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ABSTRACT (300 words max)

Introduction: Acetabular fractures in older adults have a high risk of mortality and morbidity. However, only limited data has been published documenting functional outcomes in such patients. Therefore, the aims of this study were to describe outcomes in patients aged 60 years and older with operatively managed acetabular fractures, and to establish predictors of conversion to total hip arthroplasty (THA). **Methods:** We conducted a retrospective registry-based study of 80 patients aged 60 years and older with acetabular fractures treated surgically at (blinded) and (blinded). We conducted chart review, radiological analysis, patient interviews/examinations and functional outcome scoring. Data was provided by the Victorian Orthopaedic Trauma Outcomes Registry (VOTOR). Survival analysis was used to describe conversion to THA in the group of patients that initially underwent open reduction and internal fixation (ORIF). Multivariable regression analyses were performed to identify factors associated with conversion to THA. **Results:** Seven patients (8.8%) had died at a median (IQR) follow-up of 18 months (12-25 months), 4 were in the acute THA group. Eight patients (10%) underwent acute THA. Of the patients who underwent ORIF, 17/72 (23.6%) required conversion to THA at a median (IQR) of 10.5 (4.0-32.0) months. After controlling for other factors, transport related cases had an 88% (HR 0.12, 95%CI 0.02-0.91) lower rate of conversion to THA. Mean standardised PCS-12 was comparable to the general population (age/gender matched) by 12-24 months. Over half (14/26) of patients working prior to injury returned to work by 6 months and two thirds (19/27) of patients by 12 months. **Conclusions:** Patients over 60 years of age managed operatively for displaced acetabular fractures had a relatively high mortality rate

24 and a high conversion rate to THA in the ORIF group, but overall patients who survived
25 had mean PCS-12 scores that improved over 2 years and were comparable to controls.

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27 **KEYWORDS:**

28 Acetabular fracture; elderly acetabular fracture; older adult acetabular fracture; geriatric
29 acetabular fracture; functional outcome

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For Review Only

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Introduction

Acetabular fractures in older adults have a high risk of mortality and morbidity. Estimates of the one-year mortality risk range from 8.1% to 25% in recent literature¹⁻³ and over 1 in 4 cases are converted to total hip arthroplasty (THA) following open reduction and internal fixation (ORIF) within the next 2.5 years³. Older adults are also known to have poorer outcomes following these injuries compared with younger individuals⁴. As the population ages, older adults will become the most prevalent age group sustaining acetabular fractures^{5,6}. However, only limited data have been published documenting functional outcomes in older adult patients⁷. Therefore, the aims of this study were to describe the functional outcomes post-operatively in patients 60 years and older with operatively managed acetabular fractures, and to establish predictors of conversion to THA.

Patients and Methods

A registry-based observational study was conducted. The included patients were aged 60 years of age and older with operatively managed acetabular fractures treated at the two Level 1 trauma centres in (blinded): (blinded) (Jan 2003-Dec 2012) and (blinded) (Jan 2007-Jan 2014). Patients were identified through hospital medical records and cross-checked with the Victorian Orthopaedic Trauma Outcomes Registry (VOTOR). Exclusion criteria included pathological and periprosthetic fractures. Standard management in these centres is to offer surgical options to patients with displaced acetabular fractures unless

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3 54 there are significant medical comorbidities not allowing this. Ethics approval for this
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5 55 research was obtained from (blinded) Ethics Committee (245/13) as well as the (blinded)
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7 56 Research Ethics Committee (2014.026).
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12 58 Thorough medical chart reviews were performed by two authors to identify patient
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14 59 demographics as well as all complications and reoperations. Radiographic interpretation
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16 60 was performed by two experienced pelvic/acetabular trauma fellows and included
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18 61 classification according to the Letournel and Judet classification system⁴, associated
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20 62 femoral head dislocation, marginal impaction, dome comminution, associated femoral
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22 63 head fracture in infra-foveal or supra-foveal location, quality of reduction using the Matta
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24 64 rating system⁸, heterotopic ossification according to Brooker classification⁹, final
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26 65 radiological outcomes according to Matta criteria¹⁰ and Tönis grading¹¹.
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33 67 Charlson comorbidity index¹², return to work status and 12-item Short Form Health Survey
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35 68 (SF-12)¹³ scores at 6 months, 12 months and 24 months following injury were obtained
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37 69 from VOTOR, as well as extended injury data such as cause of injury, associated injuries
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39 70 and pre-existing disability. Deaths were identified through VOTOR via linkage of the
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41 71 registry with the Victorian Registry of Births, Deaths and Marriages.
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47 73 All living patients were contacted by telephone and invited to participate in patient
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49 74 examinations and interviews. The interviews included the Harris Hip Score (HHS)¹⁴,
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51 75 Western Ontario and McMaster Universities Osteoarthritis Index (WOMAC)¹⁵, SF-12, 36-
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53 76 item Short Form Health Survey (SF-36)¹⁶, Short Musculoskeletal Functional Assessment
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77 Survey (SMFA)¹⁷ and the Merle d’Aubigné and Postel score¹⁸. Informed consent was
78 obtained for patient interviews and assessments. Patients unable or unwilling to present for
79 assessment were invited to complete the surveys by telephone, with completion of the
80 telephone interviews considered consent.

