Modular endoprosthetic replacement for failed internal fixation of the proximal femur following trauma

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Abstract

Purpose Although originally designed for reconstruction after primary malignant bone tumour resection, modular endoprosthetic replacement (EPR) can be used in salvage surgery for complex periprosthetic fracture and failed internal fixation. The purpose of this study was to assess the functional outcome following EPR for failed internal fixation of the proximal femur.

Methods We assessed clinical and functional outcomes of using a modular tumour endoprosthesis to reconstruct the proximal femur following failed internal fixation in eight consecutive patients between 2001 and 2008.

Results There were four men and four women, with a mean age of 67.5 (range 50–79) years and a mean follow-up of 16.5 (6–36) months. All patients had failed internal fixation for traumatic proximal femoral fractures—four 31.A2.3, two 31.A3.1, two 31.A3.3 using the Arbeitsgemeinschaft für Osteosynthesefragen (AO) fracture classification. Mean time from the first attempted internal fixation to definitive EPR was 34 (6–102) months, and the median number of previous surgical procedures was two (1–11). Histology revealed infection (two cases), uninfected nonunion (five cases) and plasmacytoma (one case). The EPR was carried out as a one-stage procedure in six cases and a two-stage procedure in two cases. Mean postoperative Harris Hip Score was 71.4 (range 64–85). There were no surgical complications. One patient died as a result of systemic complications of myeloma several years following EPR.

Conclusions EPR is an effective salvage procedure for

failed fixation of traumatic proximal femoral fractures. Immediate weightbearing and a good functional outcome can be expected in this difficult group of patients.

Introduction

Endoprosthetic replacement (EPR) of the proximal femur is a well-recognised treatment for primary bone tumours or destructive metastases either with impending or established pathological fracture [1]. EPR for failed internal fixation of the proximal femur has been described once previously in the scientific literature [2]. In our case series of eight patients, EPR was used for failed internal fixation of proximal femoral fractures, the incidence of which in the UK is rising as a result of an increasingly large elderly population [3]. As a result, it is likely that more complex cases of failed proximal femoral internal fixation will present requiring further surgical treatment. The principles of treating failed internal fixation are not dissimilar whether the cause of nonunion be a pathological fracture or a nonunion that has been refractory to multiple surgical interventions. In both instances, a large portion of proximal femur may have to be sacrificed, leaving a bony defect that may only be reconstructed using an EPR.

Patients and methods

Between 2001 and 2008, eight patients underwent EPR following referral to the Oxford Sarcoma Service because of failed internal fixation of the proximal femur. Patients' gender, age at presentation, clinical features, investigations, preoperative diagnosis, operative findings, histology, further treatment and complications were recorded (Table 1).

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Table 1 Patient characteristics

Case number	Age	Sex	Previous operations	Most recent surgery prior to endoprosthesis replacement	Histology	Stages	Time from fracture to EPR (months)	Harris Hip Score postsurgery
1	79	Female	1	Dynamic hip screw	Nonunion	1	32	78
2	63	Female	2	Gamma nail	Nonunion	1	6	66
3	61	Female	3	Synthes nail and bone graft	Nonunion	2	27	85
4	50	Male	3	Dynamic hip screw	Infection	2	19	64
5	76	Male	2	Dynamic condylar screw and bone graft	Infection	1	21	72
6	58	Female	11	Free fibula graft	Nonunion	1	102	64
7	76	Male	2	Dynamic hip screw	Nonunion	2	39	78
8	77	Male	1	Dynamic condylar screw	Plasmocytoma	1	29	64

EPR endoprosthesis replacement

All operations were carried out at one institution (Nuffield Orthopaedic Centre, Oxford, UK). Each operation was performed in a clean-air theatre. Antibiotic prophylaxis was given at the time of surgery and continued postoperatively depending on the index of suspicion for infection and growth from intraoperative microbiological samples. After surgery, patients were mobilised fully weight bearing.

