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Management and outcome of the dislocated hip hemiarthroplasty

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Aims

This study describes and compares the operative management and outcomes in a consecutive case series of patients with dislocated hemiarthroplasties of the hip, and compares outcomes with those of patients not sustaining a dislocation.

Patients and Methods

Of 3326 consecutive patients treated with hemiarthroplasty for fractured neck of femur, 46 (1.4%) sustained dislocations. Of the 46 dislocations, there were 37 female patients (80.4%) and nine male patients (19.6%) with a mean age of 83.8 years (66 to 100). Operative intervention for each, and subsequent dislocations, were recorded. The following outcome measures were recorded: dislocation; mortality up to one-year post-injury; additional surgery; residential status; mobility; and pain score at one year.

Results

Of 43 dislocations, 30 (70%) occurred within one month and 42 (98%) occurred within three months of hip fracture surgery. Seven (16%) of these patients were treated with a single closed reduction and sustained no further dislocations. Four (9%) were treated with open reduction and experienced no further dislocations. Three (7%) hips were left dislocated and the remaining 32 (74%) patients required additional surgery of further closed reduction, revision, or excision arthroplasty. The one-year mortality rates for patients treated with two or fewer reductions (open or closed), successful revision arthroplasty, and excision arthroplasty were 3/14 (21%), 1/7 (14%), and 8/14 (57%) respectively. The only statistically significant difference in mortality was the difference between patients who did not sustain a dislocation and those who did and were treated by excision arthroplasty (p = 0.03). Patients treated by excision arthroplasty had the greatest reduction in mobility scores and highest pain scores. The excision arthroplasty group also included the greatest proportion of patients not able to mobilize and the smallest proportion of patients remaining in their own home.

Conclusion

Most dislocations of hemiarthroplasties of the hip occur within one month of surgery. Closed reduction is generally unsuccessful. For those patients with unsuccessful closed reduction, revision arthroplasty should be considered when possible, as this results in a better functional outcome with a lower mortality than excision arthroplasty.

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Hemiarthroplasty is the commonest surgical procedure by which displaced intracapsular fractures of the femoral neck are treated in elderly patients.[1] The annual incidence of hip fracture in the United Kingdom is approximately 77 000 and, according to the 2017 report from the National Hip Fracture Database, 43.0% of all hip fractures were managed by hemiarthroplasty.[1,2] Treating these elderly patients is challenging due to their frailty and frequent multiple comorbidities. The goals of treatment are to relieve pain, to minimize further physiological insult from blood loss, dehydration, or anaesthesia, and to enable safe, early mobilization. Surgical complications in this population can be devastating. Dislocation of a hemiarthroplasty of the hip is a relatively rare but serious complication, with rates reported in the literature varying between 0.8% and 6.1%.[3-14] Management

Table I. Patient characteristics and surgical details of patients with and without dislocation

	Dislocation (n = 46)	No dislocation (n = 3280)	p-value
Patient characteristics			
Mean age, yrs (range)	83.8 (66 to 100)	82.7 (45 to 106)	0.32*
Female, n (%)	37 (*80.4*)	2600 (*79.3*)	1.00†
From own home, n (%)	29 (*63.0*)	2441 (*74.4*)	0.09†
In institutional care, n (%)	17 (*37.0*)	839 (*25.6*)	
Mean ASA (SD)	2.9 (0.7)	2.7 (0.7)	0.22*
Mean MTS (SD)	5.9 (3.4)	4.69 (3.7)	0.02*
Type of hemiarthroplasty, n (% dislocation rate)			
Austin Moore	12 (*0.8*)	1474	0.01†
Thompson	6 (*1.5*)	406	0.82†
Exeter Trauma Stem	20 (*2.2*)	892	0.02†
Bipolar	4 (*4.9*)	81	0.03†
CPT Hip System	3 (*1.1*)	274	1.00†
Furlong	1 (*0.6*)	153	0.72†
Surgical approach, n (% dislocation rate)			
Anterior lateral	31 (*1.1*)	2803	< 0.001†
Anterior	1 (*16.7*)	6	0.10†
Posterior	14 (*3.7*)	381	< 0.001†
Cement, n (% dislocation rate)			
Cemented	35 (*2.1*)	1677	0.02†
Uncemented	11 (*0.7*)	1511	
Supervising surgeon, n (% dislocation rate for surgeon grade)			
Consultant	29 (*1.3*)	2301	0.33†
Other	17 (*1.7*)	979	

*Unpaired Student's *t*-test
†Fisher's exact test
ASA, American Society of Anesthesiologists Physical Status classification, pre-fracture surgery; MTS, Mental Test Score

of patients with this problem is fraught with difficulty due to frailty, comorbidity, and poor quality of bone and soft tissues. Dislocation results in significant morbidity and an increased length of hospital stay for those patients in whom it occurs early, or re-admission to hospital for those in whom it occurs later, all of which amount to an increased financial cost of NHS and social care.[2] Effective treatment is, therefore, essential.