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82 Summary statistics were used to describe the profile of participants, their injuries,
83 management and outcomes. Means and standard deviation were reported for normally
84 distributed continuous data, and median and interquartile ranges (IQR) for continuous data
85 which was not normally distributed. Univariable and multivariable Cox Proportional
86 Hazards regression analyses were performed to establish factors associated with time to
87 conversion to THA following ORIF. Factors with a p-value ≤ 0.20 on univariable testing
88 were included in the multivariable model. Unadjusted and adjusted hazard ratios (HR) and
89 the corresponding 95% confidence intervals (CIs) were calculated. A p-value <0.05 was
90 considered significant. All analyses were performed using Stata Version 13.

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93 **Results**

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95 *Overview of cohort*

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97 A total of 80 patients met the inclusion criteria during the study timeframe; 50 at (blinded)
98 and 30 at (blinded) (Figure 1). The mean age was 69.7 (SD 7.9, range 60-89) years. Close
99 to half the patients (38/80) were involved in road traffic crashes (motor vehicle,

motorcycle, cyclist or pedestrian hit by vehicle), 14/80 were from high falls and 23/80 were from low falls (less than 1 meter or from standing height). Many patients had associated injuries, including 16.5% with a head injury, 32.5% with a thoracic injury, 20.2% with an abdominal injury, 28.8% with an upper limb injury and 13.7% with another lower limb injury. Anterior column, anterior column plus posterior hemitransverse, and both column fractures according to the Letournel and Judet classification system represented altogether over half of the cases (43/80). Patient and injury characteristics are presented in Table 1.

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108 *Acute THA*

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Acute THA was performed in 10% (8/80) of the participants (Table 2). Most were associated fracture patterns according to the Letournel and Judet classification system, all were associated with a fracture-dislocation pattern, two of which had concomitant supra-foveal femoral head fractures, and a majority also had marginal impaction and dome comminution.

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116 *Conversion to THA*

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Of the 72 patients initially treated by ORIF, 23.6% (17/72) were eventually converted to THA. The median (IQR) time to conversion was 10.5 (4.0-32.0) months. Of the patients who did not require conversion to THA, 53/55 had a follow-up XR at a median (IQR) time of 12.5 (4.0-32.0) months and the Tönnis osteoarthritis grade was 0 or 1 in 71.7% (38/53), grade 2 in 20.8% (11/53) and grade 3 in 7.5% (4/53).

Univariable analysis of potential predictors of conversion to THA was performed. Non-transport related injuries ($p=0.02$), central dislocations ($p=0.03$), gross malreduction ($p=0.10$) and age ($p=0.09$) were identified as potentially important predictors of conversion to THA, and were included in the multivariable model (Table 3). After controlling for other factors, transport related cases had an 88% (HR 0.12, 95%CI 0.02-0.91) lower rate of conversion to THA (Table 4). The Kaplan-Meier survival analysis curve demonstrating conversion to THA following ORIF comparing transport related and non-transport related injuries after controlling for other factors is represented in Figure 2.

Mortality

In the study group, 8.8% (7/80) were confirmed deceased at a median (IQR) follow-up of 18 (12-25) months (Table 5); 4/8 patients who received an acute THA and 2/17 who underwent ORIF but were later converted to THA had died (including one who died from a post-operative myocardial infarction following the conversion to THA surgery), in contrast to 1/55 patients who underwent ORIF and did not require conversion to THA.

Work status

In this study, 14% (11/80) had a documented pre-injury disability, 79% (63/80) did not, and there was missing data for 6 patients. Of the patients with pre-injury work status available, we found that 42% (29/69) were working for salary pre-injury. Of the patients

with available data, over half (14/26) had returned to work at 6 months and over two thirds (19/27) at 12 months post-operatively (the denominator changes based on data available at different time points).

Functional outcome scores

Mean functional outcome scores at median follow-up of approximately 2 years post-operatively are presented in Table 6. The overall SF-12 Physical Component Summary Scores (PCS-12) increased in time and was comparable to age and gender matched controls by 2 years post-injury, whereas the Mental Component Summary Scores (MCS-12) were comparable to population norms at all time points (Figure 3).

