and function (measured using either PROMs - Visual Analogue Score (VAS), WOMAC, KOOS, ACL-QOL, Lysholm, or Tegner scores), incidence of re-tear (e.g. clinical, MRI or arthroscopic diagnosis), further procedures, complication rate, progression of osteoarthritis changes and time to arthroplasty, healthcare costs.

Results

The initial search identified 157 records, which were reduced to 146 after removal of duplicated studies. Following screening of the title and abstracts, 59 were excluded as not relevant to the study question, and 46 were excluded due to inappropriate design (Figure 1). Two authors assessed the remaining 41 full text articles resulting in 8 systematic reviews and 9 RCTs which met our inclusion criteria. Of these 9 RCTs 2 were excluded as they were early reports of the same study. Post hoc searches identified three additional RCTs [2,5,20] identified from the reference lists of the included studies: two were included, but the second was excluded due to lack of randomisation of participants.

Methodological Quality

Inter-rater agreement of the assessment of risk of bias for RCTs and AMSTAR for systematic reviews was assessed using kappa statistics. Inter-rater agreement was assessed to be good with a k value of 0.80 (95% C.I. 0.73 – 0.87).

The quality of the 8 systematic reviews was reasonable according to AMSTAR criteria (mean 7 of 11 positive responses to AMSTAR domains). Domains which scored poorly were similar in all studies, namely the inclusion of a list of studies (domain 5, zero positive responses), publication bias (domain 10; 1 positive response) and conflict of interest (domain 11; 3 positive responses).

The method of sequence generation was judged at low risk of bias in 5 of the 9 RCTs using the Cochrane Risk of Bias criteria. Allocation concealment was judged at low risk of bias in 3 RCTs, however, this was often because the method of allocation concealment was 'unclear' according to the criteria laid out. Blinding of participants, personnel and outcome assessors was judged adequate in only 3 RCTs the majority of these being due to lack of blinding, which was often impossible due to the treatments being compared.

Overall 9 RCTs and 8 systematic reviews were included in final analysis. It was not possible to perform a meta-analysis because of the amount of clinical heterogeneity across the different studies identified. As such, we present a descriptive summary of the results and present the characteristics of the included studies and results of the quality assessment in Tables 1 and 2. A list of excluded studies is provided as an Appendix.

Meniscal Resection - 7 RCTs and 1 SR

7 RCTS AND 1 SR provided evidence for the use of partial meniscectomy. Three RCTs compared partial resection with physiotherapy[14,16,31], two RCTs employed sham surgery methodology[20,26], one RCT compared partial to total resection[12] and one RCT compared partial resection to steroid injection[29]. A further systematic review of seven trials compared arthroscopic medial meniscal resection to any form of non-operative treatment[17]. Whilst functional outcomes were different between the groups in the short-term this did not exceed the minimally important difference; the overall difference between groups long-term functional outcomes based on a clinically significant 10-point improvement in Knee Injury and Osteoarthritis Outcome Score (estimated KOOS mean difference 1.6, 95% CI –2.2 to 5.2) and visual analogue pain scores (mean difference -0.06, 95% CI -0.28 to 0.15) were not statistically significant[17].

Meniscal resection (debridement) versus physiotherapy (3 RCT)

Three RCTs[14,16,31] compared meniscal debridement versus physiotherapy, two in the presence and one in the absence of knee arthritis: all three found no difference between surgery and physiotherapy. Katz et al[16] performed the largest study, comparing arthroscopic partial meniscectomy and physiotherapy for meniscal tears in 351 patients with OA and aged over 45 years. They showed no benefit of arthroscopic partial meniscectomy at 12 months based on WOMAC score improvements compared to physical therapy (between-group difference in improvement from baseline; mean difference 0.7, 95% C.I. -3.5 to 4.9), though 35% of those initially randomised to physiotherapy went on to receive surgery.

Yim et al[31] also compared partial meniscal resection and physiotherapy in the presence of OA, randomising 102 patients with atraumatic medial sided knee pain and mechanical symptoms, with degenerate medial meniscal tears on MRI scan. After two years follow up, mean visual analogue scales scores for pain showed clinically relevant improvement in both meniscectomy (mean VAS 1.8, range 1-5) and non-meniscectomy (mean VAS 1.7, range 1-4) groups, but were not statistically different between groups (p=0.675), nor were the numbers of patients reporting 'complete' (34 vs 35 patients), 'improved' (13 vs 12) or 'persistent' (3 vs 5) pain relief ratings (p=0.652) or being 'very satisfied' (18 vs 17 patients), 'satisfied' (28 vs 29), or 'dissatisfied' (4 vs 6) with their treatment (p=0.357). At three months, there was a statistically significant difference in the Lysholm scores between the meniscectomy and physiotherapy groups (85.2 vs 80.4), but this did not persist, and at 2 years, there was no difference in Lysholm scores between the two groups (84.3 vs 83.2).

