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A case series of mortality and morbidity in distal femoral periprosthetic fractures

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ABSTRACT

Periprosthetic distal femoral fractures are occurring in increasing numbers. There is limited research into outcomes and mortality.

This study aimed to assess the 1 year mortality and complications requiring further surgery in the two years following a presentation with a periprosthetic distal femoral fracture.

A retrospective case series of periprosthetic distal femoral fractures at a single trauma centre was undertaken. All patients were included who presented with a distal femur periprosthetic fracture between 1st January and 2008 and 31st March 2015.

60 patients with 49 females and 11 males. Mean age was 80.7. Median time to surgery was 63 h 42 (70%) underwent open reduction internal fixation, 13 (21.7%) underwent revision arthroplasty and 5 (8.3%) underwent non-operative treatment. Median length of stay was 14 days. There were 12 (20%) complications requiring further surgery within 2 years. There were 2 (3.3%) deaths in 30 days and 8 (13.3%) within 1 year following fracture. Periprosthetic distal femoral fractures are becoming a common orthopaedic presentation. They occur in a complex group of patients and have high rates of mortality and complications.

1. Introduction

In the UK there were 772,818 primary knee replacements between 2003 and 2014.[12] The incidence of periprosthetic distal femoral fractures varies between 0.5 and 5.5%.[10,13,15] As the number of total knee replacements increases, so too will the number of distal femoral periprosthetic fractures.[1,5,8,10,13,15,24] They provide both surgical and anaesthetic challenges. Despite this, there is very little research into outcomes and mortality.

There is currently no consensus on the surgical treatment which depends on both fracture and patient characteristics.[15,23–25] Treatment options include conservative treatment, plate fixation, intramedullary nailing and revision arthroplasty.

There are limited studies assessing mortality following distal femoral periprosthetic fractures. A previous study found that 1 year mortality was 18.6%, which was similar to the mortality in periprosthetic fractures in total hip replacements.[20] Further studies have demonstrated similar mortality in distal femoral fractures and proximal femoral fractures.[8,20,21,24]

The primary outcome of this study was to assess 1 year mortality following distal femoral perirprosthetic fractures.

The secondary outcomes include 30 day mortality, rate of complications requiring surgical intervention and length of stay.

2. Methods

Periprosthetic distal femoral fractures were identified through a radiographic review of ICD-10 codes for distal femoral fractures and a review of an operative database between 1st January and 2008 and 31st March 2015 at a single trauma centre. An ICD code is assigned to every admitted patient that presents to the institution. This trauma centre contained at least 9 lower limb arthroplasty and trauma surgeons during the study. The radiographs of all fractures coded with an ICD code for femoral fracture were reviewed (S72.3, S72.4, S72.7, S72.8, and S72.9). A review of an operative database of all trauma operations undertaken was carried out to ensure all fractures were captured. If there was doubt about whether the patients met the inclusion criteria, xrays and notes were reviewed by both authors and a consensus decision made.

The inclusion criteria were a patient with a diaphyseal or distal femoral periprosthetic fracture following trauma and had a primary total knee replacement in situ. The exclusion criteria were a proximal femur fracture not extending into the diaphysis and an intra-operative periprosthetic fracture.

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A retrospective case note review was undertaken. All patients had at least 2 years of follow-up. Patient demographics, living status, mobility, and co-morbidities were found from patient notes. Capacity was determined by those patients that had an Abbreviated Mental Test Score of at least 7 out of 10 and had given informed consent for surgery The Charlson Co-Morbidity score was calculated which is a validated tool to predict 1 year mortality. A score is calculated based on patients co-morbidities and age.[2]

Operation notes were reviewed for operative technique and ASA grade.

