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Modern cemented Furlong hemiarthroplasty: Are dislocations rates better?

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Abstract

Background: Dislocation following hip hemiarthroplasty is a major complication with increased mortality and morbidity. Data looking at dislocation following contemporary bipolar stems are lacking in literature.

Methods: Retrospective review of our prospective national hip fracture database over a two-year period. Group 1 comprised of consecutive patients receiving bipolar Furlong prosthesis (N222) while Group 2 was made up of a historical cohort (uncemented; N254). Clinical and radiological records were reviewed to determine dislocation rates, causes and associative factors of dislocations. Data were analysed using SPSS.

Results: Following 476 hemiarthroplasties performed during the study period, 12 (2.5%) dislocations were reported (eight in Group 1; four in Group 2). There was no significant difference in dislocation rates (3.6% vs 1.6%) between groups ($p = 0.159$). Subgroup analysis of Group 1 demonstrated a significant difference in dislocations with Furlong cemented (6%) as compared with Furlong uncemented (0%) hemiarthroplasties ($p = 0.024$). Following dislocation, death rates increased to 8.3% from 1.7% in both groups.

Conclusion: There is a statistically significant increase in dislocation rate following use of cemented Furlong prosthesis when compared to similar uncemented prosthesis at the same treatment period. However, when compared to traditional uncemented prosthesis, there is no difference in dislocation rates.

Keywords

Trauma and orthopaedic surgery / Service improvement / Research-quantitative / Quality of care / Patient safety / Outcomes

Provenance and Peer review: Unsolicited contribution; Peer reviewed; Accepted for publication 9 May 2021.

Introduction

With the rising incidence of hip fractures in the United Kingdom, displaced intracapsular fractures account for half of the hip fractures nationally (NHFD Annual Report RCP, 2019). Hemiarthroplasty remains the commonest surgery in the National Hip Fracture Database (NHFD) and has been for decades (Sheth et al 2018, Yeung et al 2020). Several options for hip hemiarthroplasty are available with varying degrees of evidence to support their use. Hemiarthroplasty of the hip with a bipolar prosthesis is a primary management option in the treatment of displaced intracapsular hip fracture in the elderly patient (NICE Guidance 2019). Hemiarthroplasty implants cost over £10.6 million per year in England alone (GIRFT 2019). Early dislocation is a major complication with a documented mortality rate of up to 40% at six months (Dayanadam & Case 2006). Previous studies have considered both patient and surgical-related factors that would predispose to dislocation (Barnes et al 1995, Pajarinen et al 2003). Specific contributory factors examined include surgical approach and the use of cement (Unwin & Thomas 1994, Varley & Parker 2004). Despite the widespread use of hemiarthroplasties, data looking at contemporary stems

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in the literature has been lacking. A recent study questioned the superiority of modern cemented polished tapered femoral stems with the original monoblock cemented stems (Sims et al 2018). Advocates of the cemented Furlong hemiarthroplasty report lower dislocation rates as compared to total hip replacements or similar prostheses (Dixon & Bannister 2004, JRI Information leaflets 2013). However, in the said study, only 72 implants were studied. There remains a huge controversy with implant choices with The National Institute of Health and Care Excellence recommending the use of cemented implants in addition to the use of 'proven femoral stem designs', with Orthopaedic Device Evaluation Panel 3 rating 3B or greater (NICE Guidance 2019). In addition to this existing controversy, dislocation remains a huge cause of increased morbidity and mortality. Different studies have reported rates of dislocation in traditional bipolar prosthesis ranging from 0 to 15% (Barnes et al 1995, Bochner et al 1998, Cortell & Putz 1996, Dixon & Bannister 2004, Georgiou et al 2006, Krishnan et al 2010, Varley & Parker 2004, Yasmin et al 2002). However, there remains a lack of information in the literature on dislocation rates following a contemporary Furlong cemented bipolar hemiarthroplasty. Our study looks at our dislocation rate following the introduction of cemented Furlong bipolar hemiarthroplasty. We report and document associative factors in hip dislocation in these patients by drawing upon information from our prospective database of hip fractures treated at our institution between the periods of 2008 and 2012.

Materials and methods

The prosthesis

Cemented Furlong hemiarthroplasty stem is Müller-type femoral stem (JRI 2013). It has a 127° neck angle. The femoral component comes in five sizes (extra extra small, extra small, small, medium and large stems). The bipolar head is pre-assembled with 1mm increments. Its head is made from high nitrogen stainless steel.

