



Post-operative complications following total hip arthroplasty for trauma: A multicentre cohort study comparing dual mobility with conventional acetabular bearings

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ABSTRACT

Aims: Dislocation of a total hip replacement is a serious complication after total hip arthroplasty (THA). Dislocation rates are higher when surgery is performed following trauma. Our study compares post-operative dislocation rates between conventional acetabular bearing (CAB) and dual mobility acetabular bearing (DMB) THA performed for neck of femur fracture alongside post-operative periprosthetic fracture, revision and mortality.

Methods: A retrospective multicentre cohort study at 9 hospital trusts in the United Kingdom of all THA performed for neck of femur fracture between March 2018 and February 2019.

Results: A total of 295 operations were performed. 64% (189) were CAB and 36% (106) were DMB. Average age was 75 years (38–98). 223 Female: 72 Male. The follow-up period was an average of 42 months (36–48). Overall revision rate was 1.6%,⁸ peri-prosthetic fracture rate was 6 (2%) and overall mortality was 9.8% (29) with no significant difference between cohorts for any outcome. The posterior approach (PA) was favoured 82% (242) vs the lateral approach (LA) 18% (53) with the PA used more often in patients undergoing DMB 96% (102) vs CAB 74% (140) $p = 0.001$. Patients approached posteriorly at the time of their index procedure were significantly less likely to sustain a simple dislocation following a DMB 0 (0%) vs. CAB 8 (5.7%) $p = 0.015$.

Conclusion: Our study demonstrates that the risk of dislocation following THA for trauma is more than four times higher than when conventional bearings are used compared to dual mobility acetabular components. This effect is most pronounced when the PA is utilised for the index procedure. The use of these bearings does not impact mortality, peri-prosthetic fracture or revision rate. We would encourage the use of dual mobility acetabular bearings in patients undergoing THA for fracture via a PA.

1. Introduction

Dislocation is a significant complication following total hip arthroplasty (THA) with an incidence between 0.3% and 10%.¹ Dislocation rates are higher when the procedure is performed following a femoral neck fracture² with reported dislocation rates in the literature as high as 22%.³ In the context of intracapsular femoral neck fracture the use of a THA is recommended in preference to hemiarthroplasty for patients that are higher demand ‘community ambulators’ to reduce the need for secondary surgery⁴ however a consequence of this is twice the likelihood of post-operative dislocation.⁵ Surgical management of instability has included the use of dual mobility components for patients undergoing revision surgery for instability or those at high risk for dislocation at the time of their index procedure.^{6,7}

A recent systematic review demonstrated a lower dislocation rate with dual mobility components compared to conventional acetabular bearings⁸ however the review relied heavily on registry data and smaller

studies with a short follow up. The aim of our study was to compare post operative dislocation rates, post operative peri-prosthetic fracture, revision and mortality when either a conventional acetabular bearing (CAB) or dual mobility bearing (DMB) was used to treat patients with a fractured neck of femur at multiple centres with a minimum of three years follow up.

2. Methods

Our multiple site retrospective cohort study compared the use of CAB and DMB in the treatment of patients sustaining a fractured femoral neck requiring treatment with arthroplasty between March 2018 and February 2019. Hospitals across the North West of England were invited to take part and nine trusts elected to participate. Patients were included in the study provided they had sustained a femoral neck fracture which was treated with THA. Patients were not eligible for inclusion in the study if they had sustained a pathological fracture or had undergone

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previous fixation/surgery to the hip. The primary outcome was dislocation at any time in the study period. Secondary outcomes included revision surgery, peri-prosthetic fracture and mortality. Patients were identified from the national hip fracture database at each collaborating site and electronic patient records were reviewed to obtain information about patient demographics, intra-operative component use, revision surgery and mortality. Dislocation and peri-prosthetic fracture was determined radiographically using the regional patient archiving computer system (SECTRA).

3. Statistical analysis

Data was analysed using Microsoft Excel (Redmond, Washington, USA) and GraphPad Prism (San Diego, California, USA). Analysis was conducted using unpaired t-tests (age, length of follow up) and Chi-squared testing (Sex, Approach, Dislocation, Revision, Mortality). Statistical significance was set at $p < 0.05$.

4. Results

A total of 295 patients were included in the analysis (7 exclusions for incomplete data). Mean age of patients was 75 years (38–98). Mean age in patients receiving a CAB was 73 years (38–93) and 76 years (44–98) receiving DMB. The two cohorts comprised 106 DMB and 189 CAB. Of the DMB 71 were ADES, 1 was G7, were 5 Avantage (Zimmer Biomet, Warsaw, Indiana, USA) 11 were X3 (Stryker, Kalamazoo, Michigan, USA) and 18 were SERF (SERF, Lyon, France). Data was not collected regarding the femoral component as it was expected that the vast majority would be cemented components as per National Institute of Clinical Excellence (NICE) guidelines on using cemented arthroplasty for neck of femur fractures in the United Kingdom. In the CAB cohort head sizes included 104 28 mm heads, 74 32 mm heads, 8 36 mm heads and for 3 patients head size was not recorded. 29 (9.8%) patients died during the study period with no difference seen between CAB 18/189 (9.5%) and DMB 11/106 (10.3%) $p = 0.813$. Mean follow up was longer in the CAB cohort than the DMB cohort (42 months (36–48) vs 41 months (36–48)) $p = 0.002$, however minimum follow up in the both cohorts is over three years. A summary of the results is shown in Table 1.

