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Early Complications Following Cemented Modular Hip Hemiarthroplasty

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Abstract: *Introduction*: Hemiarthroplasty is the recommended treatment for displaced, intracapsular, femoral neck fractures. This study aimed to evaluate the early complications following insertion of the JRI Furlong cemented hemiarthroplasty, a contemporary, modular, double tapered, polished prosthesis.

Method: A series of 459 consecutive patients (May 2006 - June 2009) treated with a JRI hemiarthroplasty with a minimum of one-year (1-4years) follow-up were evaluated. Data collected retrospectively from clinical records and hospital databases included patient demographics, mortality, deep infection, dislocation, periprosthetic fracture, and any requirement for revision or complications related to the prosthesis.

Results: Full data were available for 429 of 459 (93%), partial data for 30 (7%). Average age was 83 years (52-100), 76% were female. One-year mortality was 24%. Intraoperative fractures occurred in 17 patients (3.7%). There were two intraoperative deaths. There were nine early deep wound infections (2%). There were two revisions to total hip replacement (THR), four patients required conversion to THR and one underwent an excision arthroplasty procedure.

Discussion: Early surgical outcomes for the JRI hemiarthroplasty prosthesis are equivalent or superior to other major hemiarthroplasty prostheses previously reported however, there was a high intraoperative fracture rate of 3.7%. We recommend using a stem one size smaller than the final broach in fragile, osteoporotic bone. No patients re-presented with aseptic loosening or stem failure.

Keywords: Cement, fracture, hip, hemiarthroplasty, modular, orthogeriatric.

INTRODUCTION

Hip fractures are common injuries with over 70,000 treated annually in the UK [1]. They are divided into intracapsular and extracapsular fractures with over half identified as intracapsular [2]. United Kingdom NICE (National Institute of Clinical Excellence) guidance recommends replacement arthroplasty for displaced, intracapsular femoral neck fractures [3]. Apart from the Austin Moore and Thompson's prosthesis (which are no longer recommended to be inserted) there remain sparse data about any of the hemiarthroplasty stems currently on the market. Although NICE recommends using proven, modern stem designs, many surgeons continue to use Austin Moore and Thompson's prostheses in very low physical demand patients due to cost implications. There also remains concern for the possible risks of the use of cement in this population [4].

The prosthesis related complications of hip hemiarthroplasty include: periprosthetic fracture, dislocation, infection, aseptic loosening, acetabular wear and possible bone cement implantation syndrome [5]. These complications can lead to increased morbidity, mortality and cost. This is seen in patients developing infection and dislocation, with up to 50% one-year mortality following deep infection and 65% mortality at six months following dislocation [6, 7]. Studies have identified revision rates of 4-24% following hemiarthroplasties for trauma [8-11].

Hemiarthroplasties can be divided into some simple groups; monoblock or modular, cemented or uncemented, and monopolar or bipolar. As such, they should not all be grouped together as there is significant variation in design. They have their individual complications, as well as sharing general complications to different degrees. The choice of prosthesis is based on patient factors, surgeon preference, availability and cost.

The majority of published work on hemiarthroplasty outcomes relies heavily on the uncemented Austin-Moore or the cemented Thompson's prostheses. The more sophisticated modern prostheses are often considered in the same category as these historical hemiarthroplasties and therefore complications and outcomes are often reviewed together in systematic reviews and meta-analysis. Studies on the newer prostheses include reports of 81 CPT stems, 43 Meretes stems, 228 Lubinus stems, 50 Exeter Trauma stems (ETS) (monoblock) and 68 Corail stems (uncemented) [12-16]. These studies show results comparable or superior to the historical Thompson's and Austin Moore stems with lower revision rates and better functional outcomes. However, the studies on CPT and Meretes stems were focused on the comparison of hemiarthroplasty versus total arthroplasty.