Study population and methods

Five-hundred and seven patients were entered in our hospital's NHFD as receiving an arthroplasty following intracapsular neck of femur fracture (NOF#). Fourteen patients were eliminated secondary to no images seen, one patient had no fracture, ten received total hip replacements for trauma, one received a cannulated hip screw while three patients died preoperatively. Therefore, 476 hemiarthroplasties were performed during the study period. Two treatment groups were identified from our prospective database from June 2010 to June 2012. Group 1 (N222) were consecutive patients treated in our institution following the introduction of cemented bipolar prosthesis from August 2011 to June 2012 with an average age of 82.4 years. Group 2 (N254) was made up of a historical cohort from June 2010 to July 2011 with an average age of 81.7 years. Out of the 507 patients, 347 (N156, N191 in each group respectively) patients were women in the study population (Table 1). The average time to hemiarthroplasties was 34.43h and 31.36h in Groups 1 and 2 respectively.

The primary outcome measure was dislocation between Groups 1 and 2. This was defined as any incidence of dislocation following a hemiarthroplasty up until June 2012. This time was chosen to estimate the initial one-year dislocation rates following the introduction of this

Table 1 Patient characteristics.

Characteristics	Group 1 (retrospective)	Group 2 (historical)
Study population, (*n*)	222	254
Age (years)	82.4 (SD 7.34)	81.7 (SD 7.99)
Men, *n* (%)	66 (29.7)	63 (24.8)
Female, *n* (%)	156 (70.3)	191 (75.2)
ASA grade, *n* (%)		
I	1 (0.5)	8 (3.1)
II	62 (27.9)	82 (32.3)
III	126 (56.8)	135 (53.1)
IV	26 (11.7)	16 (6.3)
V	2 (0.9)	1 (0.4)
Unknown	5 (2.3)	12 (4.7)
Fracture side, *n* (%)		
Left	121 (47.6)	118 (53.4)
Right	133 (52.4)	103 (46.6)
Fracture type, *n* (%)		
Displaced	198 (89.2)	193 (76)
Undisplaced	24 (10.8)	61 (24)
Prosthesis type (*n*)		
Cemented Furlong	133 (59.9)	0 (0)
Uncemented Furlong	82 (36.9)	192 (75.6)
Austin Moore	1 (0.5)	24 (9.4)
Thompson	6 (2.7)	38 (15)
Admission location		
Home	188 (74)	155 (70.1)
Residential home	48 (21.7)	17 (6.7)
Nursing home	7 ()	40 ()
Hospital transfer	10 (4.5)	7 (2.8)
Rehabilitation unit	1 (0.5)	0 (0)
Unknown	0 (0)	2 (0.8)
Discharge location		
Home	122 (62.6)	162 (63.8)
Residential home	38 (19.5)	17 (6.7)
Nursing home	11 (5.6)	47 ()
Inter-hospital transfer	9 (4.6)	13 (5.1)
Intermediate care	10 (5.1)	6 (2.4)
Unknown	2 (1)	1 (0.4)
Pre-morbid mobility		
Independent mobile	112 (50.7)	140 (55.1)
Aid one (person/stick)	50 (22.6)	59 (23.2)
Aid two (person/stick)	53 (24)	44 (17.3)
Wheelchair	6 (2.7)	6 (2.4)
Unknown	0 (0.0)	5 (2.0)

ASA: American Society of Anaesthesiologist.

Table 2 Dislocations rates.

Group	Dislocations (% within group) Yes	No
Group 1	8 (3.6)	214 (96.4)
Group 2	4 (1.6)	250 (98.4)
Group 1		
Furlong Cemented	8 (6.0)	125 (94.0)
Furlong Uncemented	0 (0.0)	82 (100.0)
Group 1 versus Group 2		
• Furlong Cemented		
Group 1	8 (6.0)	125 (94.0)
Group 2	No cemented patients	No cemented patients
• Furlong Uncemented		
Group 1	0 (0.0)	82 (100.0)
Group 2	3 (1.6)	189 (98.4)
• Total		
Group 1	8 (3.7)	207 (96.3)
Group 2	3 (1.6)	189 (98.4)

modern-day prosthesis. A subgroup study of cemented and uncemented Furlong prosthesis dislocation rates was further carried out to determine if the introduction of these modern cemented prosthesis affected dislocation rates. Clinical and radiological records were reviewed to determine dislocations and associated factors for the study population.

Our neck of femur fracture database had existing ethical approval for research purposes and therefore no additional approval was required.

Statistical analysis

All analyses were undertaken on SPSS (v18) with the Fisher's exact test used to compare the incidence of dislocation in both groups. Subgroup analysis of Group 1 was undertaken. As data were not skewed, means and standard deviations were used to calculate dichotomous variables, while t-test was used to compare Groups 1 and 2. A p-value of <0.05 was considered to indicate statistical significance.