Discussion

Fractures of the acetabulum are associated with significant mortality and morbidity in older adults. Older adults will become the most prevalent age group sustaining an acetabular fracture as the rate is increasing in this subset of patients^{5,6}. The social impact of acetabular fractures in older adults will therefore continue to increase.

The overall one-year mortality rate for acetabular fractures in patients aged 60 and older treated surgically and nonoperatively was found to be 8.1% in a study of 176 patients treated at a level-1 trauma center¹, mortality rates were statistically significantly lower if

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3 169 the injury was isolated when compared to those with concurrent injuries, at all time points
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5 170 of 30 days, 3 months, 6 months and 1 year ($p=0.0002-0.002$). Moreover, a large
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7 171 retrospective multicentre study of 454 patients 60 years and older has documented
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9 172 significantly higher one-year mortality rates for nonoperatively treated acetabular fractures
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11 173 in patients aged 60 and older, compared to surgically treated fractures, including ORIF,
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13 174 percutaneous fixation and acute THA (21% vs 13%, $p<0.001$), the overall one-year
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15 175 mortality rate being 16%². There was no difference within the groups when other risk
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17 176 factors for mortality were taken into account in a multivariable model. Another recent
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19 177 retrospective study reported a 25% one-year mortality rate in 46 patients treated with
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21 178 ORIF³. The mortality rate in our study compares favourably to the published literature in
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23 179 this age group. It may however be difficult to interpret the true meaning of these rates based
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25 180 on retrospective studies because of selection bias, for instance patients with more medical
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27 181 risk factors may be more often treated non-surgically or with less invasive surgical
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29 182 treatment, and different specific fracture types may be treated differently and have different
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40 185 Many studies have documented higher conversion rates to THA in older patients.
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42 186 Several predictors of conversion to THA have been reported, including combined femoral
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44 187 head fractures, pelvic fractures, marginal impaction, dome comminution⁷ and the “Gull
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46 188 sign”¹⁹. Anterior column, anterior column plus posterior hemitransverse, and both column
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48 189 fractures represent just over 50% of the acetabular fracture types in geriatric patients as
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50 190 documented in Daurka’s systematic review⁷ and this is similar in our patients (43/80
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52 191 patients). Our study is similar but larger than O’Toole’s study³, which demonstrated a 28%
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conversion rate to THA at a mean of 2.5 years (range 0.4-5.5) following ORIF of acetabular fractures in 46 patients 60 years of age and older. The findings were similar to ours, with the overall functional outcome scores based on SF-8 similar to age-matched controls ($p>0.2$). O'Toole's study³ reports that in those undergoing conversion to THA, the WOMAC scores were better than patients with untreated primary hip osteoarthritis, and similar to patients who have been treated with elective THA for primary hip osteoarthritis ($p<0.05$). Although it was not a comparative study, those results suggest that older patients with an acetabular fracture treated with ORIF that fail and require later conversion to THA generally have a similar functional outcome to patients with primary hip osteoarthritis following their THA, which is reassuring when considering surgical options acutely if acute THA does not appear to be feasible or may be technically too challenging. In contrast, in a series of 220 patients aged 18-83 (mean 48.5 years) with acetabular fractures managed with ORIF, Frietman et al²⁰ have reported 15% conversion to THA at a mean of 2.75 years post-operatively and found that the SF-36 and modified HHS were inferior in those who required conversion to THA compared to those who did not. It would be relevant in the future to consider a multicentre study comparing functional outcomes in patients who have had acute THA for acetabular fractures compared to patients who have had ORIF and subsequent conversion to THA.

Initial results with acute THA for acetabular fractures have been mixed but more recently with better patient selection, improved surgical techniques and implants, results have been promising. For example, Mears²¹ has performed acute THA in 57 patients (mean age 69, range 26-89) with acetabular fractures, and only 2 patients died within 2 years, and

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215 79% had excellent or good functional outcomes based on Harris Hip Scores. Rickman²²
216 has described promising results with combined fixation and acute THA in 24 patients over
217 65 years of age and only 1 patient had died at mean follow-up of 24 months (range 8-38
218 months). However, in our study, 4 patients out of 8 who required treatment with acute THA
219 had died, 2 within the first 2 years, these were aged 78 to 89 years with increased medical
220 comorbidities, and these results contrast those of Mears²¹ and Rickman²². Furthermore,
221 Borg et al²³ have compared 13 patients 50 years and older managed with combined fixation
222 and acute THA compared with 14 previous patients managed with ORIF alone, reporting
223 only 28.6% native hip survival following ORIF (9 requiring conversion to THA within 2
224 years and 1 requiring Girdlestone procedure at 26 months post-operatively), whereas none
225 of the patients in the combined fixation and acute THA group required re-operation with a
226 minimum 2 years follow-up. However, 3 of the 13 patients in the combined fixation and
227 acute THA group had died within 3 years post-operatively compared to no deaths in the
228 ORIF group.
229
230 In contrast, Ryan et al²⁴ has reported a 24% 1-year mortality rate in 95 patients 60 years
231 and older with acetabular fractures managed nonoperatively. The study specifically
232 reported functional outcomes of a subgroup of 27 patients with acetabular fractures
233 meeting standard operative fixation criteria but managed nonoperatively, with
234 radiological follow-up available at an average 2.2 years (range 1-65 years). Management
235 included early mobilisation and no traction, weightbearing restrictions were varied with 2
236 allowed weight bearing as tolerated, 15 flat-foot weight bearing and 10 non-weight
237 bearing. Eventually 4/27 (15%) required surgery including ORIF or THA. 26 completed

