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Original Article

Early results of the LPS™ limb preservation system in the management of periprosthetic femoral fractures

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ABSTRACT

Introduction: Achieving skeletal fixation in the presence of progressive bone loss is a surgical challenge, especially in cases of periprosthetic fracture (PPF). Unpredictable fracture patterns and preexisting bone loss frequently combine in this patient group. Megaprosthetic arthroplasty allows for immediate mobilisation and shorter periods of rehabilitation. We describe the clinical outcomes of a cohort of LPS™ megaprostheses performed for PPF by a single surgeon at our institution.

Methods: Between July 2013 and November 2015, 23 patients underwent endoprosthetic femoral replacement of which 16 were performed for PPF or bone loss. Patient demographics, surgical indication, operative details, implant composition, blood loss, survival, and revision surgery details were recorded in a prospectively maintained database. Patients underwent serial clinical and X-ray evaluations at 6 weeks, 3 months and 6 months post surgery with yearly reviews thereafter.

Results: The PPF cohort consisted of 9 males and 7 females with a mean age of 75 and a mean follow up of 19.2 months. The mean Oxford score prior to fracture was 41 (range 12–48), and 39 (range 13–48, $p = 0.6$) post megaprosthesis insertion. Postoperative dislocation of the megaprosthesis occurred in two patients (12.5%), with no postoperative infections recorded.

Conclusion: We report minimal postoperative changes in functional outcome scores. The results of revision arthroplasty with LPS™ proximal femur megaprosthesis were satisfactory in 15/16 patients at a mean follow-up of 19.2 months. We recommend the use of megaprostheses in patients with markedly deficient bone stock for whom other available reconstructive procedures are unavailable.

1. Introduction

Achieving skeletal fixation in the presence of progressive bone loss is a surgical challenge in patients following multiple revision arthroplasties, periprosthetic infection, malignancy or extensive limb trauma.[1–4] Periprosthetic femoral fractures (PPF) are a potentially devastating complication following total hip arthroplasty. Unpredictable fracture patterns and preexisting bone loss frequently combine in this patient group where medical comorbidities are also common.[5] Their reported incidence in the literature ranges from 1% to 4.1% intraoperatively.[6–8] The postoperative fracture risk has been described as 1% during the subsequent life of the implant.[9] Patients who suffer PPF experience higher postoperative mortality rates of 7.3%[10] and 11.0%[11] within 6 months and one year, respectively.

A variety of alternative reconstructive options are available to address advanced femoral bone loss including impaction allografting, allograft-prosthetic composite (APC) and megaprosthetic arthroplasty. Modern megaprostheses are modular, allow extensive resections and are available with porous coated or cemented fixation. Megaprosthetic arthroplasty while technically demanding allows for immediate mobilisation and shorter periods of rehabilitation, avoiding the risk of disease transmission and graft incorporation associated with allografts.[12] These reconstructions however are frequently complicated by dislocation, loosening and infection which can adversely affect limb function and prosthetic longevity.[13–15] The purpose of our study was to assess the clinical outcomes of a cohort of megaprostheses performed for PPF by a single surgeon at our institution.

2. Methods

In July 2013, the Depuy Limb Preservation System (LPS™) was introduced at GUH. The LPS includes metaphyseal segments bearing articular surfaces for proximal and distal femoral

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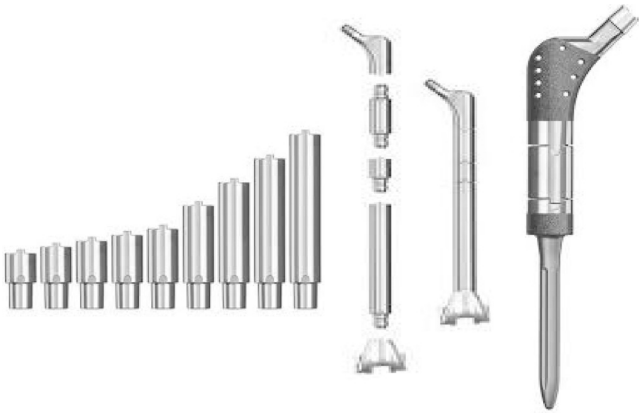

Fig. 1. Segmental implants (left), complete modular femoral implant (centre), proximal femur with one segment and non porous stem (right).

replacements, diaphyseal anchor segments allowing cemented or cementless fixation and intercalary segments which allows prosthetic lengthening in 5 mm increments (Fig. 1).