Treatment options include closed or open reduction, revision hemiarthroplasty, revision to total hip arthroplasty (THA), and Girdlestone excision arthroplasty, all of which entail advantages and disadvantages. Closed reduction is non-invasive and can usually be performed with a relatively short general anaesthetic but there is, however, significant risk of further dislocation. Open reduction may be successful if it includes release of soft tissues trapped in the hip joint and contributing to an early dislocation. Revision arthroplasty carries the greatest anaesthetic risk, due to both the duration of the procedure and potential blood loss, but has the benefit of improved mobility and reduced pain in the longer term.[15] Excision arthroplasty obviates further dislocations but compromises mobility and can result in persistent pain.[16-18]

There is a lack of high-quality literature to guide decision making in the management of patients with dislocated hemiarthroplasties of the hip. The aim of this case series is to describe the operative management and outcomes from the largest published series to date of patients with dislocated hemiarthroplasties of the hip, and to outline our treatment strategy.

Patients and Methods

A review of the prospectively maintained hip fracture database at our institution was conducted to identify all patients who underwent hemiarthroplasty for a fractured neck of femur and subsequently sustained a dislocation between October 1986 and December 2016. Only patients who had their primary surgery performed at our institution (Peterborough City Hospital, Peterborough, United Kingdom) were included. Operative interventions for each dislocated hemiarthroplasty and subsequent dislocations were recorded. All surviving patients were reviewed either in a hip fracture clinic or by a telephone assessment of pain and function, along with whether the patient had required further surgery within one year of injury. In addition, any patient referred back with a dislocation more than one year from injury was included. Death within one year of injury and residential status, mobility, and pain score at one year formed the outcome measures of this study. Mobility was assessed using a scale ranging from 0 (least mobile) to 9 (most mobile) and the use of walking aids was also noted.[19,20] Pain was recorded according to a scale from 1 (no pain) to 6 (severe and constant pain).[21] Residential status was recorded as either living at home or in institutional care.

Statistical analysis. Statistical analysis was performed using SPSS version 25 software (IBM Corp., Armonk, New York). The unpaired Student's *t*-test and two-tailed Fisher's exact test were used to compare the means of continuous data and categorical data, respectively, with significance set at $p < 0.05$.

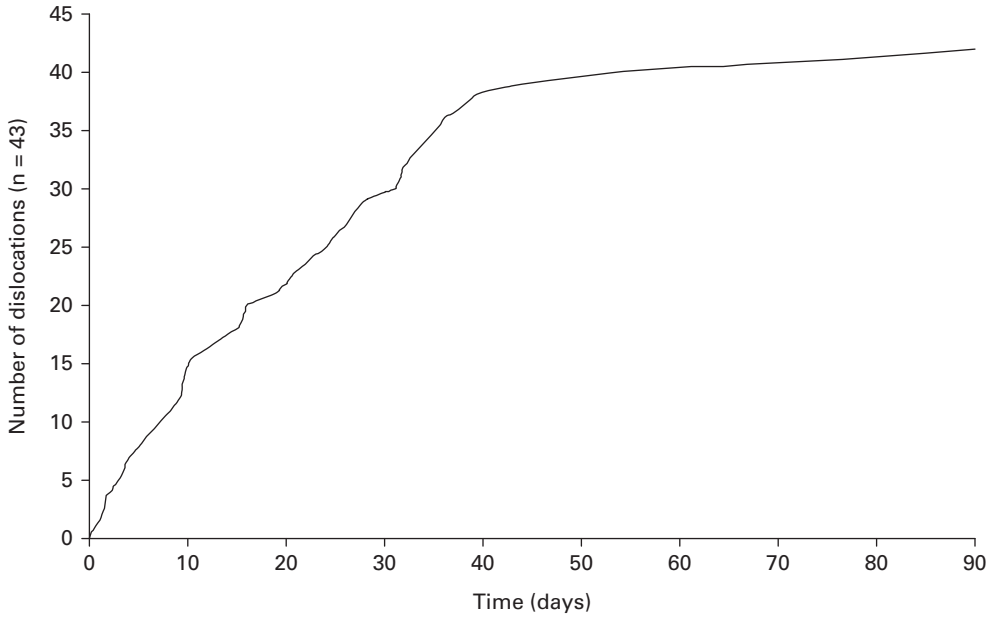

Fig. 1

Graph showing time to first dislocation following hemiarthroplasty (excluding the patient who sustained a first dislocation 1979 days postoperatively).

Kaplan–Meier survivorship analysis with 95% confidence intervals (CIs) was used to compare patient mortality.

Results

During the 30-year study period, 3326 patients underwent hemiarthroplasty for displaced intracapsular fractures of the femoral neck, of whom 46 (1.4%) sustained one or more dislocations. Table I details the characteristics of the patients who experienced a dislocation and compares them with those of the 3280 patients who did not. Dislocation was more common when the posterior surgical approach, bone cement, a bipolar prosthesis or an Exeter Trauma Stem (ETS; Stryker, Newbury, United Kingdom) were used. The mean mental test score (MTS) was significantly lower in patients who sustained a dislocation when compared with those who did not.[22] The proportion of initial operations performed by consultants was higher in the group with no dislocations, but this difference was not statistically significant. The median time from surgery to dislocation was 21 days (interquartile range (IQR) 9 to 33) (Fig. 1). Of 43 dislocations for which the time of dislocation was known, 30 (70%) occurred within one month and 42 (98%) occurred within three months of surgery.

The operative management of the cohort of patients experiencing dislocation is outlined in Figure 2. Data were incomplete for six patients who were initially treated by closed reduction, but later sustained a further dislocation for which the treatment and outcome was unknown. These six patients were all treated during the early part of the study and it was not possible to retrieve the missing data.

