

Bilateral distal femoral endoprosthesis for trauma

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Summary

In this paper, we describe the outcome of bilateral distal femoral endoprosthesis for the management of acute severe trauma. We also review the literature to ascertain the published functional results of distal femoral endoprosthesis for acute trauma of native knees. In severely comminuted intra-articular fractures, such as those our patient sustained, reconstruction is not always possible, and predictable outcomes can rarely be assured with conviction. Endoprosthesis is an established treatment modality for replacement after resection in limb salvage surgery. In this regard, there is a limited but vital role that endoprosthesis can play in acute complex trauma. We demonstrate a good short-term outcome when bilateral endoprostheses are utilised for complex distal femur trauma.

Keywords

clinical, emergency medicine, orthopaedic and trauma surgery, surgery, trauma

Introduction

Fractures of the distal femur represent a significant injury. Distal femoral fractures around a native knee are relatively uncommon, with an incidence of 5 per 100,000, and they constitute approximately 3–6% of all femoral fractures.¹ Distal femoral fractures can be grouped according to the AO Foundation classification.² Type A fractures (33A1–3) are extra-articular, type B fractures (33B1–3) are partial articular and type C fractures (33C1–3) are complete articular. AO classification of 33C3 fractures are defined as multi-fragmentary complete articular fractures and they are arguably the most difficult to reconstruct.

Type A fractures are reported to be the most frequent, followed by type C, with type B representing a minority.^{3–5} A bimodal distribution is described, which groups the two main mechanisms of injury: elderly women having fallen from standing height, inducing type A closed fractures, and younger men, sustaining high-energy trauma inducing (often open) type C fractures.³

33C3 fractures of the distal femur are typical seen in the younger male, with the leading mechanism being a motor vehicle accident.⁶ Reconstruction and bone preserving surgeries are generally favoured in the young patient, but they may not be possible. Here, we present the outcome of bilateral 33C3 fractures treated with distal femoral replacement and we search the current literature in English for outcomes of acute fracture management by means of distal femoral replacement.

Case report

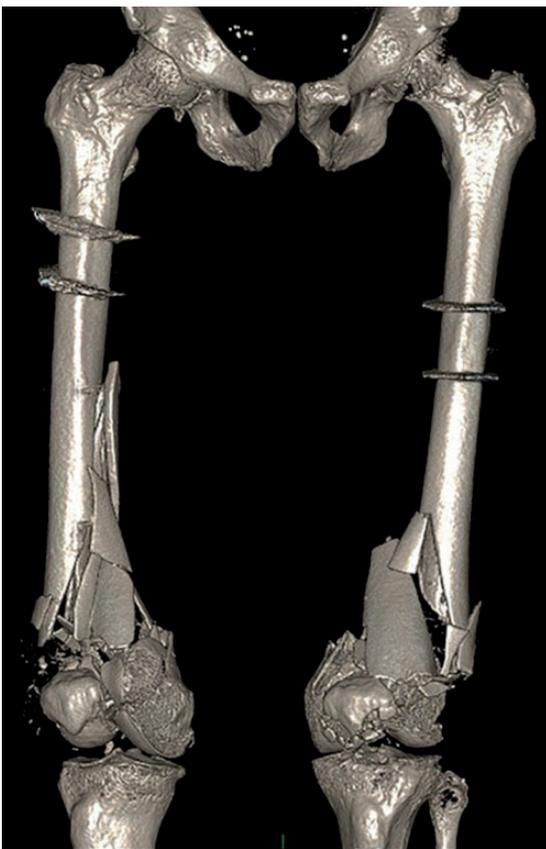
A 58-year-old man was retrieved to the Royal Victoria Infirmary, Newcastle, by air ambulance following a significant motor vehicle accident. The work van he was travelling in collided with an oncoming lorry at a combined speed of approximately 60 mph. Medical air evacuation was prompt and he received blood products en route to the major trauma centre. On arrival, he underwent resuscitation and assessment in the emergency department. He had sustained the following injuries: left clavicle fracture, right posterior acetabular fracture, right comminuted intra-articular open distal femoral fracture, left comminuted distal femoral fracture, bilateral pneumothoraces, scalp laceration, liver laceration, L1 and T12 stable endplate fractures, right adrenal haematoma and sternal fracture. The bilateral comminuted distal femoral fractures are presented in Figure 1.

After adequate resuscitation, he was taken to theatre where bilateral bridging external fixators were applied to his femoral fractures. Washout and debridement of a severely contaminated Gustilo Anderson 3B fracture of the right knee was undertaken. Bone loss from the right femur was noted at the time of operation. A CT scan was acquired after spanning external fixation (Figure 2). The CT scan illustrated the severely comminuted intra-articular

Figure 1. Bilateral distal femur fractures.



Figure 2. 3D CT reconstruction bilateral femora.



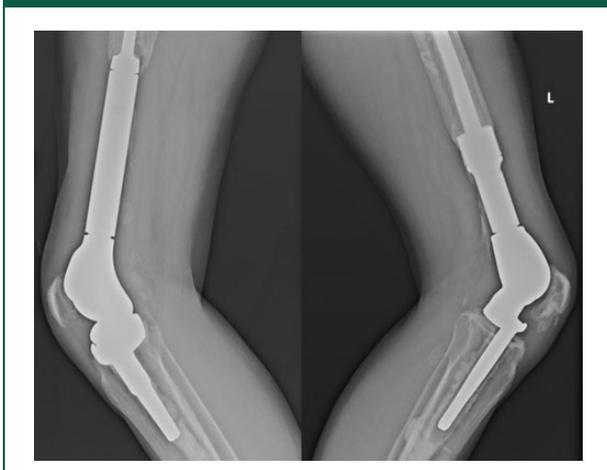
nature of both fracture patterns, which extended into the diaphysis of the femora.