Only one patient with a DMB dislocated (0.9%) at a mean follow up 41 months (36–48) whereas a total of 8 (4.2%) patients with a CAB dislocated at a mean follow of 42 months (36–48) $p = 0.115$. In the DMB cohort one patient was revised for infected dislocation with a two stage

Table 1
Summary of results.

Summary of Results	Cohort (n = 295)	Dual Mobility (n = 106)	Standard(n = 189)	P-value
Age, years (range)	75 (38–98)	76 (44–98)	73 (38–93)	0.026 ^a
Approach, n (%)	Posterior 242 (82)	Posterior 102 (96)	Posterior 140 (74)	0.001 ^c
	Lateral 53 (18)	Lateral 4 (4)	Lateral 49 (26)	
Dislocation, n (%)	9 (3.0)	1 ^b (0.9)	8 (4.2)	0.115 ^c
Revision, n (%)	5 ^d (1.6)	2 (1.8)	3 (1.5)	0.848 ^c
Post-operative Peri-prosthetic Fracture, n (%)	6 (2.0)	3 (2.8)	3 (1.5)	0.468 ^c
Mortality, n (%)	29 (9.8)	11 (10.3)	18 (9.5)	0.813 ^c
Length of Follow up, months (range)	42 (36–48)	41 (36–48)	42 (36–48)	0.002 ^a

^a unpaired t-test.
^b dislocation of entire loose acetabular component due to loosening secondary to infection.
^c chi-squared test.
^d DMB one infection with complex dislocation, one periprosthetic fracture/CAB one recurrent instability, two periprosthetic fractures.

revision. This patient also accounted for the only dislocation in this cohort as the large dual mobility femoral head had both dislocated from the acetabular liner and the acetabular liner had de-bonded from the bony pelvis due to infection. With infected (complex) dislocations excluded from the analysis 0 (0%) simple dislocations occurred in the DMB cohort vs 8 (4.2%) in the CAB cohort $p = 0.031$.

In the CAB cohort 4 dislocations occurred in patients with a 28 mm head, 4 in patients with a 32 mm head and 0 dislocations in patients with a 36 mm head. All dislocations were simple dislocations without superimposed infection or component loosening. Three of the dislocations were revised, one for recurrent instability alone and two for peri-prosthetic fractures that occurred at a later time following the initial dislocation episode.

For the index procedure 242 (82%) procedures were performed via the posterior approach vs 53 (18%) via the lateral approach. There were no dislocations in patients in whom the procedure was performed via a lateral approach $p = 0.153$. No patients who had their index procedure via a lateral approach required a revision procedure. The posterior approach was more likely to be used when a DMB was used 102/106 (96%) vs CAB 140/189 (74%) $P = 0.001$. Whilst the lateral approach did seem favourable in terms of dislocation when combined with CAB; the sample sizes were inadequate to draw firm conclusions.

In the 242 patients who had undergone surgery via a posterior approach, with the exclusion of infected (complex) dislocations there were no dislocations in the DMB cohort and 8 dislocations in the CAB cohort $p = 0.015$ as seen in Table 2.

In total 4 patients in each cohort underwent a revision procedure during the study period $p = 0.667$. In the DMB cohort one patient was revised for an infected dislocation with a two-stage revision. Three patients sustained a peri-prosthetic fracture one of which underwent component revision and the other two open reduction and internal fixation (ORIF) alone. In the CAB cohort one patient underwent revision surgery for instability. Three patients were treated for periprosthetic fracture two of which were treated with component revision and one with ORIF. One of the periprosthetic fractures treated with revision occurred following an initial post operative infection managed with a DAIR. The rate of periprosthetic fracture across both cohorts were 3/106 for DMB and 3/189 for CAB.

5. Discussion

Dislocation is a significant complication following THA and multiple reasons are known to cause post-operative instability including factors relating to the patient (age, sex, neuromuscular problems, postoperative confusion) and surgical factors (head size, constraint, component orientation and surgical approach).⁹ In addition to the above, it is also suggested that femoral neck fracture is an independent risk factor for dislocation with up to a 3.9 times the risk of post-operative dislocation in some studies.¹⁰ This patient group are frail and often have significant

Table 2
Posterior approach sub-group analysis.