Of the 46 patients in this cohort, 43 had an attempted closed reduction performed in the operating theatre, for whom this was successful on 18 occasions and resulted in a hemiarthroplasty found to be stable when examined under anaesthesia (EUA). Seven required no further treatment after a single closed reduction, thereby rendering the chance of a single closed reduction being successful and requiring no further treatment as 7/43 (16.3%). If the hip could be reduced closed and was stable at EUA, the chance of no further dislocation was 7/18 (38.9%), while the risk of subsequent dislocations was 11/18 (61.1%). Of the four patients who were treated with a closed reduction for a second dislocation, two experienced no further dislocations (although one died within one month of the second dislocation and so there was limited time for a third dislocation to occur). The chance of re-dislocation in our cohort following a second closed reduction was, therefore, between 2/3 (66.6%) and 2/4 (50%). Three patients with dislocations were managed non-operatively with no attempted reduction, as they were deemed to be chronic injuries discovered at follow-up of patients who had struggled to mobilize and the time at which the dislocations had occurred could not be determined.

In total, six patients required an open reduction, four (66.7%) of whom required no further treatment. The indications for open reduction were a hemiarthroplasty that was either irreducible closed or unstable on EUA after closed reduction. In all cases in which an open reduction was performed without the need to proceed to revision arthroplasty, joint capsule was found interposed in the joint; once it was removed and a capsular repair was performed, the joint remained stable. Three open reductions were performed for first-time dislocations and none of these patients sustained further dislocations.

A total of nine revision THAs were performed. The revision femoral implants used were dual-taper cemented femoral components (CPT, Zimmer Biomet, Warsaw, Indiana) in seven cases, a Furlong uncemented long femoral component (JRI Ltd,

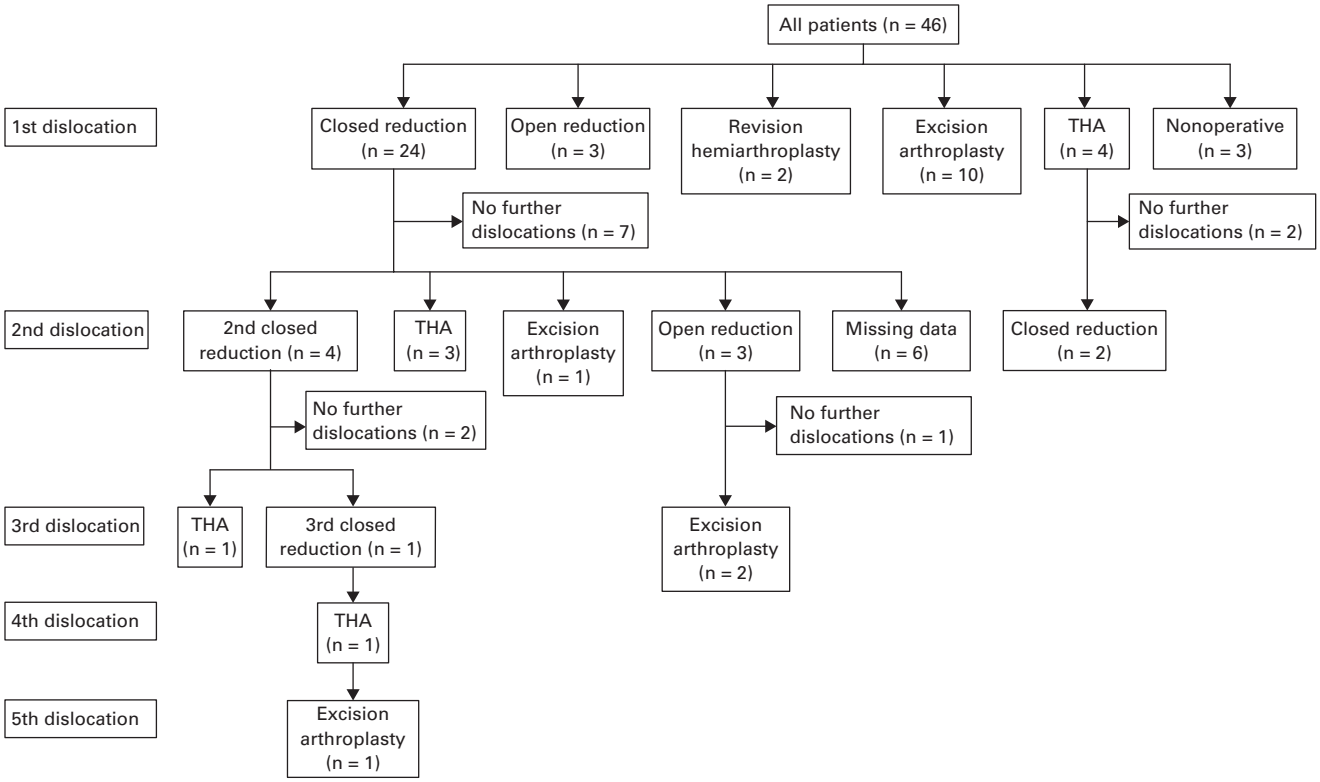

Fig. 2

Tree diagram displaying the operative management of patients with a dislocated hemiarthroplasty. THA, total hip arthroplasty.