238 WOMAC and SF-8 functional outcome scores and these were found to be relatively good
239 overall (average WOMAC score 12.9 +/- 15.6 (range, 0–59.4), average physical SF-8
240 score 51.1 +/- 8.7 (range, 30.4–58.6), average mental SF-8 score 55 +/- 6.2 (range, 30.4–
241 58.6)). The authors discussed that these scores were similar to another group of
242 operatively managed elderly patients in the same time period, however statistical
243 comparison was not possible due to inherent differences in the groups and selection bias;
244 non-operatively managed patients were significantly older, had more medical
245 comorbidities, shorter follow-up time, and different fracture types.

247 Because of the number of patients required for appropriate statistical power, a
248 multicentre randomised controlled trial is required to assess differences in mortality rates
249 and functional outcomes between acute THA, ORIF and conservative management. A
250 feasibility study has recently completed recruitment in the United Kingdom: ACEfit²⁵.

252 There are various studies in the literature that describe specific operative techniques
253 for specific fracture types, and report mortality rates, conversion rates to THA, and use a
254 heterogeneity of general and hip-specific outcome scores⁷. However, there has been a lack
255 of literature describing the overall functional outcome following operatively managed
256 acetabular fractures in older adults. Our study documents the mean and interquartile range
257 of functional outcome scores of patients over 60 years of age following surgical
258 management of acetabular fractures. Our study group had an 8.8% mortality rate at a
259 median of 18 months, with a high proportion of associated injuries, such as head injuries,
260 thoracic or abdominal injuries, and upper or lower limb injuries. There was a conversion

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261 rate to THA of 23.6% at a median of 10.5 months, particularly in patients involved in non-
262 transport related injuries. We believe this specific finding represents the low-velocity
263 injury causing significant injuries in possibly a more osteopaenic pelvis, leading to failure
264 following ORIF. Specific features that have previously been linked to conversion to THA,
265 such as central dislocations, marginal impaction and dome comminution, were found in
266 high frequency in our study, and it is likely that the study was not powered significantly
267 enough to identify these factors as specific predictors for conversion to THA. Furthermore,
268 the other way of interpreting this data is that 76.4% have not required any further surgery.
269 When considering the functional outcomes of the patients who have survived, it is essential
270 to remember that in groups of older adults there is already a number of patients with pre-
271 existing disability before injury, 15% in our study group. Regarding patients that survive,
272 more than two-thirds of those who were working pre-operatively return to work by 1 year
273 post-operatively, and overall SF-12 PCS scores improved over time and were comparable
274 to age and gender matched controls by 2 years post-injury.

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276 We acknowledge several limitations inherent to our study design. With its
277 retrospective nature and relatively small number of patients, the study was not specifically
278 powered for many sub-analyses. Potential selection bias should be taken into account when
279 interpreting conversion rates to THA as treating surgeons have selected ORIF in cases
280 where they believed appropriate reduction was feasible, and fixation and acute THA has
281 been selected in other cases. We acknowledge that being able to compare surgical
282 outcomes to non-operative management in this patient group would provide very valuable
283 information to help guide decision making. We have not included non-operatively

managed patients in this study as standard management in both centres is to offer surgical management to patients with displaced acetabular fractures, unless there are significant medical comorbidities not allowing this to safely occur. Therefore, in our opinion, comparing ORIF to non-operative management would not add any relevant information as there would be a significant selection bias with only patients with significant medical comorbidities or minimally displaced fractures having been offered non-operative management. Furthermore, there is always a risk to overfit the Cox proportional model, however the measures of overall goodness of fit of the model (Cox-Snell residuals) showed acceptable goodness of fit and there were no highly influential observations. The wide confidence intervals for a number of the estimates do suggest caution in interpretation of the findings and this is expected given the relatively small sample. Finally, there were issues with loss to follow-up which is typically encountered in studies with older patients. This has led to many of our patients being transferred from out of town in the acute trauma setting and subsequently returning to their region of residence and unable or unwilling to travel back for clinical examinations and functional outcome scoring. We attempted to minimise effects of this through the use of telephone-based functional outcome scoring for patients unable to present in person but still willing to participate in the study. We also attempted to increase our sample size by including the two largest major trauma centres in (blinded). Our data was overall rich, particularly through data provision from VOTOR.