The JRI Furlong Hemiarthroplasty (Joint Replacement Instrumentation Limited, Sheffield, UK) prosthesis designed

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for use with cement comprises of a stainless steel, double tapered, collarless, polished stem and a physiological, monopolar or bipolar head. This is a contemporary, modular system. The potential benefits relate to a greater variation in stem and head size tailored to the patient, greater ease in stem insertion (when compared to monoblock prostheses), and the ability to convert to total hip replacement whilst retaining the original stem.

The aims of this study were to review early complications associated with the use of the JRI cemented, modular hemiarthroplasty prosthesis and to try to establish the standard of performance expected for current modular hemiarthroplasty designs.

METHOD

A retrospective review of a consecutive series of 459 patients who underwent hemiarthroplasty with the JRI hemiarthroplasty stem was undertaken (76% female, average age 83years, range 52-100 (Table **1**)). The JRI hemiarthroplasty was used for all displaced, intracapsular fractures when the clinical decision had been made not to reduce and internally fix or proceed to a total hip replacement (THR). This clinical decision included assessment of mobility (able to shop independently or walk one mile), alcohol excess, pre-existing osteoarthritis of the hip joint, pathological fracture (malignancy) and co-morbidities, especially cardiac, neuromuscular and dementia.

Table 1. Patient and prosthesis demographics.

Sex			
	♂ & ♀	♂	♀
	459 (100%)	122 (27%)	337 (73%)
Age (Years)			
	♂ & ♀	♂	♀
Mean	83	83	83
Range	52:100	59:97	52:100
Prosthesis			
	♂ & ♀	♂	♀
Monopolar	338 (74%)	91 (75%)	247 (73%)
Bipolar	121 (26%)	31 (25%)	90 (27%)
Mean head size	48	52	46
Mean stem size	Small (33%)	Small (40%)	Extra-small (38%)

All prostheses were inserted *via* the anterolateral approach, using the recommended technique for the implant and performed or supervised by a consultant. Third generation cementing techniques were used [11]. The cement was Palacos R + G Cement (Heraeus, Newbury, UK). Patients received prophylactic antibiotics at induction in line with local antimicrobial policy. All patients were mobilised full weight bearing with physiotherapists on day one post operatively as tolerated. One set of standard antero-posterior and lateral radiographs of the hip was taken post operatively. Venous thromboprophylaxis was given with aspirin 150 mg for four weeks post injury. Patients were not routinely followed up after discharge. Any radiographs performed after the initial post-operative xrays were scrutinised.

An electronic patient management system (Bluespier) was used to identify all patients treated with a JRI Furlong cemented hemiarthroplasty at our institution between May 2006 and July 2009. In-patient notes and charts, clinic letters, operation notes, dictations and theatre records were scrutinised, including any evidence for subsequent admissions to the hospital trust of the primary operation). Data collected included: demographics, details of surgery, prosthesis and any immediate surgical, anaesthetic complications and mortality. The electronic x-ray systems for the hospitals in the surrounding 50 miles were screened for any further radiographs of the pelvis/hip, and the reasons for/findings of those radiographs recorded. Specific complications including periprosthetic fracture (iatrogenic or late), dislocation, infection, aseptic loosening and acetabular wear were recorded, along with reasons for any revisions or conversions. There was no clinical patient follow-up conducted.

RESULTS

Over the three year period 459, patients were identified. Complete notes were available for 429 (93%) patients, and were reviewed with a minimum of one-year follow up (range12-56 months, mean 26 months, median 24 months); incomplete records were available for the remaining 30 patients (7%).

Intraoperative fractures occurred in 17 (3.7%). These included fractures of the medial calcar in ten, the greater trochanter in three, three fractures of the anterior cortex and one major fracture. Cables were used in ten of these fractures, screws in one and one were managed with a plate and cables. An example of a cabled fracture is shown in Fig. (**1**) and a follow-up radiograph at 49months (following a fall) is shown in Fig. (**2**). The others required no extra fixation. Six fractures occurred during stem implantation, two during broaching, two during trialing, one during reduction and six were not clearly specified in the written operation note.

There were 2 intra-operative deaths. These intraoperative deaths were scrutinised. Both patients had significant ischaemic heart disease and heart failure with multiple comorbidities. Cardiac arrest occurred whilst transferring from the operating table, greater than 20 minutes following cement implantation in both cases. There was no evidence of bone cement implantation syndrome found.