A similar approach was taken by Herrlin et al[14] who randomised 96 patients with MRI verified degenerative medial meniscal tears and pain, to either exercise therapy alone, or in combination with arthroscopic surgery. At 5 year follow up, both groups showed significant improvements (p<0.0001) in KOOS score and satisfaction, but no difference was found between the groups. One third of the patients randomised to exercise therapy did not improve after initial treatment, and subsequently underwent arthroscopic surgery an average of 6.5 months after enrollment. At five years, based on the Lysholm knee scoring scale (0 to 100, 100 best), the exercise only group (mean Lysholm score 95; IQR 85-100) and exercise with delayed arthroscopy group (mean Lysholm score 99; IQR 89-100) had the same outcome as those randomised to arthroscopy and exercise initially (mean Lysholm score 89; IQR 80-100), and overall, p-values between the groups were not statistically significant.

All three RCTs had patients assigned to physiotherapy alone who underwent partial meniscal resection (up to 35% in one study[16]). Of those patients who crossed over between arms of the study, their functional improvement occurred primarily after the surgery, and ultimately they gained the same improvements as those initially randomised to arthroscopic partial meniscectomy, and those randomised to physiotherapy. These studies imply there is a cohort of patients who will not do well with conservative treatment initially, but once identified by a trial of physiotherapy, they will gain the same benefit and do not suffer long term despite their initial trial period. Arthroscopic partial meniscectomy does not improve outcomes overall compared to physiotherapy, but it does have place in those resistant to physiotherapy, providing beneficial effect of similar magnitude.

Meniscal debridement versus sham surgery *(2 RCT)*

Two randomised control trials compared meniscal debridement to sham surgical procedures. The FIDELITY group recently reported a 146 patient, multi-centre RCT comparing arthroscopic partial meniscectomy to sham surgery in patients with knee pain, a degenerative meniscal tear and no knee arthritis[26]. At 12 months both groups gained clinically significant symptomatic relief based on validated PROMs: the improvements in Lysholm scores for the partial meniscectomy group and sham surgery group were not significantly different (mean difference between groups, -1.6; 95% C.I. -7.2 to 4.0), nor were the improvements in WOMAC scores significantly different between the groups (mean difference between groups, -2.5; 95% C.I -9.2 to 4.1). This study provides an additional perspective to those recruited a previous sham trial in the presence of knee arthritis. An earlier RCT by Moseley et al[20] report similar findings in a three arm trial with a group who received debridement of degenerative meniscal tears who fared no better than those receiving only arthroscopic lavage, or sham surgery.

Meniscal debridement versus total meniscectomy *(1 RCT)*

One RCT with eight year follow up randomised 200 patients to partial or total meniscectomy for meniscal tears[13]. Lysholm scores were worse after partial mensicectomy for posterior horn tears compared to anterior or bucket handle tears , while outcome was reported to be the same for tears at all locations if treated with total meniscectomy (median Lysholm score 90). When less than 30% of the meniscus had been removed, location did not affect outcome scores , but after 30-99% excision bucket handle tears had better symptomatic relief than anterior or posterior horn tears. They report "no association was found between radiological signs of degeneration and the site or part of the meniscus removed" but provide no data for this statement, or an indication of the degree of progression noted, which is significant given the association of total mensicectomy with progression of arthritis. There was no account of nature of the tear (degenerative or traumatic), or the presence of knee arthritis.

Meniscal debridement versus steroid Injection *(1 RCT)*

One RCT compared partial meniscectomy to an intra-articular steroid injection for atraumatic knee pain with MRI confirmed meniscal and chondral degenerative changes in 120 patients[29]. At one month, Oxford Knee Scores showed a 'marginal benefit' of arthroscopic debridement compared to intra-articular injection (mean Oxford Knee Score 42.8 [95% C.I. 42.0 – 43.6] vs 39.9[95% C.I. 38.9-40.9]; p=0.0001), but the statistical difference in OKS between groups did not persist to 1 year follow up

Meniscal repair

No studies compared meniscal repair to non-operative treatment or meniscectomy. However, a number of studies addressed the merits of different repair techniques.

