Pegrum et al., J Trauma Treat 2014, 3.2
DOI: 10.4172/2167-1222.1000186

Journal of Trauma & Treatment
ISSN: 2167-1222

Research Article Open Access

Reduced Leg Lengthening found with a Modular Hip Hemiarthroplasty Stem versus the Monoblock Equivalent

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Abstract

The frequency of hip fractures are increasing in the globally. Cemented implants offer less pain and improved mobility post operatively. To date there has been no comparison between The Exeter Trauma Stem (ETS), which is a monoblock single size stem versus the Joint Replacement Instrumentation (JRI), a modular cemented hip used in the treatment of intracapsular fracture neck of femur fractures. It was postulated that the monoblock single size stem would be more difficult to insert in smaller femoral canals, and as such would have a greater tendency to lengthen the leg and greater incidence of calcar fractures. Over a 2 year period we have reviewed, the operative complications and radiological outcomes of the JRI hip hemiarthroplasty stem with a matched group of ETS implants. The study highlights the one-size-fits-all ETS system is more likely to be placed longer than a modular JRI system (p=0.01). There was no statistical difference in calcar fractures between the two prostheses. There were 40/99 JRI implants (40%) patients which required a smaller prosthesis than the ETS, these patients may have been over lengthened if the ETS was used. Careful radiographic pre-operative evaluation is required in order to avoid over lengthening the ETS prosthesis in patients with a narrow canal. A modular prosthetic design offers a valuable alternative to such a scenario.

Keywords: Hip; Fracture; Modular; Monoblock; Cementing; Leg lengthening; Complications

Introduction

Hip fracture is a significant public health issue, with up to 75,000 cases presenting per year at an annual cost of approximately £2 billion in the UK [1]. Globally there are over 1.5 million femoral neck fractures with 740,000 deaths, with this figure rising to 3.9 million by 2050 [2,3]. The increasing ageing population dictates that the burden of this condition is only set to rise to 100,000 in the UK annually by 2033 [4], risk stratification and operative planning will be essential to avoid the burden of complications from unsuitable patient selection, the revision rate from hip hemiarthroplasty has been reported to be as high as 20% at 9 years follow up [5].

There are various types of hip hemiarthroplasty prostheses available for the treatment of femoral neck fractures. Recent developments have favoured the smooth stem prosthesis inserted with cement, which is supported by NICE (National institute of clinical excellence CG124 [1]. This design of prosthesis has commonly been used for total hip replacement in the elective setting with good long term survivorship [6-8]. A Cochrane review in 2006 reported that patients with cemented prostheses have less pain and a tendency to better mobility than those with uncemented prostheses [9,10].

Previous studies assessing the common cemented implants, the ETS and Thompson hemiarthroplasty, have found these prostheses to be equivalent in radiographic outcomes and surgical complications [11]. Although the ETS has been found surgical easier to insert than the Thompson counterpart, due to the tapered smooth stem nature [12]. To date there has been no research comparing the ETS to a modular cemented equivalent in the treatment of intra-capsular neck of femur fractures. Currently the ETS is a universal sized implant with a fixed offset of 40 mm. The feared complications intra-operatively are that of calcar and femoral fractures or implant over lengthening causing increased operating times and patient morbidity [13].

The ETS in the literature has been shown to inserted long as a result of the universal size [13]. This is something we had experienced in our department and with the availability of the JRI modular prosthesis hypothesized that that the ETS monoblock single size stem would have a greater tendency to lengthen the leg and greater incidence of calcar fractures in an attempt to avoid placing the prosthesis too long.

With no previous studies comparing the two prostheses there is a need to evaluate the intra-operative complications and radiographic outcomes associated with using a smooth monoblock Exeter Trauma Stem (ETS, Stryker, Montreux, Switzerland) with the modular JRI system (Joint Replacement Instrumentation, Sheffield, UK) prosthesis, which allows the choice of stem sizes (extra-extra small, extra small, small, medium, large) to better match the diameter of the femoral canal (Figure 1a, 1b and 2a, 2b).