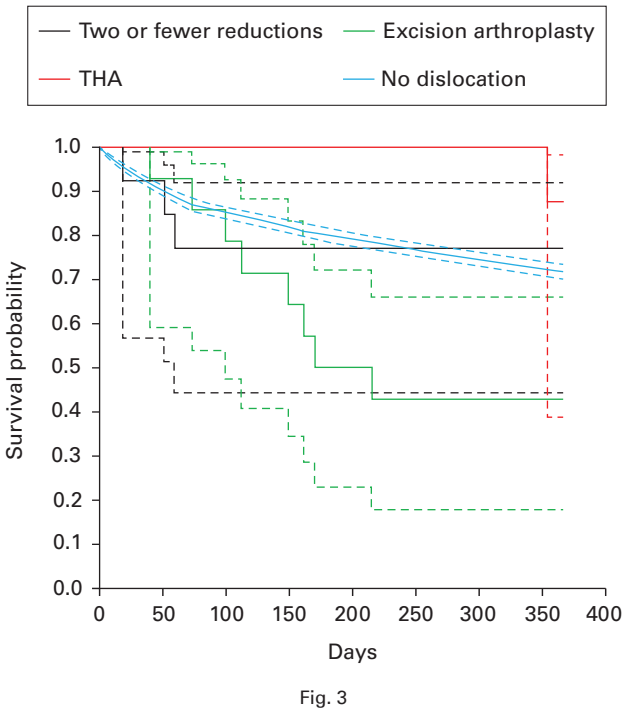

Fig. 3

Kaplan–Meier survival curve comparing mortality up to one-year post-primary hemiarthroplasty, by group. Dotted lines represent upper and lower confidence intervals.

London, United Kingdom), and a ZMR modular femoral component (Zimmer Biomet). Constrained acetabular components were not used in any procedures. Six of the nine patients (66.7%) undergoing revision THA experienced no further dislocations. Of the three (33.3%) that went on to a further dislocation following revision THA, two were managed successfully with a single closed reduction and the remaining patient was treated by excision arthroplasty. The patient in whom revision THA failed and was treated by excision arthroplasty had previously undergone three closed reductions for dislocation of their hemiarthroplasty prior to undergoing revision THA and so the soft tissues were in a poor condition.

In total, the treatment of 14 patients concluded with excision arthroplasty; in ten cases, these were performed for treatment of a first-time dislocation due to the hip being irreducible or unstable following attempted reduction. In three of these cases, deep wound infection was also present.

The one-year mortality for all patients with dislocation when compared with those without dislocation was 18/46 (39.1%) *versus* 852/3011 (28.3%); this difference was not statistically significant (Fisher's exact test; $p = 0.14$). The one-year mortality for patients treated with two or fewer reductions (open or closed), THA, and excision arthroplasty was 3/14 (21%), 1/7 (14%), and 8/14 (57%), respectively (Fig. 3 and Table II).

The only difference in mortality that was statistically significant was that between patients without dislocation and those with dislocation who were treated by excision arthroplasty

Table II. The one-year mortality rate according to stability and subsequent management

	Mortality, n (%)	p-value*
No dislocation	852/3011 (*28.3*)	N/A
All dislocations	18/46 (*39.1*)	0.1368
Dislocations treated with:		
Two or fewer reductions	3/14 (*21.4*)	0.7689
Revision total hip arthroplasty	1/7 (*14.3*)	0.6809
Excision arthroplasty	8/14 (*57.1*)	0.0317

*Fisher's exact test
N/A, not applicable

Table III. Patient characteristics for patients who sustained a dislocated hemiarthroplasty and were managed with two or fewer reductions, revision total hip arthroplasty (THA), excision arthroplasty and those without dislocation

	No dislocation (n = 3280)	Two or fewer reductions (n = 14)	p-value*	Revision THA (n = 8)	p-value*	Excision arthroplasty (n = 14)	p-value*
Mean age, yrs (SD)	82.7 (7.7)	84.5 (8.3)	0.39	85.5 (6.6)	0.30	84.2 (9.8)	0.47
Mean ASA (SD)	2.7 (0.7)	2.6 (0.9)	0.46	3.1 (0.4)	0.09	2.7 (0.5)	0.96
Mean MTS (SD)	5.9 (3.4)	4.4 (4.5)	0.16	6.0 (3.7)	0.95	3.2 (3.0)	0.005

*Unpaired Student's *t*-test
ASA, American Society of Anesthesiologists Physical Status classification, pre-fracture surgery; MTS, Mental Test Score

Table IV. Functional outcomes for surviving patients one-year post-injury

	No dislocation	Two or fewer reductions	p-value	Revision THA	p-value	Excision arthroplasty	p-value
Mean pain score (SD)	1.8 (1.1)	1.0 (0.0)	0.08*	1.3 (0.5)	0.23*	2.3 (1.0)	0.44*
Mean mobility score (SD)	4.3 (2.4)	3.0 (2.6)	0.13*	2.9 (1.1)	0.19*	0.4 (0.9)	0.0003*
Mean change in mobility score (SD)	-1.4 (2.0)	-1.8 (2.5)	0.60*	-2.1 (2.9)	0.31*	-3.6 (0.5)	0.0131*
Not able to walk, n (%)	225/2097 (*10.8*)	2/7 (*29*)	0.17†	0/7 (*0*)	1.00†	2/3 (*67*)	0.09†
Remaining in own home (%)	1891/2199 (*86.0*)	6/8 (*75*)	0.31†	5/5 (*100*)	1.00†	1/3 (*33*)	0.05†

*Unpaired Student's *t*-test
†Fisher's exact test

(Fisher's exact test; p = 0.03). Characteristics for patients treated with two or fewer reductions, revision THA, and excision arthroplasty are displayed in Table III. Patients treated by excision arthroplasty had a significantly lower MTS than those without dislocation. The details of functional outcomes at one year post-injury by group are shown in Table IV. Patients who sustained dislocations and were treated by no more than two reductions, revision THA, or excision arthroplasty had lower mobility scores one year subsequent to their primary surgery when compared with patients who did not sustain dislocation. Those treated by excision arthroplasty had the greatest reduction in mobility scores, the highest pain scores, the greatest proportion not able to mobilize, and the fewest patients remaining in their own home (Table IV). Two revision hemiarthroplasties were performed for treatment of first-time dislocations of hemiarthroplasty but both patients died within one year of primary surgery and so no functional outcome data were available for either.