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305 Conclusions

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307 Patients 60 years and older treated surgically for displaced acetabular fractures had
308 a significant mortality rate and a high conversion rate to THA in the ORIF group, but
309 overall those who survived had SF-12 PCS scores that were comparable to age and gender
310 matched controls over the next 2 years. Over two-thirds of patients who were working pre-
311 injury were able to return to work by 1 year post-operatively. Further multicentre studies
312 are required to compare functional outcomes following acute THA, ORIF and conservative
313 management to assist surgeons in selecting the optimal management option based on a
314 multitude of patient and fracture-related factors.
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318

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401 **Tables**

402 **Table 1.** Patient and fracture characteristics.

403 **Table 2.** Characteristics of patients who had an acute THA.

404 **Table 3.** Univariate analysis of potential predictors of conversion to THA.

405 **Table 4.** Multivariate analysis of potential predictors of conversion to THA.

406 **Table 5.** Description of mortality cases.

407 **Table 6.** Summary functional outcome scores

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3 409 **Figures**
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5 410 **Figure 1.** Flowchart of patients included in the study.
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7 411 **Figure 2.** Kaplan-Meier survival analysis curve demonstrating conversion to THA
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9 following ORIF comparing transport related and non-transport related injuries after
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12 412
13 controlling for other factors.
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15 414 **Figure 3.** PCS and MCS components of the SF-12.
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|--|--|--|
| Age | Mean (SD) years Range (years) | 69.7 (7.9) 60-89 |
| Gender | N (%) Male Female | 61 (76.3) 19 (23.7) |
| Charlson Comorbidity Index weight ^a | N (%) 0 1 >1 | 47 (68.1) 10 (14.5) 12 (17.4) |
| Cause of injury | N (%) Motor vehicle/motorcycle crash Pedestrian/cyclist Low fall High fall Other | 19 (23.7) 19 (23.7) 23 (28.8) 14 (7.5) 5 (6.3) |
| Isolated injury | N (%) No Yes | 49 (61.3) 31 (38.7) |
| Other injuries | N (%) head injury N (%) thoracic injury N (%) abdominal injury N (%) upper limb injury N (%) other lower limb injury N (%) spinal injury | 13 (16.5) 26 (32.5) 16 (20.2) 23 (28.8) 11 (13.7) 17 (21.2) |
| J-L classification | N (%) Anterior wall Anterior column Posterior wall Posterior column Transverse Posterior column + posterior wall T-type Transverse + posterior wall Anterior column + hemitransverse Both column | 0 (0) 13 (16.2) 15 (18.8) 1 (1.3) 9 (11.3) 5 (6.2) 2 (2.5) 5 (6.2) 8 (10.0) 22 (27.5) |
| J-L classification dichotomized | N (%) Elementary pattern Associated pattern | 38 (47.5) 42 (52.5) |
| Dislocation | N (%) None Central Posterior | 45 (56.3) 21 (26.2) 14 (17.5) |
| Marginal impaction | N (%) No Yes | 53 (66.3) 27 (33.7) |
| Femoral head Fx | N (%) No Yes | 65 (81.3) 15 (18.7) |

| | | |
|---------------------------------------|------------------------------|-----------|
| Infra/supra-foveal femoral head Fx | N (%) | |
| | N/A | 65 (81.3) |
| | Infra-foveal | 7 (8.7) |
| | Supra-foveal | 8 (10.0) |
| Dome comminution | N (%) | |
| | No | 47 (58.8) |
| | Yes | 33 (41.2) |
| Severe osteopenia | N (%) | |
| | No | 72 (90.0) |
| | Yes | 8 (10.0) |
| Pre-existing osteoarthritis | N (%) | |
| | No | 58 (72.5) |
| | Yes | 22 (27.5) |
| Side | N (%) | |
| | Left | 33 (41.3) |
| | Right | 47 (58.7) |
| Surgical approach | N (%) | |
| | Kocher-Langenbeck | 35 (43.8) |
| | Stoppa and lateral window | 16 (20.0) |
| | Iliolinguinal | 7 (8.7) |
| | Stoppa only | 6 (7.5) |
| | Modified IF + ASIS osteotomy | 5 (6.2) |
| Malreduction ^b | Other | 11 (13.8) |
| | N (%) | |
| | No | 66 (83.5) |
| Matta criteria ^c | Yes | 13 (16.5) |
| | N (%) | |
| | Anatomic (0-1mm) | 31 (43.1) |
| | Satisfactory (2-3mm) | 24 (33.3) |
| | Unsatisfactory (>3mm) | 17 (23.6) |

^a11 patients missing data for Charlson comorbidity index, ^bsurvivors to hospital discharge included only, ^cORIF cases only, Fx = fracture, N/A = non-applicable, IF = iliofemoral, ASIS = anterior superior iliac spine

Table 1. Patient and fracture characteristics.