Results

Of the 476 patients receiving arthroplasty, 12 (2.5%) dislocations were recorded during the treatment period. Out of all surgical cases, seven of the cases were performed by modified Hardinge approach, two by direct lateral approach, two by posterior approach and there was no documentation of any approach in two cases. Group 1 had eight dislocations (eight cemented Furlong) while four dislocations (three uncemented Furlong; one Austin Moore) were reported in Group 2. There was no significant difference in dislocation rates (3.6% vs 1.6%) between groups (Chi (1) = 1.984, $p = 0.159$ (Table 2). The average time to dislocation was 17.25 days in Group 1 (4–138 days) and 18.25 days in Group 2 (6–30 days).

A further subgroup analysis was done comparing only patients receiving Furlong prosthesis between Groups 1 (all cemented) and 2 (Table 2). In patients receiving uncemented Furlong prostheses, there was no significant difference (Chi (1) = 1.295, $p = 0.255$) between the historical and retrospective dislocation rate (0% vs 1.6%). Overall, there was no significant difference in dislocation rates between Furlong uncemented and cemented prostheses (3.7% vs. 1.6%), Chi (1) = 1.797, $p = 0.180$.

Subgroup analysis of Group 1 demonstrated a significant difference between dislocations comparing Furlong cemented (6%) and uncemented (0%) (Chi (1) = 5.0123, $p = 0.024$) (Table 2).

Dislocations

The average ages of the patients were 82.25 and 81 years in the two groups, respectively. The majority of cases were in women (62.5% in Group 1 and 75% in Group 2). The average number of dislocations was 1.6 in Group 1 (mode 1, range 1–3) and 2.25 in Group 2 (mode 2, range 2–3). The mean American Society of Anaesthesiologist (ASA) grade was 2.5 in Group 1 and 3.25 in Group 2. The Abbreviated mini-mental score (AMT) was ≥ 6 in both groups. All cases of dislocation had a mean of ≥ 4 comorbidities in both groups. Most of the dislocated cases were operated on by surgical trainees (five cases in Group 1, two by consultants and one unknown) and three cases in Group 2 (one by a consultant).

The majority of cases had documented capsular repair at surgery (not documented in three cases in Group 1 and one case in Group 2). All cases were documented as stable intraoperatively in both groups.

Table 3 Death rates.

Group		Dislocations		
		No	Yes	Total
Group 1				
Deaths				
Dead	Count	1	0	1
	% within dislocations	0.5%	0.0%	0.5%
No	Count	213	8	221
	% within dislocations	99.5%	100.0%	99.5%
Total	Count	214	8	222
	% within dislocations	100.0%	100.0%	100.0%
Group 2				
Deaths				
Dead	Count	7	1	8
	% within dislocations	2.8%	25.0%	3.1%
No	Count	243	3	246
	% within dislocations	97.2%	75.0%	96.9%
Total	Count	250	4	254
	% within dislocations	100.0%	100.0%	100.0%

Subsequent management after dislocation

In Group 1, seven closed relocations were achieved following the first episode of dislocation. All cases were recorded as difficult closed reduction intraoperatively. However, two cases had subsequent dislocations (two and three episodes) and went on to have resection arthroplasty. One patient had a resection arthroplasty following initial dislocation. In Group 2, all cases had an attempt on initial closed reduction, due to persistent dislocations, three had resection arthroplasty while one was revised to a total hip replacement. Three cases went on to have resection arthroplasty in Group 2. No difference was noted between the two groups with regards to age, gender, ASA or AMT in relation to dislocation.

Deaths

Group 1 reported a mortality of 0.5% of patients at the time of this study, while 3.1% died in Group 2 (Table 3). Following dislocation, death rates increased to 8.3% in both groups. One patient in Group 1 died days after discharge while another died as an inpatient after the relocation of the dislocated hip. In Group 2, one died as an inpatient after resection arthroplasty.

Discussion

Since their advent in the 1970s, bipolar prosthesis has been used increasingly in the treatment of NOF# (Bochner et al 1998, Georgiou et al 2006). Due to the additional articulating joint within its head, there is movement both at the prosthesis – acetabular interface and within the interface in the prosthetic bipolar head, thereby hopefully increasing stability (Krishnan et al 2010, Varley & Parker 2004). Other studies have recommended its use in patients with increased risk of instability (Iorio et al 2001). This remains the argument of proponents of bipolar prosthesis. Other studies have suggested that bipolar prosthesis presents a 'double joint' thereby reducing dislocation rates (Yasmin et al 2002). However, a review of 135 articles (23,107 cases) failed to demonstrate a difference in dislocation rate between bipolar and monopolar hemiarthroplasties (adjustments were made for cement and surgical approach) (Varley & Parker 2004). Cementing was noted in this study to cause a non-significant increase in the risks of dislocation rate by 1%.

Although we noted an increase in dislocation rate from 1.6% in Group 2 to 3.6% in Group 1, this was not statistically significant. These rates are comparable to other older prosthetic designs in the literature. We failed to demonstrate any difference in age, gender, AMT, ASA, pre-morbid mobility or admission and discharge locations between the groups.