Materials and Methods

Over a 2 year period, all femoral neck fractures undergoing a JRI hip hemiarthroplasty implant from June 2009 to June 2011 were retrospectively reviewed and compared to a matched cohort of ETS hip hemiarthroplasty implants over the same time course. There were 99 patients undergoing JRI hemiarthroplasty with all assessed using the NICE CG124 (national institute of clinical excellence) guidelines

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Received November 23, 2013; **Accepted** January 24, 2014; **Published** January 26, 2014

Citation: Pegrum J, Giannakakis N, Subramanian P, Abbas D, Pearce O (2014) Reduced Leg Lengthening found with a Modular Hip Hemiarthroplasty Stem versus the Monoblock Equivalent. J Trauma Treat 3: 186. doi:10.4172/2167-1222.1000186

Figure 1a: Exeter Trauma Stem (ETS).

Figure 1b: Joint Replacement Instrumentation (JRI).

Figure 2a: Cemented Exeter Trauma Stem (ETS).

[1]. Total hip replacement was offered to those who were mobile with one or less walking aids, no history of dementia and anaesthetically fit. The choice of hemiarthroplasty implant was decided by one of the seven Orthopaedic consultant leads for the trauma list on the day of admission. The 99 JRI hemiarthroplasties were matched with 99 ETS prostheses carried out during the same time period.

All procedures were through a modified Hardinge anterolateral approach to the hip, with the patient in a lateral position. The native femoral head was removed atraumatically, and measured to enable an equivalent sized prosthetic head. All stems underwent a trial reduction before definitive implantation. The stems were all cemented with Palacos refobacin and gentamicin (Heraeus Medical GmbH, Wehrheim, Germany). All patients were given prophylactic Teicoplanin on induction and at 12 hours post-operatively. All wounds were closed using vicryl sutures and skin staples. Early full weight bearing mobilisation was encouraged from day one post operatively in all patients. All operating surgeons had training on both implants and neither of which were newly introduced into the department. There were no exclusion criteria.

The patient records and radiographs were reviewed using the Electronic Document Managing (EDM) system and the Patient Archiving and Administration System (PACS – GE Medical systems 2005) by an independent observer (NG), who had not been involved in the care of any of the patients in question. Leg length was measured radiographically using the Woolson methodology [14]. The statistical analysis was performed using SPSS version 18. A Shapiro-Wilk test was performed on the relevant data for normality. Continuous variables were analysed using an unpaired two-tailed t-tests and non-parametric binary data calculated using Wilcoxon signed ranked test. A P-value of <0.05 was considered to be statistically significant.

Results

The patients undergoing an ETS hip hemiarthroplasty were matched against the JRI for age, American Society of Anaesthesiologists (ASA) score and pre-operative haemoglobin (Table 1). None of these differences between these groups was statistically significant.

The operative details and radiographic analysis are shown in Table 2. The ETS was statistically more likely to be placed longer than the JRI prosthesis (P 0.01). There was a trend towards reduced operating time using the ETS hip hemiarthroplasty, which did not reach statistical significance (0.057). There was no statically significant difference in the number of intraoperative fractures, blood loss, and length of hospital stay or mortality between the two prostheses. Table 3 shows the frequency of the different sized JRI prostheses used.

Discussion

Selecting the appropriate prosthesis has never been so important. By 2033 there will be over 100,000 hip fractures annually in the UK

Figure 2b: Cemented Joint Replacement Instrumentation (JRI).

	ETS	JRI
Number of patients	99	99
Mean age	84.2	83.4
Mean ASA score	2.51	2.8
Pre-operative Haemoglobin	12.43	12.27

Table 1: Patient Demographics.

	ETS	JRI	P value	95% confidence interval of the difference
Operative fracture	0	2	0.5	-
Blood loss g/dl	2.66	2.63	0.572	-0.37 to 0.67
Leg lengthening (mm)	11.3	6.67	0.01	-5.36 to -2.67
Leg shortening (mm)	4.5	4.1	0.39	1.30 to 9.46
Length of hospital stay (days)	18.6	23.0	0.305	-15.3 to 4.9
Mortality	8	7	0.322	-

Table 2: Operative details and radiographic analysis of leg length.