Between July 2013 and November 2015, 23 patients underwent endoprosthetic femoral replacement of which 16 were performed for PPF or bone loss. Appropriate informed consent was acquired from patients prior to inclusion in the study. A database was created prospectively recording patient demographics, surgical indication, operative details, implant composition, blood loss, survival, and revision surgery details where appropriate. Patients underwent serial clinical and X-ray evaluations at 6 weeks, 3 months and 6 months post surgery with yearly reviews thereafter. The Oxford hip score was used to objectively grade hip function.

2.1. Surgical technique

Cases of PPF necessitating fixation were treated using a standardised operative protocol. Following standard intravenous tranexamic acid and prophylactic antibiotic administration the patient is placed in the lateral decubitus position with the operative limb draped freely. A direct lateral approach centred distally over the femoral shaft and curving posteriorly over the greater trochanter is deepened through the subcutaneous tissue and fascia lata to expose the greater trochanter and Vastus Lateralis. The Vastus is dissected from the Vastus ridge proximally and from proximal to distal along the linea aspera posteriorly, ligating the perforating branches of the profunda femoris sequentially. Posterior dissection progresses until the most distal extent of the fracture is visualised. The greater trochanter and as much of the attached lateral femoral cortex as the fracture pattern allows is isolated with saw cuts along the anterior and posterior aspects of the proximal femur. The remaining fragments are retained with the muscle attachments for later fixation. The extended trochanteric fragment is then reflected anteriorly to expose the femoral stem and surrounding cement mantle. The cement/implant composite is extracted and excision of the inferior pseudocapsule then affords excellent exposure of the acetabular component which can be revised if necessary. The femur is osteotomised transversely just distal to the fracture. The canal is reamed sequentially to a diameter 2 mm larger than the selected diaphyseal anchor to accommodate a cement mantle for anchor fixation. The trochanteric segment, distal anchor and appropriate length of intercalary segments are trialled for stability and version is selected by marking the femur opposite the notch on the shoulder of the anchor segment. Cemented femoral fixation with Palacos™ (Heraeus Medical) and a modular head appropriate to the acetabular component was used in all cases after reduction of the implant of the trochanteric fragment is secured with a 150 mm trochanteric cable plate that incorporated cerclage wires around the trochanter and any femoral shaft fracture fragments. The wound was then closed in layers without vacuum drainage or compressive dressings (Table 1).

Table 1
Indications for use of LPS™ megaprosthesis.

Surgical indication	
Periprosthetic fracture	16
Aseptic loosening of femoral stem	3
Aseptic loosening of femoral ORIF	2
Proximal femoral metastases	1
Neck of femur fracture with poor proximal bone stock	1

Patients are mobilised with physiotherapy the day after surgery, with unlimited progressive weightbearing as tolerated.

3. Results

Between July 2013 and November 2015, 23 patients underwent endoprosthetic femoral replacement of which 16 were performed for PPF or bone loss. The PPF cohort consisted of 9 males and 7 females with a mean age of 75 years (range 59–94). Surgery was indicated in those with poor proximal bone stock in combination with a Vancouver B1, B2, B3 and C fracture patterns (Fig. 2).

As indicated in Table 2, the majority of femoral stems revised in the PPF cohort were cemented, with only two uncemented stems included in the study. The stems revised reflect the practice within the region over the preceding number of years. The mean resection length was 207.5 mm (range 90–305), with one whole femur resection equivalent to a resection length of 475 mm. The mean hospital length of stay (LOS) was 21.7 days (range 5–48). The mean intraoperative blood loss was 1439 ml (range 400–2750), with no correlation identified between length of resection and volume of blood loss ($p = 0.2$). Upon discharge from the hospital six patients mobilised with crutches while 9 mobilised with frames. One patient whose pre-morbid state was non-ambulatory secondary to advanced dementia remained thus. The mean Oxford score prior to fracture was 41 (range 12–48), while the mean Oxford score post megaprosthesis insertion was 39 (range 13–48, $p = 0.6$). This demonstrates a minimal loss of function despite undergoing surgery which involved bone loss with altered fixation of abductor and adductor muscle groups.

Table 2
Patient demographics of PPF cohort.

Gender	
Male	9
Female	7
Mean age	75 (range 59–94)
Primary implant	
Exeter™ (Stryker)	9
Charnley™ (DePuy Synthes)	5
Corail™ (Depuy Synthes)	2
Stem fixation	
Cemented	10
Uncemented	2
Hybrid	2
Cemented hemiarthroplasty	2
Components revised	
Stem only	16
Both components	0
Survival of primary implant	73 months (range 2–168)
Classification of periprosthetic fractures	
Vancouver B1	1
Vancouver B2	7
Vancouver B3	7
Vancouver C	1