Meniscal repair techniques *(5 SR, 2 RCTs)*

Xu and Zhao[30] present a meta-analysis a single, poorly-randomised trial[5] and six case-control studies suggesting better outcomes (based on IKDC, Lysholm, Tegner) following meniscal repair compared with menisectomy, despite a higher re-operation rate. Two systematic reviews including case series, case-control studies, and randomised studies reviewed evidence for outcomes in meniscal repair by any method or technique. Barber-Westin et al[4] reported an average clinical healing rate (defined as no additional surgery and no clinical meniscal symptoms) of 83% overall from 767 repairs in the red-white zone of any tear morphology. Kurzweil et al[18] selectively reported repairs of horizontal cleavage tears, and used re-operation as the criterion for failure in reporting 77.8% of 98 meniscal repairs. Neither systematic review addressed the differences between repairs techniques, nor the long-term chondroprotective effects of meniscal preserving surgery over resection.

One RCT [6] compared inside-out suturing with arrows repairs. No difference was shown in the re-tear rate (11 in each group), nor in any of the PROM or ROM secondary outcomes: at two years, ACL-QOL score mean difference between groups was 1.6% (95% C.I -11.3% to 14.4%), and WOMET score between group difference 2.4 (95% C.I. -10.5 to 15.4). Comparing the range of motion of the operated and non-operated knees, there was no difference between the arrow and suture repair groups (mean difference of -1.0° [95% C.I. -3.6° to 1.5°] of passive extension and -2.0° [95% C.I. -7.1° to 3.0°] degrees of passive flexion). Of note, this study was underpowered, recruiting only 100 of 152 intended participants. Highlighted differences included significantly faster repair times when using arrows (24.8 vs 41.9 minutes) and the profile of surgical complications: three patients receiving arrow repairs complaining of prominent subcutaneous arrows or problems related to arrows loosening, while the approach required for suture repair caused foot drop from peroneal nerve injury. The nature of the tears is not specified, but given the young ages (mean 25.4 years), with 65% of those recruited undergoing concomitant ACL repairs, these are less likely to be degenerative.

One RCT [2] performed repeat arthroscopy of 65 patients randomised to arrow or suture repair of meniscal tears to inspect the integrity of the repairs at 3-4 months, finding no significant difference in the healing rates between the arrow and suture repair groups (91 % vs 75%; $p=0.11$). Interestingly, half of the cases that were not healed at re-arthroscopy did not present with symptoms to suggest recurrent tear. This study included some repairs in patients with unstable knees, with 19 patients undergoing concomitant ACL reconstruction, and a further 19 patients with ACL insufficient knees that were not reconstructed: no difference in healing rate of either meniscal repair technique was noted between unstable knees whether they were ACL reconstructed or ACL insufficient ($p=0.08$). No was no difference in healing rates between arrow versus suture repair techniques in stable , ACL reconstructed , or ACL insufficient knees.

One systematic review [11] including poorly randomised control trials, retroscpective cohort studies and case series to focus on repair isolated meniscal tears in knees with intact ACLs treated with inside-out or all-inside repair techniques. They reported no differences in failure rates (odds ratio 0.92; 95% C.I. 0.45 to 1.86), or patient related outcome scores (data not published) between inside-out and all-inside repair techniques. However, inside-out techniques were associated with fewer complications than all-inside techniques (odds ratio 0.55, 95% C.I. 0.27 to 1.1).

All three studies above reported that arrow/all-inside techniques take less operative time than suture/inside-out techniques. A systematic review by Ayeni et al[3] cites insufficient data to perform a formal meta-analysis when assessing suture versus arrow techniques for meniscal repair, and could not find compelling evidence from four included RCT and observational studies to support either technique for repair.

Meniscal Replacement

A recent systematic review of 35 case series studies by Smith et al[27] analysed the PROMS measures at final follow up after meniscal transplants. Mean pre-operative and final post-operative (at least 1 year) scores for Lysholm (55.7 vs 81.3), IKDC (47.8 vs 70) and Tegner (3.1 vs 4.7) PROMS all showed clinically relevant symptomatic improvements: none-the-less, given the mean age of the patients (33.7 years) these are not 'normal' scores and indicate persistent symptoms despite the improvements. They reported a mean failure rate (excision of graft or conversion to arthroplasty) of 11% and a complication rate (e.g. infection, meniscal tear, synovitis) of 14%. Meniscal extrusion was noted to be significant in many of the studies [27].

Noyes et al[21] attempted to study the incidence and clinical significance of post-operative meniscus transplant extrusion in 814 cases, but meta-analysis was not possible due to heterogenous study design.