Discussion

The dislocation rate in our cohort was 46/3326 (1.4%), comparable to rates reported to range between 0.8% and 6.1%.[3-14] Previous studies also noted that the majority of these dislocations occur early after primary surgery (Fig. 1).[3,8,9,12,13,23]

For patients in this cohort, there was a significantly increased risk of dislocation associated with a posterior surgical approach, bipolar or Exeter Trauma Stem prosthesis, and with the use of cement. Numerous authors have reported the association with the posterior approach.[4,23,24] The association with a cemented prosthesis was reported in a systematic review, although the results became non-significant when adjusting for posterior approach.[4] Bipolar hemiarthroplasties were designed to reduce acetabular wear and were suggested to reduce the risk of dislocation, but this has not been supported by the results of this study nor other published literature.[4] Preoperative MTS was significantly lower in patients who went on to dislocate compared with those who did not. This is in keeping with the findings of Ninh et al,[8] who have also shown cognitive impairment to be a risk factor for dislocation of hemiarthroplasties. Other surgical and anatomical factors that might contribute include the version of the implant, head size and offset, excessive length of residual femoral neck, and acetabular coverage.[8,25]

In this cohort, mortality was significantly increased for patients with dislocations who were ultimately treated by excision arthroplasty when compared with those who did not dislocate. There was no significantly different rate of mortality when comparing all patients with dislocation with those with no dislocation. While some studies have reported an increased mortality with dislocations of hemiarthroplasties,[5,10,12] there is an equivocal evidence base.[6,11] It is possible that the heterogeneity in these results may be underpinned by the wide range of treatment options reported, as well as highly diverse patient cohorts.

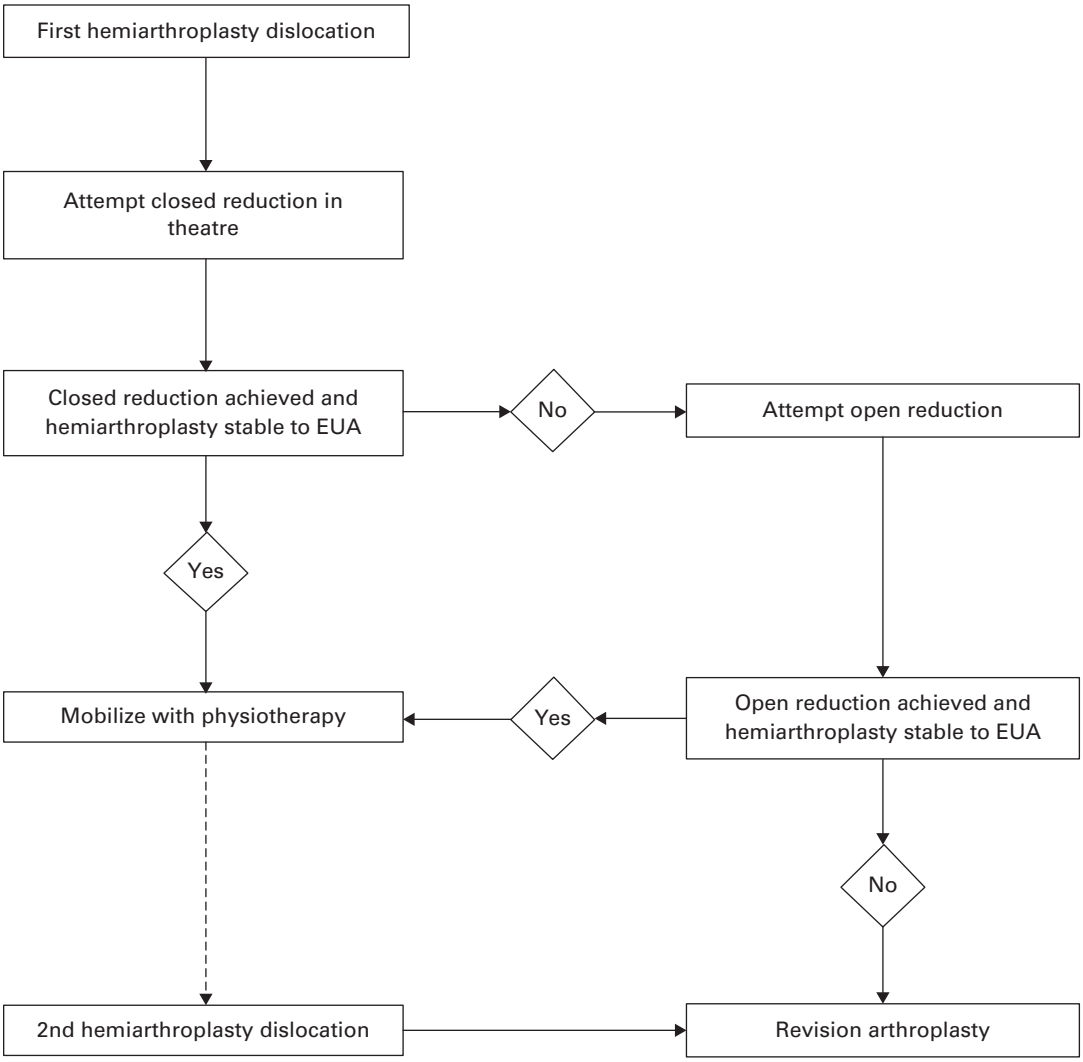

Fig. 4

Algorithm for treatment of patients with dislocated hemiarthroplasty of the hip. EUA, examination under anaesthesia.