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| Patient | Age | Hospital | J-L Classification | Dislocation | Femoral head Fx | Marginal impaction | Dome comminution |
|---------|-----|-----------|-----------------------------------|-------------|------------------|--------------------|------------------|
| 1 | 61 | (blinded) | Posterior wall | Posterior | Y (supra-foveal) | Y | Y |
| 2 | 83 | (blinded) | Anterior column | Central | N | Y | Y |
| 3 | 82 | (blinded) | Anterior column + hemitransverse | Central | N | Y | Y |
| 4 | 78 | (blinded) | Posterior column + posterior wall | Central | N | Y | Y |
| 5 | 89 | (blinded) | Both column | Central | N | N | Y |
| 6 | 86 | (blinded) | Posterior wall | Posterior | Y (supra-foveal) | Y | N |
| 7 | 71 | (blinded) | Both column | Central | N | N | Y |
| 8 | 66 | (blinded) | Transverse | Central | N | N | N |

420 J-L = Judet-Letournel, Fx = fracture, Y = yes, N = no, (blinded) = (blinded)
421 **Table 2.** Characteristics of patients who had an acute THA.

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| | | Hazard Ratio (95% CI) | p-value |
|------------------------------------|------------------------|---------------------------|---------|
| Age | | 1.06 (0.99, 1.14) | 0.09 |
| Sex | Male (reference) | 1.00 | |
| | Female | 2.08 (0.71, 6.08) | 0.18 |
| Compensable | No (reference) | 1.00 | |
| | Yes | 0.69 (0.22, 2.16) | 0.53 |
| CCI weight | 0 (reference) | 1.00 | |
| | >0 | 0.99 (0.32, 3.04) | 0.98 |
| Transport related | No (reference) | 1.00 | |
| | Yes | 0.22 (0.06, 0.76) | 0.02 |
| Isolated injury | No (reference) | 1.00 | |
| | Yes | 1.15 (0.42, 3.09) | 0.79 |
| Femoral head fracture | <u>No (reference)</u> | <u>1.00</u> | |
| | <u>Yes</u> | <u>1.53 (0.50, 4.66)</u> | 0.46 |
| Infra/supra-foveal femoral head Fx | N/A | 1.00 | 0.33 |
| | Infra-foveal | 0.64 (0.08, 5.11) | |
| | Supra-foveal | 2.33 (0.71, 7.67) | |
| Dome comminution | Yes (reference) | 1.00 | |
| | No | 1.37 (0.49, 3.89) | 0.55 |
| Severe osteopenia | <u>No (reference)</u> | <u>1.00</u> | |
| | <u>Yes</u> | <u>2.92 (0.63, 13.52)</u> | 0.17 |
| Osteoarthritis | <u>No (reference)</u> | <u>1.00</u> | |
| | <u>Yes</u> | <u>1.07 (0.38, 3.00)</u> | 0.90 |
| J-L classification | Elementary (reference) | 1.00 | |
| | Associated | 1.21 (0.45, 3.30) | 0.70 |
| Dislocation | None (reference) | 1.00 | 0.03 |
| | Central | 4.56 (1.39, 15.02) | |
| | Posterior | 2.46 (0.54, 11.18) | |
| Side | Right (reference) | 1.00 | |
| | Left | 0.93 (0.34, 2.50) | 0.88 |
| Marginal impaction | <u>No (reference)</u> | <u>1.00</u> | |
| | <u>Yes</u> | <u>1.52 (0.56, 4.11)</u> | 0.41 |
| Malreduction | <u>No (reference)</u> | <u>1.00</u> | 0.10 |
| | <u>Yes</u> | <u>2.47 (0.85, 7.18)</u> | |
| Matta criteria | Anatomic (0-1mm) | 1.00 | 0.17 |
| | Satisfactory (2-3mm) | 2.08 (0.55, 7.79) | |
| | Unsatisfactory (>3mm) | 3.17 (0.90, 11.12) | |

CCI = Charlson comorbidity index, Fx = fracture, J-L = Judet-Letournel, N/A = non-applicable

Table 3. Univariate analysis of potential predictors of conversion to THA.