Discussion

Mensical tears are common and if found in association with pain or mechanical symptoms are often treated surgically, with resection/debridement, repair or replacement. Despite a rigorous search strategy, we found limited high quality evidence to support or refute the use of many treatments for meniscal surgery. The evidence that does exist is largely inconclusive or poor-quality. This is surprising given the volume of meniscal operations performed globally. Evidence did exist challenging the efficacy of menisectomy of degenerative meniscal tears, but overall there is a lack of high quality studies covering the full spectrum of meniscal disease.

Evidence for meniscal resection/debridement

Evidence from RCTs shows no clear benefit of arthroscopic menisectomy over non-operative treatment for a significant proportion of patients with degenerative tears, with improvement in both groups. This pattern was seen in presence or absence of osteoarthritic change in the knee. However for patients who do not respond to non-operative measures arthroscopic menisectomy does appear to be a successful second line treatment in degenerative tears in those who fail a course of physiotherapy. The pattern of tear appears to be important in defining outcome but to date very few studies have not stratified patients by tear type. This may be a critical part of understanding the exact indications for this procedure.

Evidence for meniscal repair

No RCTs have compared meniscal repair with non-operative treatment. There is some evidence from systematic reviews of cohort and case series that there appears to be no clear difference in outcome between repair methods. The lack of high quality evidence to support the practice of meniscal repair is surprising, as this treatment has been in widespread practice for many years. Technological advances have produced many new methods of repair and evidence does exist comparing them. As yet studies have not clearly defined any major advantage of one technique over another. The goal of meniscal preservation, particularly in the younger patient, is valid but the reality of proving that our interventions achieve this is critical to support this approach. Therefore trials of efficacy are required.

Evidence for meniscal replacement

Our systematic review shows evidence that encouraging cohort data exists to support the development of this treatment option. However the existing evidence is Level 4 with no controlled trials completed of these interventions. A trial of treatment versus non-operative treatment is required to advance the area and support its use before widespread adoption can occur.

Strengths and weaknesses of this study.

We performed comprehensive search across a number of databases and used robust standardised accepted methodology to perform this systematic review. We identified an increasing number of RCTs investigating the efficacy of meniscal surgery for degenerative meniscal tears in the presence or absence of OA, however in other areas our study revealed important gaps in the current evidence base for the management of meniscal tears. Our study has some limitations. Firstly, it was not possible to perform a meta-analysis because of the amount of clinical heterogeneity, in terms of the interventions assessed and outcomes measured, across the different studies identified. Second, while we only included reports of RCTs, we also included some systematic reviews which included both randomised and non-randomised studies (e.g. cohort, case series). These non-randomised studies have, due to the nature of their design, a much higher degree of bias. As such, evidence reported from those systematic reviews which also included non-randomised studies should be viewed with a degree of caution.

Implications of this study for clinical practice and future research.

Contemporary arthroscopic surgical practice has clearly been influenced by evidence based medicine. Notably, the role arthroscopic lavage in the treatment of degenerative arthritis, once considered therapeutic has been phased out in the face of overwhelming evidence to the contrary[20]. In a similar way the indications for meniscal surgery are evolving as further evidence is produced. Level one data now exists demonstrating that menisectomy is not superior to non-operative therapy as the initial treatment for patients with a painful knee and MRI scan evidence of meniscal tear in a degenerative knee [18]. Given current evidence menisectomy should be focused in patients with mechanical symptoms who do not improve with initial non-operative measures. At the same time further evidence should be urgently sort to support this practice forming the basis for guidelines for treatment of this cohort of patients. In particular the definition of mechanical symptoms and the influence of pattern of tear on patient outcome need to be explored. At one extreme there would be consensus that arthroscopic debridement (or repair in a young patient) of a bucket handle tear in a patient with a locked knee would be the correct management. In fact an RCT in this patient group with extreme mechanical symptoms and a distinct pattern of tear could not be preformed due to ethical reasons if the knee remained locked. However this is the exceptional case and more evidence is required to establish which other combinations of mechanical symptoms and tear pattern, if any, are amenable surgical intervention. A similar approach is required for meniscal repair and replacement. In truth their role cannot be defined at present. There is some promising cohort study data but now higher level evidence is required to address efficacy.

Patterns of clinical care that that have been shown by high quality level 1 evidence to be ineffective should stop. It has been established that arthroscopic washout for osteoarthritis is ineffective and its practice has decreased. In addition we now know that arthroscopic menisectomy used to treat the general population of patients presenting with knee pain and a meniscal tear is a non-effective strategy and this practice should now end. A more informed approach is required to develop the true indications for surgery. It is very clear that a pressing need exists for further research and evidence production to define which sub-groups of patients with meniscal pathology will do well with surgery, be it resection, repair or replacement.

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