Mobility scores at one year post-injury were lower for all groups, regardless of whether the patient had sustained a dislocation or how it was treated. There is little literature reporting pain and mobility in patients who have been treated for a dislocated hip hemiarthroplasty. Enocson et al[26] assessed the impact of dislocation on health-related quality of life (HRQoL) using the EuroQol (EQ-5D)[27] in patients treated with hip arthroplasty for a neck of femur fracture. The cohort comprised patients who were treated by both hemiarthroplasty and THA for hip fracture. There was a significant, persistent reduction in HRQoL in patients experiencing two or more dislocations, but only a temporary reduction in those with a single dislocation.

The main aim of this study was to describe and compare the management of patients with dislocated hemiarthroplasties of the hip. While there is an abundance of literature on the management of patients with a dislocated THA, there is a paucity of evidence to guide management of those with dislocated hemiarthroplasties. Our results reflect that the management of these patients differs greatly from that of those with a dislocated THA. The patients tend to be much frailer with poorer bone and soft-tissue quality. Stable closed reduction is less likely to be successful. Closed reduction does not address the main factors that contribute to hemiarthroplasty dislocation: compromised soft tissues and implant version. Hemiarthroplasty dislocation results in further soft-tissue disruption due to dislocation of the large prosthetic head. Our re-dislocation rates are comparable to those reported in other case series, which range from 44% to 80%.[3,9-14,23,28,29] The limited success of closed reduction reinforces the message of previous studies advocating further surgical intervention in preference to repeated attempts at closed reduction.[10,11]

Our management strategy has changed over the 30-year timeframe of this study. The series showed a trend away from excision arthroplasty as an early treatment in the earlier years, towards management by revision arthroplasty more latterly. We attribute this to increased awareness of the poor mobility and pain associated with excision arthroplasty.[16-18,30,31] There are also now more revision implant options available,

Fig. 5a

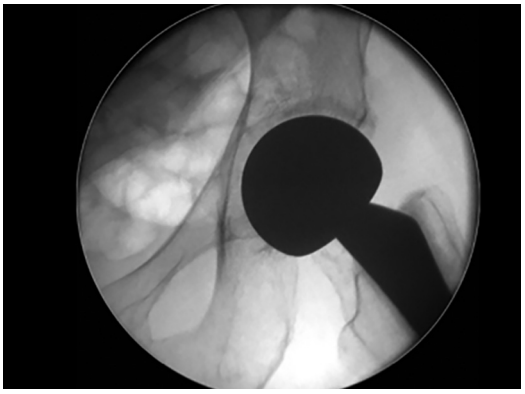

Fig. 5b

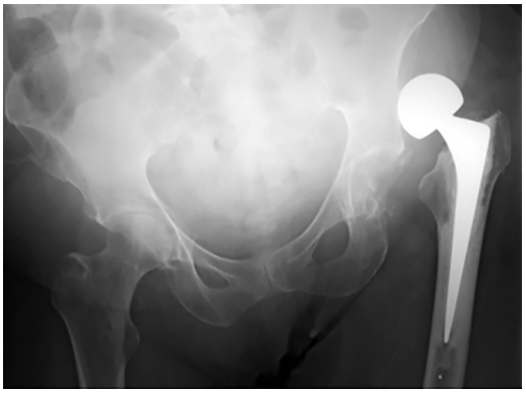

Fig. 5c

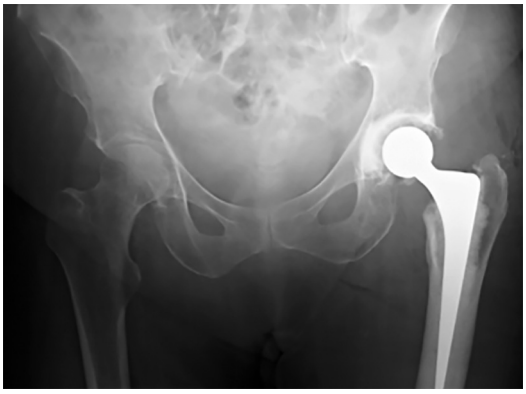

Fig. 5d

Radiographs of a 99-year-old female patient treated for a left hemiarthroplasty dislocation: a) first dislocation; b) fluoroscopic image confirming successful closed reduction; c) second dislocation; and d) postoperative radiograph following revision total hip arthroplasty, femoral component exchanged utilizing cement-in-cement technique.

including polished dual tapered femoral components, allowing cement in cement revisions, larger head sizes for THA, dual mobility acetabular components, and constrained liners.[32] The benefits of THA as a primary surgical treatment for patients with a displaced intracapsular neck of femur fracture are recognized in the literature but so too are the increased risks of dislocation.[15,33] Coomber et al[34] published a review of the evidence on technique for performing a THA in the trauma setting and advised the use of larger head sizes (32 mm to 36 mm) in order to reduce the risk of dislocation. Sierra and Cabanela[35] published a series of 132 patients with hemiarthroplasties of the hip revised to THA. Although none of the revisions were performed for dislocation, major complications were reported in 44% of cases. Sah and Estok[33] reported a case series of 89 patients with hemiarthroplasties revised to THA with a dislocation rate of 22%; only three of the revisions were performed for instability of the hemiarthroplasty. The dislocation rate following revision to THA in our series was 3/9 (33.3%); the higher rate could be due to the small sample size and the fact that all revisions were performed for dislocation.