| | | Adjusted Hazard Ratio (95% CI) | p-value |
|-------------------|-----------------------|--------------------------------|---------|
| Age group | | 1.02 (0.92, 1.14) | 0.69 |
| Sex | Male (reference) | 1.00 | 0.14 |
| | Female | 3.39 (0.67, 17.14) | |
| Transport related | No (reference) | 1.00 | 0.04 |
| | Yes | 0.12 (0.02, 0.91) | |
| Severe osteopenia | No (reference) | 1.00 | 0.39 |
| | Yes | 2.21 (0.36, 13.65) | |
| Dislocation | None (reference) | 1.00 | 0.45 |
| | Central | 0.98 (0.17, 5.55) | |
| | Posterior | 3.78 (0.48, 30.01) | |
| Malreduction | No (reference) | 1.00 | 0.51 |
| | Yes | 2.09 (0.23, 18.90) | |
| Matta criteria | Anatomic (0-1mm) | 1.00 | 0.79 |
| | Satisfactory (2-3mm) | 1.91 (0.30, 12.36) | |
| | Unsatisfactory (>3mm) | 1.42 (0.11, 18.05) | |

Table 4. Multivariate analysis of potential predictors of conversion to THA.

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| | Patients | Deaths* (%) | |
|--|----------|-------------|--|
| Acute THA | 8 | 4 (50%) | Death at 4y11m, 1y6m, 1y3m, 1 unknown time |
| ORIF converted to THA | 16 | 2 (12.5%) | Death at 3y, 1 death from post-operative myocardial infarction following conversion to THA at 2y6m |
| ORIF converted to THA then Girdlestone for infection | 1 | 0 (0%) | |
| ORIF with native hip | 55 | 1 (1.8%) | Death from aspiration at 3m |

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*7/80 (8.8%) patients confirmed deceased at median (IQR) follow-up of 18 months (12-25 months)

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Table 5. Description of mortality cases.

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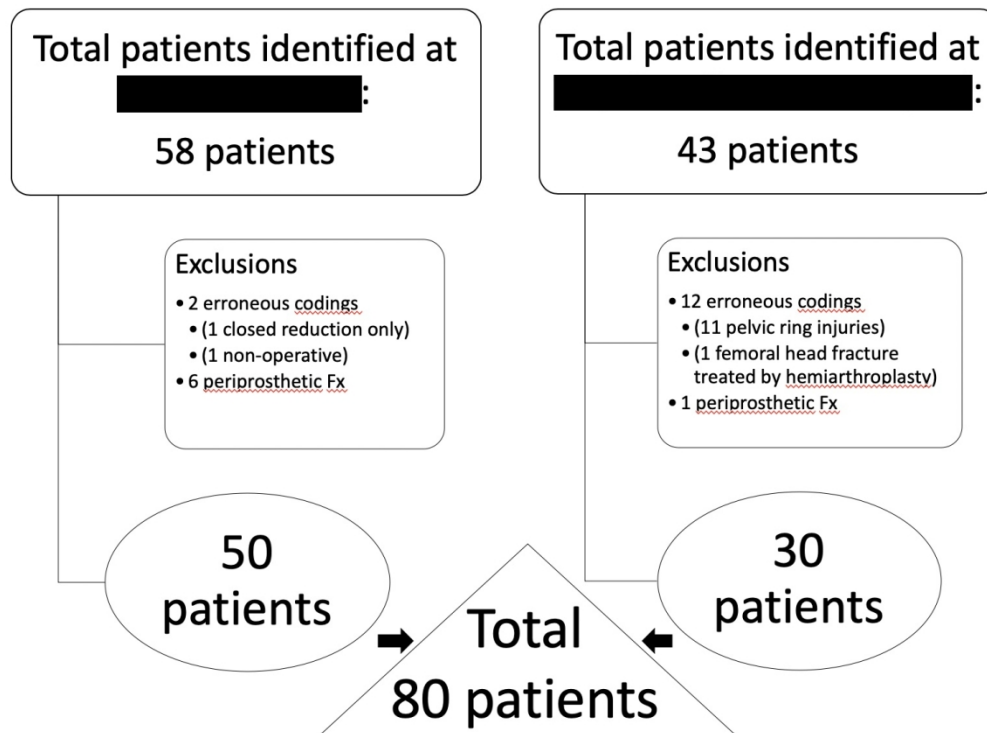
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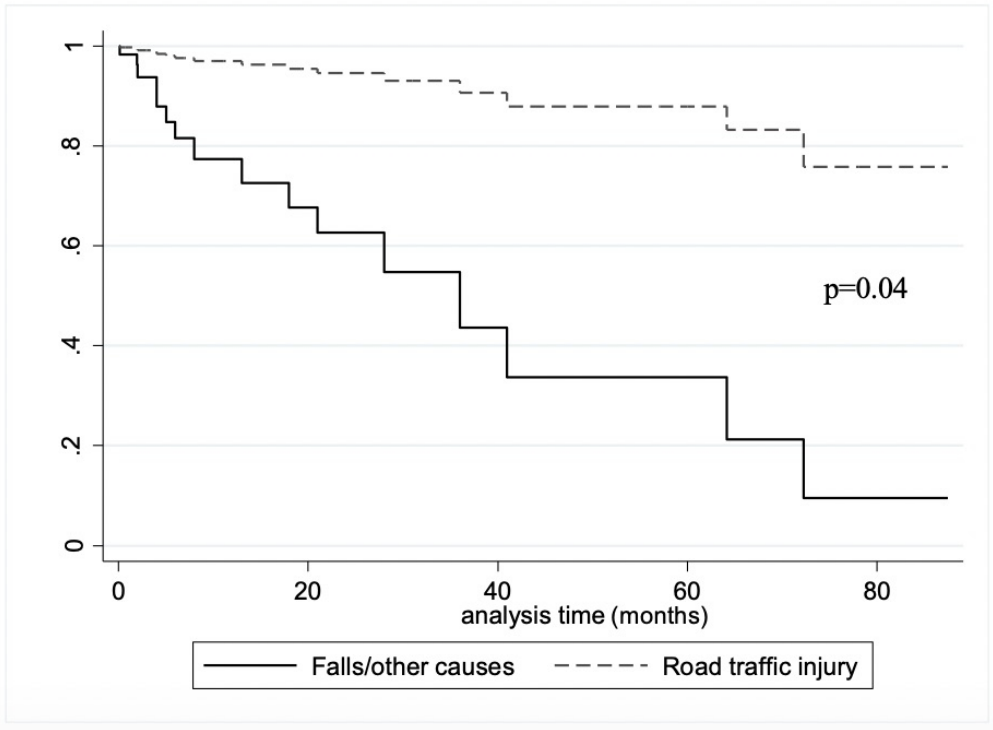
| Outcome | N | Median (IQR) last follow-up (months since injury) | Mean (SD) score |
|-----------------------|----|---|-----------------|
| PCS-12 | 64 | 24.0 (13.0-24.7) | 41.6 (13.0) |
| MCS-12 | 64 | 24.0 (13.0-24.7) | 53.6 (9.6) |
| PCS-26 | 28 | 24.8 (10.1-55.6) | 40.8 (12.9) |
| MCS-36 | 28 | 24.8 (10.1-55.6) | 57.5 (7.7) |
| SMFA Function | 30 | 24.5 (12.5-53.7) | 20.5 (18.4) |
| SMFA Bother | 29 | 24.5 (12.5-53.7) | 17.6 (18.3) |
| WOMAC | 32 | 23.3 (10.1-53.7) | 83.9 (15.7) |
| Harris Hip Score | 26 | 25.4 (12.5-55.6) | 82.2 (15.8) |
| Outcome | N | Median (IQR) last follow-up (months since injury) | N (%) |
| Merle D'Aubigné score | 21 | 39.8 (23.6-56.9) | 0 4 (19.0) |
| | | | 1 9 (42.9) |
| | | | 2 5 (23.8) |
| | | | 3 3 (14.3) |
| Return to work* | 28 | 24.2 (18.5-24.6) | No 9 (32.1) |
| | | | Yes 19 (67.9) |