Posterior approach	Total (n = 242)	Dual Mobility (n = 102)	Standard(n = 140)	P-value
Simple Dislocation, n (%)	8 (3.3)	0 ^a (0.0)	8 (5.7)	0.015 ^b
Component Revision, n (%)	5 ^c (2.0)	2 (1.9)	3 (2.1)	0.922 ^b
Post-operative Peri-prosthetic Fracture, n (%)	6 (2.4)	3(2.9)	3 (2.1)	0.693 ^b

*unpaired t-test.
^a infected (complex) dislocation excluded.
^b chi-squared test.
^c DMB one infection with complex dislocation, one periprosthetic fracture/CAB one recurrent instability, two periprosthetic fractures.

co-morbidities¹¹ and the aim of surgery in the short term is to promote early mobilisation, reduce sarcopenia and promote rehabilitation to reduce peri-operative morbidity and mortality.¹² In this frail population revision surgery for instability is associated with significant surgical risk and the potential for further dislocation episodes of between 5.1% and 14.4%.¹³ A recent systematic review has put the post-operative dislocation rate when a DMB is used at 1.5% which compares favourably to the literature.⁸

Our multi-centre retrospective cohort study compares DMB and CAB THA in patients with a neck of femur fracture and suggests that the rate of post-operative dislocation in the medium term is up to 4.5 times higher when a CAB is used. In our study only one DMB dislocated and this was in the context of a prosthetic joint infection with concurrent debonding of the acetabular component from the bony pelvis requiring revision surgery. Revision rates for both cohorts are similar however it is important to acknowledge that dislocation can be more problematic when it occurs with a DMB due to the risk of intra-prosthetic dislocation requiring an open reduction or revision.¹⁴ The mortality in our series is lower than that expected for neck of femur fracture¹⁵ and this is likely due to surgeon preference for total hip replacement in relatively younger, fitter patients. No difference was seen between either group with regards to mortality. The posterior approach was favoured overall and was more likely to be used in patients undergoing DMB surgery. Interestingly no patients who underwent surgery via a lateral approach have dislocated or required a subsequent revision procedure in our series however the merits and disadvantages of surgical approach in THA have been extensively debated and the most recent Cochrane review found insufficient information to determine an optimum surgical approach.¹⁶

The use of dual mobility components has been criticised by some due to the theoretical risk of increased peri-prosthetic fracture – the rationale being that the increased torque required to dislocate a DMB would lead to preferential failure at the femur. This has been demonstrated in the literature in small papers with cortical thickness suggested to be protective¹⁷ which would make the use of such implants less desirable in the osteoporotic bone stock typically seen in neck of femur fractures. However the peri-prosthetic fracture rates are equitable in our study between both cohorts. The strengths of this study include the fact it has been completed at multiple sites with multiple surgeons across the United Kingdom which enhances its generalisability and makes it applicable to current practice. It is also the largest non-registry study to date looking at dislocation as the primary outcome. The study dates were chosen to give a minimum of 3 years follow up which provides ample time for assessing the primary outcome as the majority of dislocations occur within 6 months of the index surgery⁸. Our study also directly compared THA alone in the treatment of the neck of femur fractures, ensuring that the cohorts are best matched for a retrospective study. All sites included in the study submit data on a monthly basis to the National Hip Fracture Database¹⁸ in which pre-operative factors are reviewed alongside peri-operative assessment and surgical procedure choice. National guidance in the UK suggests that patients who are independently mobile, use one walking aid or less and are fit for surgery should receive a THA however in practice this is ultimately left to surgeon choice. This compares favourably to the majority of studies comparing hemiarthroplasty to DMB THA.^{19,20,21} Limitations of our study include its retrospective nature and ability to match the cohorts, however as previously discussed we have only included patients that have had a THA so they should be comparable. Implant choice may be determined by either surgeon preference or procurement and we had no control over either however it stands to reason that surgeons would use DMB in patients more susceptible to dislocation to reduce this risk and therefore this bias should negatively impact the findings. Our primary outcome did not reach statistical significance however when complex dislocations are excluded it reaches significance. This effect is more pronounced on sub-group analysis of patients undergoing their index procedure via a posterior approach – this is of particular relevance in the

United Kingdom as the majority of THA are undertaken via this approach.

Our dislocation rate is however comparable in both cohorts to existing literature and demonstrates a 4.5 fold increase in dislocation risk when a CAB is used and a six-fold increase in patients following posterior approach. In conclusion, given the increasing amount of literature demonstrating a reduced dislocation rate when DMB is used in patients with a neck of femur fracture alongside our contemporary, generalisable experience in our region we would advocate the use of DMB THA in patients who are candidates for THA following a fractured neck of femur – particularly when undertaking the procedure via a posterior approach.

5.1. Take home points

- DMB reduces the incidence of simple dislocation following THA for fractured neck of femur
- DMB should be considered in preference to CAB if a posterior approach is to be utilised
- DMB doesn't increase the likelihood of peri-prosthetic fracture, revision or mortality in patients with a fractured neck of femur.

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Institutional ethical committee approval (for all human studies)

Local approval was obtained at each site contributing to the study.

Author contribution

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Declaration of competing interest

None.

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