Operative technique

The Modular Endoprosthesis Tumour System (METS; Stanmore Implants Ltd, Stanmore, Middlesex, UK), which can be used to replace diseased or deficient bone in the proximal femur, was used in all cases. The system has a variety of different trochanter sections shaped anatomically, with provisions for trochanteric attachment with a range of shafts to accommodate differing amounts of femoral resection. It is a stemmed implant with a range of collars

Fig. 1 Infected hip screw: preoperative radiograph (case 4)

Fig. 2 Case 4 following first-stage procedure

and stems to match the size of the resected bone and intramedullary canal, respectively. All cases underwent preoperative planning, and templates were used to establish appropriate component size for each patient. In patients with confirmed infection, a two-stage procedure was carried out (Figs. 1, 2 and 3). The first stage consisted of a comprehensive debridement and metal-work removal. A spacer of antibiotic-impregnated cement modeled around a guidewire was used, and the patient was treated for a minimum of six weeks with targeted antibiotic therapy guided by microbiology results from samples taken from the first stage of the procedure. The second stage was then embarked upon once the patient was well and all infective indices, including C-reactive protein (CRP) had returned to normal.

Results

There were four men and four women with a mean age of 67.5 (50–79) years. Mean time from initial injury to EPR was 34 (6–102) months, and median number of previous operations was two (1–11). All patients had sustained traumatic fractures of the proximal femur—four 31.A2.3,

Fig. 4 Failed intramedullary device (case 2)

Fig. 3 Case 4 following second-stage procedure

Fig. 5 Case 2 following endoprosthetic replacement

two 31.A3.1, two 31.A3.3 according to the Arbeitsgemeinschaft für Osteosynthesefragen (AO) fracture classification. The ultimate failed internal fixation was a dynamic hip screw in three cases (Fig. 1), intramedullary nail in two (Figs. 4 and 5), dynamic condylar screw in two and a free fibula graft in one. A two-stage procedure was employed in three cases, of which two were infected and one a suspected infection. All patients undergoing a two-stage procedure were treated with at least six weeks of intravenously administered antibiotics between the two stages. One infected case was managed with a one-stage procedure followed by six weeks of antibiotics i.v. The cause of nonunion was infection in three cases and malignancy (plasmocytoma) in one. The mean length of stay was 8.3 (7–18) days.

The mean Harris Hip Score (HHS) was 71.4 (64–85) at a minimum follow-up of one year [mean follow-up 17 (range 12–36) months]. There were no cases of reoperation, infection or dislocation. One patient died within two years of surgery secondary to systemic complications of multiple myeloma.

Discussion

Patients who undergo EPR following failed internal fixation of proximal femoral fractures are a complicated group, as evidenced by this study. One patient had undergone 11 previous surgical procedures over a period of over eight years, whereas two of the eight cases were infected. This series demonstrates that EPR is an effective salvage procedure in this group of patients. This is evidenced by the mean postoperative HHS of 71.7 and the absence of major surgical complications. When repeated attempts at internal fixation fail, the likelihood of success from further surgery aimed at achieving bony union decreases significantly. Once attempts at achieving bony union have been abandoned, the treating surgeon is left with the option of EPR, Girdlestone's excision arthroplasty (GEA) or hip disarticulation. GEA has been shown to be a viable option to salvage irretrievably failed hips following failed internal fixation [4]. Hip disarticulation is a mutilating option that is only used as an absolutely last resort. Limb shortening and the inevitable need for a walking aid mean that GEA may be poorly tolerated in the more active and demanding patient. The functional scores observed in patients undergoing GEA as a result of infected total hip replacements [5] is considerably less than that of patients following two-stage revisions for infection [6]. Hip replacement for failed internal fixation of intertrochanteric fractures also demonstrates far better functional outcomes than would be

expected following GEA [7]; reimplantation has also been shown to be functionally superior to GEA [8].

Two widely reported problems with EPR are dislocation and infection, which vary from approximately 1–20% in the literature [1]. The problem with dislocation is thought to be a result of the extensive soft tissue resection around the hip that creates great difficulty in repairing the capsule and abductor lever arm. This complication was not encountered in our series. Despite two patients in our series being treated for infected failed internal fixation of the proximal femur, no cases were complicated by infection postoperatively. This demonstrates that adequate debridement in combination with prolonged targeted antimicrobial therapy can minimise the risk of endoprosthesis infection. Of note, proximal femoral replacements have been used to treat failed hip replacements with severe proximal bone loss, and functional outcomes were similar to those in our study [9].

Conclusions

EPR is an effective salvage procedure for failed fixation of traumatic proximal femoral fractures. Immediate weight-bearing and a good functional outcome can be expected in this difficult group of patients.

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