At one year, further radiographs had been performed for 106 (23%) patients after the initial post-operative film. No abnormality was identified in 74, 20 patients had suffered a contralateral fractured neck of femur or pubic ramus fracture, three showed heterotopic ossification, two sustained a dislocation (0.4%) and one sustained a periprosthetic fracture. Additional six patients were imaged following a diagnosis of wound infection.

Fig. (1). Initial post operative radiograph of a hemiarthroplasty following an intra-operative peri-prosthetic fracture, treated with cables.

Fig. (2). Further radiograph taken 49 months post operatively due to the patient sustaining a fall with pain around the left hip.

Twenty (4%) of wound infections were identified from clinical notes, of which 11 (2.4%) were superficial and treated with antibiotics and nine (2%) were deep requiring surgical debridement. Three deep infections subsequently required revision. There were four clinically evident (and confirmed with duplex scan), below knee and one above knee deep venous thromboses, with no recorded pulmonary emboli. There was a single diagnosis of foot-drop. No patients represented with aseptic loosening. Mortality rate at 30 days was 9%, at six months was 19% and at one year was 24% as shown in Table **2**.

Table 2. Complications at 1 year.

Peri-operative Complications		
Complication	**n**	**%**
Intraoperative fracture	17	3.7
Intra-operative death	2	0.4
Post-operative Complications		
Dislocation	2	0.4
Periprosthetic fracture	1	0.2
Infection - deep	9	2
Infection - superficial	11	2
Aseptic loosening	0	0
Acetabular wear	2	0.4
Heterotopic ossification	3	0.7
Foot drop	1	0.2
Clinically evident below knee DVT	4	0.4
Clinically evident above knee DVT	1	0.2
Pulmonary embolus	0	0
Revision - dislocation	2	0.4
Revision - infection	3	0.7
Revision - wear	2	0.4
Mortality - 30 days	42	9
Mortality - 3 months	62	14
Mortality - 6 months	89	19
Mortality - 9 months	97	21
Mortality - 12 months	112	24

All revision operations identified took place within 15 months of the primary operation. In total, seven (1.2%) patients required revision surgery, two for dislocation, two for acetabular wear and three for infection. The dislocation and acetabular wear cases underwent a conversion to THR. Two infected cases underwent full revision to THR and one required an excision arthroplasty.

No significant differences in outcomes between bipolar and monopolar prosthesis were found.

DISCUSSION

This is the first study to report on the early complications of the JRI Furlong cemented modular hip hemiarthroplasty. This stainless steel, double tapered, collarless, polished stem can allow for better control of length, version, offset and soft tissue tension compared to the traditional uncemented Austin Moore and Thompson's prostheses. It has also the advantage that the modular system accommodates conversion to THR whilst retaining the original stem.

Our study includes 76% monopolar and 24% bipolar hemiarthroplasties. The type of prosthesis used was at the discretion of the operating surgeon. The use of the bipolar

prosthesis became infrequent towards the end of the study period with only 11% of hemiarthroplasties in the last 6months being bipolar (13 *vs* 107). This change in practice reflects the lack of evidence in published work that there is any significant difference in outcomes between monopolar and bipolar prostheses. Raia *et al.* (2003) showed no functional or quality of life benefit for bipolar over monopolar hemiarthroplasty in their randomised control trial [17]. It is also this lack of proven difference in outcomes that prompted this study to group the two prostheses together.

The periprosthetic fracture rate of 3.7% in this study is high when compared to that found in the cemented Thompsons (1.8%) but considerably lower than in the uncemented Austin Moore (12-14%) [18]. Reviewing these more closely indicated that stem implantation was a stage with an increased risk. A close relation of broach to prosthesis size may be implicated in this problem. This may lead to a learning curve using this prosthesis in unforgiving, osteoporotic bone. The fractures are spread throughout the four years of data collection and may represent the regular six-monthly turnover of junior orthopaedic trainees becoming familiar with this aspect of the prosthesis and broaches. This may be negated by choosing a stem size one size smaller than the final broach which fits the canal.