Extra-extra small (XXS)	12
Extra small (XS)	28
Small (equivalent to the ETS)	33
Medium	24
Large	6

Table 3: Frequency of different sized JRI prostheses used.

[4], risk stratification and operative planning will be essential to avoid the burden of complications from unsuitable patient selection. Despite NICE CG124 clinical guidelines recommending a cemented implant for fractured femoral neck fractures, little is known about which implant is best. Both the ETS and JRI are commonly available implants used for this purpose. Previous studies have compared cemented and uncemented implants, hemiarthroplasties with total hip replacement, bipolar prosthesis with unipolar and recently modern and traditional cemented implants [12,15]. To date there has been no studies comparing two modern stem cemented prostheses.

The study highlights the one-size-fits-all ETS system is more likely to be placed longer than a modular JRI system (p=0.01). Problems with leg lengthening using the ETS have also be published in the literature due to the underlying femoral size and narrow canal diameter found in patients [13]. This has important implications for the operating surgeon to carefully analyse the femoral canal before operating on a patient, to avoid this known complication which results in hampered mobilisation, lateral buttock pain syndrome, or failed on table reduction [13].

Although small stem Exeter prostheses are available in 30mm, 33mm and 35.5mm offsets in modular total hip arthroplasty with good long term survivorship [16], these have yet to become available in the trauma setting. As the ETS only comes in a 40 mm offset the surgeon needs to be aware of potential complications with a fixed sized femoral implant and have an alternative prosthesis should there be a narrow canal. Standard Exeter femoral stems do come in a variety of sizes, which can be used in the trauma setting by using a monopolar head on the V40 taper. Although this is a costlier option over the ETS.

The frequency of calcar fractures in the literature is relatively rare event [17,18]. Our other hypotheses of less calcar neck fractures in the JRI group proved unfounded. There were 2 calcar fractures in the group, which was not statistically different p>0.05.

The implant sizing has been calculated directly from the manufacturers implant templates. The dimensions of the ETS equates to the same size as the 'Small' JRI prosthesis (when measured against the implant templates of both manufacturers). The size and density of femur varies with the gender and age of the patient, with females typically having smaller osteoporotic femurs [19,20]. With females being the predominant population with underlying osteoporosis and at subsequent risk for neck of femur fractures, there needs to be pre-operative evaluation of the femoral canal prior to fixation. In our cohort of patients there were 40/99 (40%) with extra-extra small and extra small JRI prostheses inserted. If the ETS was used instead of the JRI in these patients, the canals may have been of insufficient size to accommodate the ETS, and thus further lengthening or fractures may have occurred.

The further added advantage in using a modular system allows for head to be changed, and conversion to a THR, without the need to remove a well fixed cemented stem. The reported revision rate of 20% at 9 years [5] needs to be taken into account when selecting a prosthesis. Converting a modular hemiarthroplasty into a THR, for protrusion or wear, will undoubtedly be a much simpler operation, and avoid the need for cement in cement revision.

This study highlights an important consideration when planning a hip hemiarthroplasty operation to carefully analyse the femoral canal diameter in order to choose an appropriately sized prosthesis [12]. The bloods loss, mortality and length of stay are comparative to other studies [21,22]. However, no power analysis was carried out and there are limited patients, which precludes firm conclusion regarding the occurrence of calcar fractures. Due to the infrequency of calcar fractures finding statistical significance would require a larger study into the thousands.

Conclusion

With the increased burden of the aging population choosing an appropriate hip hemiarthroplasty implant has never been so important. This study is the first study to compare two commonly used cemented implants and evaluate their surgical considerations. Careful radiographic pre-operative evaluation is required in order to avoid over lengthening the ETS prosthesis in patients with a narrow canal, which can result in failed on table reduction, difficulty in mobilising the patient and lateral buttock pain syndrome. It is important to be able to choose a smaller prosthesis in such an event, the modular JRI offers such an option and is a valuable alternative to such a scenario. A modular system may also be beneficial should revision surgery be required from acetabular wear or protrusio.

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