Two patients early in our series were managed with a revision hemiarthroplasty; in both cases a Thompson hemiarthroplasty was revised to an Austin Moore. We no longer advocate performing a revision hemiarthroplasty with a monoblock prosthesis; a revision modular hemiarthroplasty remains an option. The use of a modular polished dual taper femoral component for fracture surgery is now favoured at our institution, as it affords the option of component retention or cement-in-cement revision.[36] Use of a modular femoral prosthesis in revision arthroplasty surgery also allows the option of a trial of stability with a hemiarthroplasty head. In cases where instability is due to femoral component malposition alone, a revision hemiarthroplasty may be adequate to restore stability without the need for preparation of the acetabulum and a revision THA.

There are a number of limitations of this study. It is possible that patients presented to another institution for treatment of a dislocated hemiarthroplasty and so were lost to follow-up. The heterogeneity of management and relatively small cohort makes comparison of outcomes difficult. The high mortality associated with the index injury means that the cohort dwindles rapidly and loss to follow-up is therefore high. The follow-up of individual patients also varied substantially. Due to the wide dates for inclusion, radiographs were not available for many of the patients and so it was not possible to ascertain surgical or anatomical factors such as implant position, head size, or acetabular coverage in these patients. As is inherent to all retrospective case series, patients were not randomized and this

could result in confounding of mortality and functional outcome data.

The knowledge gained from this study has been distilled into a treatment algorithm for patients with a dislocated hemiarthroplasty (Figs 4 and 5). A first-time dislocation can be treated with an attempt at closed reduction in the operating theatre. If it reduces successfully and is stable upon EUA, no further operative intervention need be performed. If the hemiarthroplasty will not reduce with a closed reduction, an open reduction should be attempted. If the hip is found to be unstable following an open reduction, revision arthroplasty should be performed. If the patient sustains a second dislocation following initial management with closed reduction, revision arthroplasty should be considered. Excision arthroplasty remains a last resort for patients with irretrievably failed hips associated with additional problems including prosthetic joint infection.[37]

Take home message

- A single closed reduction of a dislocated hemiarthroplasty was successful in only 7/43 (16%) patients.
- Revision arthroplasty results in outcomes comparable to those seen in patients without dislocation, while excision arthroplasty results in a very poor outcome and should be avoided.