Fractures were classified based on the Unified classification system for periprosthetic fractures.[4] A type A fracture is apophyseal or extra-rtciular/periarticular. A type B fracture occurs in the bed of the implant or around the implant. This is divided into type B1 where the prosthesis is stable and there is good bone, a B2 fracture with a loose prosthesis and good bone and a type B3 where the prosthesis is loose and there is poor bone or a bone defect. A type C fracture is clear or distant to the implant and a type D is an interprosthetic fracture. E and F are not relevant for this study.[4] All radiographs were classified individually by the two authors, and if there was uncertainty about the classification, a conscensus decision was made.

Union was classified as the presence of bridging callous on two perpendicular views.

Statistical Analysis was undertaken. The Mann Whitney test as used for parametric data, and the Chi squared test for non-parametric data. The level of significance was 0.05.

3. Results

60 patients sustained a periprosthetic fracture around a total knee replacement between 1st January and 2008 and 31st March 2015.

There were 49 females and 11 males. The mean age was 80.7 (range 63–98).

1 patient was ASA 1, 30 were ASA 2, 27 were ASA 3, and 2 were ASA 4.52 had capacity to consent for surgery, whilst 8 did not. 29 patients were completely independent pre-operatively using no mobility aids, 21 patients used 1 aid and 10 used a zimmer frame. 53 lived in their own home, whilst 7 lived in institutional care. There were no patients with a Charlson co-morbidity score of 0 or 1, 13 had a score of 2 or 3, 34 had a score of 4 and 5, 10 had a score of 6 and 7 and 3 a score of 8 or more.

The median time to surgery from admission was 63 h (range 7.4–491 h s).

42 (70%) underwent plate fixation with a distal femoral locking plate. A single lateral plate was used in all cases. No cables were used. The approach was determined by the individual surgeon. 13 (21.7%) underwent revision total knee replacement in the form of long stemmed rotating hinge implant. All revisions involved removal of both tibial and femoral components. 5 (8.3%) underwent non-operative treatment with either cast or brace treatment and restricted weight bearing for 6 weeks.

The median length of stay was 14 days (range 1–49).

Twelve patients (21.8%) suffered complications following operative management that required further surgery. There were 2 (3.3%) infections (1 in a patient undergoing ORIF and 1 in a patient that underwent revision arthroplasty). These both went on to require 2 stage revisions for infection. There were 4 fractures proximal to the implant postoperatively that required further surgery, and 2 periprosthetic fractures. 3 metalwork failures occurred following non-union in patients that underwent ORIF that required revision plating. 1 patella resurfacing was undertaken. In patients that underwent plate fixation 8 (19%) required further surgery and 4 out of 13 that underwent revision surgery (30.7%) ($p = 0.2666$). Pre-operative mobility was the only significant risk factor for suffering a complication that required further surgery in the 2 years following fracture (Table 1).

The mean age in patients undergoing ORIF was 80.5 (63–98), and was 79.2 (67–91) in patients undergoing revision ($p = 0.522$). In the patients that underwent revision, there were 13 females and 0 males, in the ORIF group there were 8 males and 34 females ($p = 0.294$). The median wait to surgery was 53.9 h in ORIF and in 227.5 h in revision arthroplastys ($p < 0.001$). Of the patients that underwent ORIF, 3 (7.1%) patients suffered a non-union and subsequently had plate breakage. These patients all required revision plate fixation, and had successful union following this.

The mean length of stay in patients that underwent ORIF was 14.8 days compared to 22.8 days in those that underwent revision surgery ($p = 0.0078$).

The fractures were classified according to the Unified classification

Table 1
Demographics of patients that underwent further surgery within 2 years post-op.