Such was the degree of comminution within the left distal femur that reconstruction was deemed implausible. Acute distal femoral replacement was undertaken at the Major Trauma Centre in Newcastle. Through an extensile anterior approach, distal femoral resection to the origin of the fracture within the diaphysis was performed. A medium Stanmore Modular Endoprosthetic Tumour System (METS) modular distal femoral prosthesis with polyethylene rotating hinged tibia was implanted. There were no perioperative complications.

The right femur was treated as an open fracture. Infection became established and multiple washouts with insertion of antibiotic-eluting cement beads were performed. After the patient had recovered from his acute trauma, he was transferred to his hometown in Scotland and cared for at the Royal Infirmary Edinburgh. The wounds around the right knee were left to heal and the bone stock of the distal femur was re-assessed. It was hoped that this knee would be suitable for open reduction and internal fixation, but operative assessment of the intra-articular fracture pattern and bone loss from the metaphyseal region gave rise to the opinion that misadventure would be likely if fixation was attempted. A two-consultant intraoperative decision for definitive management of the right distal femur with endoprosthesis was made. Through an anterior utility approach,⁷ a medium Global Modular Revision System GMRS prosthesis was implanted. Radiographs of the prosthesis are shown in Figures 3 and 4. Physical therapists worked with the patient twice daily while in the hospital, with immediate range of motion activities and strengthening tolerated.

The concurrent injuries were treated as follows: acetabular fracture with open reduction internal fixation (Newcastle), pneumothoraces with bilateral chest drains in the acute setting, liver laceration and adrenal haematoma non-operatively, stable spine fractures with a range of movement as tolerated and the clavicle fracture was treated non-operatively (later to go onto non-union and require plate with bone graft). The total hospital admission amounted to 11 weeks in Newcastle and 4 weeks in the Royal Infirmary Edinburgh. He required a two-month period of inpatient rehabilitation and was discharged home requiring the use of a single point stick.

At the two-year review, there were no radiographic features of concern. The range of movement was full extension to 120° bilaterally. Power was recorded at Medical Research Council, five bilaterally. Our patient ambulates without the use of gait aids and is

Figure 3. AP radiographs of endoprostheses.**Figure 4.** Lateral radiographs of endoprostheses.

well functioning at home and in the community. His Oxford knee scores were 43 at two years post op.

Discussion

Although open reduction and fixation with a locking plate is the most common treatment method for distal femoral fractures, 33C3 fractures or those with significant bone loss may prove impossible to reconstruct, thereby lending weight to the option of replacement. The indications for tumour endoprostheses have reached into revision arthroplasty surgery and now the orthopaedic surgeon will rarely find the need for this form of replacement in the acute trauma setting.

A review of the literature yields a small number of reported cases of distal femoral replacement in acute trauma not involving a knee replacement (Table 1).^{8–13} Some authors consider hinged knee replacement as distal femoral arthroplasty; however, the distal femoral metaphysis is retained in some prostheses. The authors agree with Clement et al. on the definition of distal femoral arthroplasty as an endoprosthesis that replaces the distal femoral diaphysis and metaphysis.¹²

Bettin et al. present the largest case series of the kind, with 18 patients at an average age of 77.1 (62–94) years.¹³ They specifically researched the role of endoprosthesis in the elderly population, with the majority suffering fracture after fall from standing height. The Knee Society Score averaged 85.7. Implant-related complications occurred in only two (11%) patients. One patient had a periprosthetic fracture that required revision to a total femoral prosthesis, and one patient had a deep infection that required debridement and irrigation and exchange of the modular components.

Clement et al. report on the functional outcome, implant survival and patient mortality after mega prosthetic distal femoral arthroplasty for non-tumour-related indications.¹² They conclude that the functional outcome, revision rate and mortality of patients undergoing distal femoral arthroplasty for non-tumour reasons are not influenced by the surgical indications and should be considered as a salvage procedure in the management of complex distal femoral fractures.

The authors believe this to be the first case of bilateral distal femoral endoprosthesis for acute trauma of native knees reported in the literature. To add to the complexity, this case was managed at two different tertiary institutions, ultimately resulting in a very good outcome. We concur with the small volume of already published results indicating that distal femoral replacement is a viable option for complex

Table 1. Reported cases of distal femoral prosthesis for acute trauma.

Author	Year	Number of cases	Survivorship	Function
Stevens et al.	2017	2	100% at 2 years	SF 12 at 2 years
Clement et al.	2013	11	90% at 5 years	SF 12 at 1 year: 51.8
Clori et al.	2014	2	Not recorded	No complications
Ennaciri et al.	2015	1	100% at 1 year	IKSS 79
Atrey et al.	2017	4	100% at 3 years	OKS: 31
Evans et al.	2016	1	100% at 3 years	Not recorded
Bettin et al.	2016	18	89% at 2 years	IKSS: 85.7

SF-12: Short form 12; IKSS: International Knee Society Score; OKS: Oxford Knee Score

distal femoral fractures and it may yield good short-term results.

Declarations

Competing interests: None declared

Funding: None declared

Ethical Approval: Written informed consent was obtained from the patient for publication of this case report

Guarantor: JS

Contributorship: JS: Case write-up, NC: Case review and final draft, TB: Guidance and review, JTP: Senior author and clinical guidance and review.

Acknowledgements: None.

Provenance: Edinburgh

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