This study identified a rate of dislocation of under 0.5%. This is less than the rate of 3% seen in studies using the same approach [19, 20]. This is likely to represent greater ability to control offset, version and, subsequently, tissue tension. Indeed, a recently published study by Pegrum *et al.* (2014) has shown greater leg length discrepancy with the ETS when compared to the modular JRI hemiarthroplasty [21]. The two intra-operative deaths appear to have happened a significant time following the implantation of cement, in patients with known severe cardiopulmonary disease. We believe that these deaths are unlikely to represent a cement implantation syndrome. There were no other critical events recorded on the anaesthetic records in relation to cement implantation. With recent caution expressed regarding the use of cement in this group this was an important finding and correlated with the findings from a recent meta-analysis [22]. Ahn *et al.* [22] showed no difference between post-operative outcomes for peri-operative (<1 month), intermediate mortality (<3 months) and long-term mortality (≥6 months) when using cemented or uncemented prostheses [23].

The revision rate of 1.2% in our study at 15months compares favourably with revision rates of 3-24% identified in the literature [9-11, 18]. These are early results and the volume of revisions for acetabular wear would be expected to increase with time. The Australian Joint registry has large volumes of hemiarthroplasties with long term follow up [24]. This registry has shown a one year revision rate of 1.7% for cemented, modular, monopolar hemiarthroplasty, and 1.8% for bipolar. The registry figures shed light on hemiarthroplasty outcomes, but clearly patient groups are not matched and significant biases will impact on the relative outcomes of varying prostheses. The benefit of the modular system is the ability to convert the hemiarthroplasty to a THR if necessary. The four cases revised for non-infective reasons all had conversion procedures. The potential benefit of this is a shorter operation with reduced associated morbidity and reduction in cost. We have seen no dislocations following conversion procedures to date. However, recent studies have found better results with stem exchange, particularly in relation to dislocation rates [25, 26]. This may be due to problems matching the version of the *in situ* stem with the position of the acetabular cup and/or achieving adequate soft tissue tension.

Cost of treatment and implants is a continued concern for those purchasing health care treatment, especially with the worldwide rising incidence of femoral neck fractures [27]. Orthopaedic departments require a prosthesis which has a low complication rate and a lifespan that will outlast the patient into which it is inserted. The JRI cemented stem and monopolar head have a list price of £319 (Euro398, $515 November 2012), significantly less than other arthroplasty stems on the market and but more expensive than the historical prostheses. At the time of writing, prices available to our department are ETS £350, Austin Moore £90 and Exeter stem (without head) £400.

Limitations of this study include its retrospective nature, which makes identification of complications from patient notes less reliable. Review of regional computer xray archiving systems and databases has not been validated as an accurate method of data collection and although complication rates have been quoted, these cannot be completely verified. This cohort is difficult to follow-up due to high mortality and high levels of dementia. Patients with dementia are less likely to present with hip pain or complaints of loss of function, though they are at higher risk of dislocation. Another weakness is that 100% follow-up cannot be guaranteed. It is not known how many patients have moved out of the area and subsequently complications occurring outside the region are not included. It was based on the assumption that this patient cohort is not socially mobile and the vast majority remains in the area following injury. There are also no face to face functional assessments or pain scores. This is an area that requires further study.

CONCLUSION

This large, retrospective, cohort study has illustrated some benefits of using a polished, tapered, cemented stem for the displaced intracapsular fractured neck of femur patients. The high intraoperative fracture rate may relate to a learning curve with the new prosthesis in unforgiving bone, with many fractures occurring during stem implantation; we recommend using a stem one size smaller than the final broach in fragile, osteoporotic bone. The low dislocation rate is significantly better than previously published results with other devices. This may be related to modularity of the device, and the ability to better restore length, offset, and soft tissue tension. There has been no aseptic loosening. This modular design has allowed conversion to THR in non-infective cases.

CONFLICT OF INTEREST

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