	Alive and no further surgery at 2 years (n = 42)		Further surgery within 2 years (n = 12)		P Value
Age	80.3		78.8		0.2959
Sex	Males Females	8	Males	1	0.3798
		34	Females	11	
ASA	ASA 1	1	ASA 1	0	0.6668
	ASA 2	22	ASA 2	8	
	ASA 3	19	ASA 3	4	
	ASA 4	0	ASA 4	0	
Classification	B1	14	B1	1	0.1719
	B2	10	B2	2	
	B3	2	B3	2	
	C	16	C	7	
Surgical Treatment	ORIF	31	ORIF	8	0.2769
	Rev	7	Rev	4	
	Cons	4	Cons	0	
Capacity	Capacity	38	Capacity	9	0.1593
	No capacity	4	No capacity	3	
Residential Status	Home	39	Home	9	0.0826
	Institution	3	Institution	3	
Pre-op mobility	Independent	23	Independent	5	0.0234
	1 aid	13	1 aid	1	
	Zimmer	6	Zimmer	6	
Charlson co-morbidity score	0–1	0	0–1	0	0.6277
	2–3	9	2–3	4	
	4–5	25	4–5	7	
	6–7	7	6–7	1	
	> 7	1	> 7	0	

Table 2

	Unifed type B fracture (n = 33)		Unified type C fracture (n = 27)		P value
Age	77.7		81.7		0.0026
Sex	M	4	M	7	0.1968
	F	29	F	20	
ASA	ASA 1	1	ASA 1	0	0.0298
	ASA 2	18	ASA 2	12	
	ASA 3	13	ASA 3	14	
	ASA 4	1	ASA 4	1	
Pre-op mobility	Independent	17	Independent	12	0.5765
	1 aid	12	1 aid	9	
	Zimmer	4	Zimmer	6	
Capacity	Capacity	31	Capacity	21	0.1239
	No capacity	2	No capacity	6	
Residential status	Home	30	Home	23	0.6901
	Institution	3	Institution	4	
Charlson co-morbidity score	0–1	0	0–1	0	0.6418
	2–3	9	2–3	4	
	4–5	18	4–5	16	
	6–7	5	6–7	5	
	> 7	1	> 7	2	
Complications requiring further surgery	5		7		0.2993
1 year mortality	3 (9.1%)		5 (18.5%)		0.2852

Table 3
Surgical treatment based on the Unified classification system.

	Unifed B1 fracture (n = 15)	Unified B2 fracture (n = 13)	Unified B3 fracture (n = 5)	Unified C fracture (n = 27)
ORIF	11	5	2	24
Revision	1	8	2	2
Conservative	3	0	1	1

Table 4
Risk factors for 1 year mortality.

	Alive at 1 year (n = 52)		Dead at 1 year (n = 8)		P Value
Age	79.0 (63–94)		91.4 (84–98)		0.0003
Sex	Males	9	Males	2	0.6007
	Females	43	Females	6	
ASA	ASA 1	1	ASA 1	0	0.0012
	ASA 2	29	ASA 2	1	
	ASA 3	22	ASA 3	5	
	ASA 4	0	ASA 4	2	
Capacity	Capacity	46	Capacity	6	0.2971
	No capacity	6	No capacity	2	
Residential Status	Home	47	Home	6	0.2070
	Institution	5	Institution	2	
Pre-op mobility	Independent	27	Independent	2	0.1921
	1 aid	18	1 aid	3	
	Zimmer	7	Zimmer	3	
Charlson co-morbidity score	0–1	0	0–1	0	0.04182
	2–3	13	2–3	0	
	4–5	30	4–5	4	
	6–7	8	6–7	2	
	> 7	1	> 7	2	

system. There were 0 A fractures, 33 B fractures of which 15 were type B1, 14 B2 and 5 B3. There were 27 type C, fractures and no D fractures. The demographics are shown in Table 2 and the surgical treatment in Table 3. Patients who suffered a type C fracture were significantly older and had a significantly higher ASA grade. There was a trend for an increased 1 year mortality in this group (18.5% v 9.1%) but this did not reach clinical significance.

Overall of the patients with a B type fracture 18 underwent plate fixation, 11 revision and 4 conservative treatment. Of the patients that suffered a C type fracture 24 underwent plate fixation, 2 revision and 1 conservative treatment.