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References

1. **No authors listed.** National Hip Fracture Database (NHFD) annual report 2017. Falls and Fragility Fracture Audit Programme. Royal College of Physicians. https://www.nhfd.co.uk/files/2017ReportFiles/NHFD-AnnualReport2017.pdf (date last accessed 16 August 2018).
2. **White SM, Griffiths R.** Projected incidence of proximal femoral fracture in England: a report from the NHS Hip Fracture Anaesthesia Network (HIPFAN). *Injury* 2011;42:1230–1233.
3. **Madanat R, Mäkinen TJ, Ovaska MT, et al.** Dislocation of hip hemiarthroplasty following posterolateral surgical approach: a nested case–control study. *Int Orthop* 2012;36:935–940.
4. **Varley J, Parker MJ.** Stability of hip hemiarthroplasties. *Int Orthop* 2004;28:274–277.
5. **Suh KT, Kim DW, Lee HS, Seong YJ, Lee JS.** Is the dislocation rate higher after bipolar hemiarthroplasty in patients with neuromuscular diseases? *Clin Orthop Relat Res* 2012;470:1158–1164.
6. **Unwin AJ, Thomas M.** Dislocation after hemiarthroplasty of the hip: a comparison of the dislocation rate after posterior and lateral approaches to the hip. *Ann R Coll Surg Engl* 1994;76:327–329.
7. **Petersen MB, Jørgensen HL, Hansen K, Duus BR.** Factors affecting postoperative mortality of patients with displaced femoral neck fracture. *Injury* 2006;37:705–711.
8. **Ninh CC, Sethi A, Hatahet M, et al.** Hip dislocation after modular unipolar hemiarthroplasty. *J Arthroplasty* 2009;24:768–774.
9. **Blewitt N, Mortimore S.** Outcome of dislocation after hemiarthroplasty for fractured neck of the femur. *Injury* 1992;23:320–322.
10. **Sierra RJ, Schleck CD, Cabanela ME.** Dislocation of bipolar hemiarthroplasty: rate, contributing factors, and outcome. *Clin Orthop Relat Res* 2006;442:230–238.
11. **Barnes CL, Berry DJ, Sledge CB.** Dislocation after bipolar hemiarthroplasty of the hip. *J Arthroplasty* 1995;10:667–669.
12. **Noon AP, Hockings M, Warner JG.** Dislocated Thompson hemiarthroplasty--the management of the recurrent dislocator. *Injury* 2005;36:618–621.
13. **Salem KMI, Shannak OA, Scammell BE, Moran CG.** Predictors and outcomes of treatment in hip hemiarthroplasty dislocation. *Ann R Coll Surg Engl* 2014;96:446–451.
14. **Odumala AO, Iqbal MR, Middleton RG.** Failure of closed reduction after dislocation of Austin Moore hemiarthroplasty: an analysis of risk factors a 6-year follow-up study. *J Arthroplasty* 2010;25:781–784.
15. **Baker RP, Squires B, Gargan MF, Bannister GC.** Total hip arthroplasty and hemiarthroplasty in mobile, independent patients with a displaced intracapsular fracture of the femoral neck. A randomized, controlled trial. *J Bone Joint Surg [Am]* 2006;88-A:2583–2589.
16. **Manjón-Cabeza Subirat JM, Moreno Palacios JA, Mozo Muriel AP, et al.** Functional outcomes after resection of hip arthroplasty (Girdlestone technique). *Rev Esp Geriatr Gerontol* 2008;43:13–18. (in Spanish)
17. **Hudec T, Jahoda D, Sosna A.** Resection hip arthroplasty--mid- and long-term results. *Acta Chir Orthop Traumatol Cech* 2005;72:287–292. (in Czech)
18. **Malcolm TL, Gad BV, Elsharkawy KA, Higuera CA.** Complication, survival, and reoperation rates following girdlestone resection arthroplasty. *J Arthroplasty* 2015;30:1183–1186.
19. **Parker MJ, Palmer CR.** A new mobility score for predicting mortality after hip fracture. *J Bone Joint Surg [Br]* 1993;75-B:797–798.
20. **Kristensen MT, Bandholm T, Foss NB, Ekdahl C, Kehlet H.** High inter-tester reliability of the new mobility score in patients with hip fracture. *J Rehabil Med* 2008;40:589–591.
21. **Charnley J.** The long-term results of low-friction arthroplasty of the hip performed as a primary intervention. *J Bone Joint Surg [Br]* 1972;54-B:61–76.
22. **Qureshi KN, Hodkinson HM.** Evaluation of a ten-question mental test in the institutionalized elderly. *Age Ageing* 1974;3:152–157.
23. **Enocson A, Tidermark J, Törnkvist H, Lapidus LJ.** Dislocation of hemiarthroplasty after femoral neck fracture: better outcome after the anterolateral approach in a prospective cohort study on 739 consecutive hips. *Acta Orthop* 2008;79:211–217.
24. **Keene GS, Parker MJ.** Hemiarthroplasty of the hip--the anterior or posterior approach? A comparison of surgical approaches. *Injury* 1993;24:611–613.
25. **Pajarinen J, Savolainen V, Lindahl J, Hirvensalo E.** Factors predisposing to dislocation of the Thompson hemiarthroplasty: 22 dislocations in 338 patients. *Acta Orthop Scand* 2003;74:45–48.
26. **Enocson A, Pettersson H, Ponzer S, et al.** Quality of life after dislocation of hip arthroplasty: a prospective cohort study on 319 patients with femoral neck fractures with a one-year follow-up. *Qual Life Res* 2009;18:1177–1184.
27. **Brooks R.** EuroQol: the current state of play. *Health Policy* 1996;37:53–72.
28. **Maxwell HA, Turner PG.** Dislocation of the Austin Moore hemiarthroplasty: is closed manipulation justified? *J R Coll Surg Edinb* 1994;39:370–371.
29. **Li L, Ren J, Liu J, et al.** What are the risk factors for dislocation of hip bipolar hemiarthroplasty through the anterolateral approach? A nested case-control study. *Clin Orthop Relat Res* 2016;474:2622–2629.
30. **Sharma H, De Leeuw J, Rowley DI.** Girdlestone resection arthroplasty following failed surgical procedures. *Int Orthop* 2005;29:92–95.
31. **Sharma H, Kakar R.** Outcome of Girdlestone's resection arthroplasty following complications of proximal femoral fractures. *Acta Orthop Belg* 2006;72:555–559.
32. **Chalmers BP, Perry KI, Hanssen AD, Pagnano MW, Abdel MP.** Conversion of hip hemiarthroplasty to total hip arthroplasty utilizing a dual-mobility construct compared with large femoral heads. *J Arthroplasty* 2017;32:3071–3075.
33. **Sah AP, Estok DM II.** Dislocation rate after conversion from hip hemiarthroplasty to total hip arthroplasty. *J Bone Joint Surg [Am]* 2008;90-A:506–516.
34. **Coomber R, Porteous M, Hubble MJW, Parker MJ.** Total hip replacement for hip fracture: surgical techniques and concepts. *Injury* 2016;47:2060–2064.
35. **Sierra RJ, Cabanela ME.** Conversion of failed hip hemiarthroplasties after femoral neck fractures. *Clin Orthop Relat Res* 2002;399:129–139.
36. **Mounsey EJ, Williams DH, Howell JR, Hubble MJ.** Revision of hemiarthroplasty to total hip arthroplasty using the cement-in-cement technique. *Bone Joint J* 2015;97-B:1623–1627.
37. **Sharma H, Dreghorn CR, Gardner ER.** Girdlestone resection arthroplasty of the hip: current perspectives. *Curr Orthop* 2005;19:385–392.

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J. R. Gill: Designed the study, Analyzed the data, Conducted the statistical analysis, Prepared the manuscript.
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