* if working prior to injury (n=29 working prior to injury)

Table 6. Summary functional outcome scores

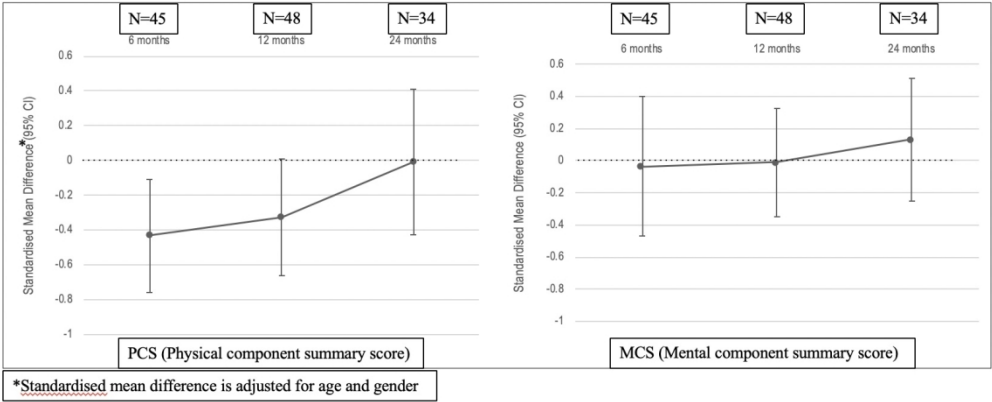


Flowchart of patients included in the study.



Kaplan-Meier survival analysis curve demonstrating conversion to THA following ORIF comparing transport related and non-transport related injuries after controlling for other factors.

161x119mm (144 x 144 DPI)



PCS and MCS components of the SF-12.

292x119mm (144 x 144 DPI)