There were 2 (3.3%) deaths in 30 days, 6 deaths (10%) within 3 months and 8 (13.3%) within 1 year following fracture. 2 year mortality was 10 patients (16.7%). The significant risk factors for 1 year mortality were an increased age, a higher ASA grade, and an increased Charlson co-morbidity score (Table 4).

4. Discussion

This study is one of the largest assessing results of distal femoral periprosthetic fractures. This increasingly common area currently has limited research into management and outcomes. This study demonstrates that these fractures have a high risk of mortality, and a high number of complications.

The mortality in our series was 3.3% at 30 days, and 13.3% at 1 year. This is lower than those of hip fractures,[19] and the study published by Shields et al. which found mortality rates of 14% and 18.6% at 3 months and 12 months.[20] This study demonstrated that an increased age, increased ASA and an increased Charlson co-morbidity are significant risk factors for 1 year mortality. With these high mortality rates, patients should undergo regular medical review and optimisation to improve outcomes.

This study did not find a significant difference in mortality or complications between the two surgical treatment options. It did demonstrate that patients undergoing revision arthroplasty had a significantly longer wait to surgery, and a significantly longer in-patient stay. This may be due to many reasons. The first is that whilst a large number of Orthopaedic surgeons are able to undertake ORIFs of these fractures, only a small number have the required expertise to undertake revision arthroplasty. The second is that whilst plates for ORIFs are routinely available, many hospitals do not have ready access to revision arthroplasty sets, which often requires ordering causing further delays. Conventional thinking would have thought that those undergoing ORIF would have had an increased length of stay compared to those undergoing revision arthroplasty, due to the ability to fully weight bear immediately post-operatively. This was surprisingly not bore out in the results, even when accounting for an increased length of time to surgery in patients undergoing revision. This studies length of stay was longer than the previous study by Hoffman with a mean length of stay of 6.9 days (range 3–34 days).[8] The reasons for this are unclear.

The most common treatment option used is open reduction internal fixation. Several studies have looked at the outcomes of these and found non-union rates between 12 and 22%,[6,7,9,14,16–18] whilst the non-union rate in this study was 7.1% which is lower than many previous studies. This studies complication rate is similar to the other published research. Performing an ORIF presents many operative challenges. The distal locking plate is the most commonly favoured technique and has been shown to have better outcomes when compared to non-locked plates.[3,15,18,22] Locking plates were used in all the cases. The treatment also depends upon a simple fracture pattern where compression plating may be used or a comminuted fracture where indirect reduction and bridge plating is required.[15] Some authors also advocate double plating to improve outcomes.[9,11] Further research is required to identify the reasons these patients went on to develop a non-union and develop complications with those older patients with an increased ASA found to have significantly higher complications.

The time to surgery in this study was over 63 h. This is not surprising as these are complex fractures that require specialist surgeons to undertake the operative procedure. For revision arthroplasty, patients also require specialist implants that may not be routinely available.

In cases with an unstable implant, insufficient bone stock for distal purchase or a severely comminuted fracture, revision arthroplasty is the surgery of choice. Non-operative treatment is reserved for those undisplaced fractures in patients with multiple medical co-morbidities.[15]

There has been limited previous published data on these fractures that are managed non-operatively. 2 of the 5 patients that were managed conservatively in this study died within 30 days of the injury.

Limitations of this study include the retrospective nature of data collection. the time from index procedure to periprosthetic fracture is not recorded. Functional outcomes and post-operative living status were also not recorded as part of this study, but would have been of benefit when comparing different treatment strategies.

Further research should aim at developing treatment algorithms and evaluating different operative techniques on functional outcomes. These would aim to improve outcomes for the patients sustaining distal femoral periprosthetic fractures.

5. Conclusions

Periprosthetic distal femoral fractures are becoming a more common orthopaedic presentation. They occur in a complex group of patients and have high rates of mortality and complications.

Conflicts of interest

No acknowledgements or other conflicts of interest.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jor.2019.09.007.

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