Subgroup analysis of Furlong specific prosthesis (cemented versus uncemented; Group 1 versus Group 2) failed to demonstrate a significant difference in dislocation rates between these two groups despite the increase in dislocation rates in Group 1. These cases were however treated during different treatment periods and we assume that increased dislocation rates in Group 1 (3.7% versus 1.6%) may be due to difference in surgeons and possible learning curve following the introduction of cemented prosthesis. The majority of the dislocations occurred within three weeks of insertion of the prosthesis.

Subgroup analysis of Group 1 demonstrated a significant difference ($p = 0.024$) in dislocation rates when only Furlong cemented and uncemented hemiarthroplasties were compared with each other, with cemented having a greater dislocation rate than uncemented hemiarthroplasties. This finding confirms

the literature findings of cementing been an increased risk of dislocation in older prosthesis (Varley & Parker 2004). It is possible that during cementing, the femoral stem position may be altered either in exaggerated anteversion or retroversion thereby predisposing to dislocation. The Furlong cemented prosthesis also has a fixed offset, thereby meaning that accurate positioning of the femoral stem is paramount to reduce dislocation rates. Other studies have suggested that this could be a problem in cemented prosthesis and have suggested a possible increase in dislocation episodes in relation to the length of the residual femoral neck (Pajarinen et al 2003). In our series, the femoral neck cut was all defined as optimal intraoperatively. With the cemented Furlong, we posit that during trialling of the prosthesis, the surgeons will usually try to account for suboptimal femoral neck cut by adjusting the implant to the most stable position. However, in all cases, the prosthesis was assessed to be stable when tested intraoperatively.

For patients presenting with dislocation, comorbidities were identified as a factor that could have predisposed them to increased dislocation rate, although this did not demonstrate any statistical significance. Despite the majority of patients with dislocation having low ASA grades, most had an average of four comorbidities. This has been noted in the literature. We believe that despite their good AMT scores, they were still prone to possible accidents and subsequent falls and dislocations. However, no significant relationship was noted between AMT, ASA grades or comorbidities with dislocation.

The difficulty of closed reduction of bipolar prosthesis has been greatly discussed in the literature (Bhuller 1,982, Drinker & Murray 1979, Sierra et al 2006, Varley & Parker 2004). This was noted in all cases in our study although the reduction was achieved in all cases when an attempt was made. Our study is similar to that of 1934 hips in which all 29 dislocated bipolar hips achieved closed reduction (Barnes et al 1995). Our observation of an increased risk of recurrent dislocations, following an initial episode of dislocation in our cemented subgroup requiring either resection arthroplasty or revision arthroplasty is consistent with that reported in the literature (Barnes et al 1995).

Dislocation after hemiarthroplasty is associated with increased mortality with death rates quoted as high as 65% (Unwin & Thomas 1994). Some studies have reported lower mortality rates in bipolar prosthesis when compared with unipolar prosthesis but have adjusted for dichotomous variables and have not addressed dislocation as an entity (Sabnis & Brenkel 2011). In our study, 0.5% of patients and 3.1% of patients died following hemiarthroplasty in both groups respectively. However, following dislocation, the death rate increased to 8.3% as compared to 1.7% in patients without dislocations. Although this rate is low when compared to figures quoted in the literature, the findings support the fact that the risk of death is still increased by dislocations following hemiarthroplasty. There was no increase in the death rate in cemented Furlong patients following dislocation when compared to the uncemented group.

Our study is limited because this was a retrospective review of a prospective database and depended on clinical records. Some of the lack of statistical significance could be secondary to the fact that this study was not powered, although the numbers in the group were similar. In our study, the surgery was carried out by different grades of surgeons with varying experience. The learning curve associated with the introduction of the cemented bipolar arthroplasty could have also affected the outcomes. Groups 1 and 2 initially used different types of prosthesis although the subgroup analysis identified only Furlongs and studied these in detail. Although the majority of the cases with dislocation were done via a modified Hardinge approach, in Group 1, on two occasions, the approach was not documented. Since we have not accounted for the effect of the approach (identified as an independent risk of dislocation), this could have influenced the dislocation rates. Unfortunately, we were unable to examine the postoperative mobility of these patients since this was not recorded in our hospital's national hip database. Postoperative mobility may have given us an insight into the patients' mobility status before dislocation as well as an assessment of the risk of falls.

Conclusion

There is a statistically significant increase in the dislocation rate following the use of cemented Furlong prosthesis when compared to similar uncemented prosthesis at the same treatment period. However, when compared to the older uncemented prosthesis, there is no difference in dislocation rates. Closed reduction remains difficult in these cases with increased risk of subsequent dislocations and mortality. Due to the increased number of comorbidities in the dislocated group, we believe that the use of cemented bipolar should be used with great caution in these cases and possibly performed by an appropriately trained specialist.

No competing interests declared

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