Orthopaedics & Traumatology: Surgery & Research 105 (2019) 587–589

Contents lists available at ScienceDirect

Orthopaedics & Traumatology: Surgery & Research

journal homepage: www.elsevier.com

Original article

Outcome of surgical treatment of inter prosthetic fractures: A case series

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ARTICLE INFO

Article history:
Received 6 June 2018
Accepted 31 August 2018

Keywords:
Interprosthetic fracture
Union
Revision arthroplasty

ABSTRACT

Introduction: Interprosthetic fractures occur between a total knee replacement and a femoral stem of either a hemiarthroplasty or total hip replacement. The number of interprosthetic fractures will increase as the number of joint replacements rises. There is currently a paucity of literature looking at the outcomes of interprosthetic fractures. Therefore, we performed a retrospective study to: (1) determine fracture union in patients following surgical treatment of a femoral interprosthetic fracture, (2) measure outcomes included mortality and complications.
Hypothesis: Favoring bone fixation instead of prosthetic revision gives an acceptable rate of reoperation.
Materials and methods: A retrospective case note review of all interprosthetic femoral fractures admitted to a tertiary trauma centre over a 7-year period. There were 24 patients (4 males and 20 females) with a mean age of 82.3 (65–98). The initial operative procedure was a total hip replacement (THR) and a total knee replacement (TKR) in 19 patients, one THR and revision TKR, four hip hemiarthroplasty and TKR. There were 23 cemented femoral stems, and 1 uncemented femoral stem. The median time to surgery was 84 hours. The median length of hospital stay was 16 days. Nineteen patients underwent open reduction internal fixation and 1 of these used a strut graft. Two patients underwent revision knee replacements and 3 underwent a revision hip replacement. All patients had at least 2 years clinical follow-up.
Results: One patient died within 30 days of fracture, leaving 23 patients to assess bone union. Another patient died within 1 year of fracture. Three out of 24 patients (12.5%) suffered a complication that required further surgery. The fracture united in 19/23 (82.6%) of patients and the 2-year mortality rate was 5/24 (20.8%).
Discussion: Interprosthetic fractures are complex fractures occurring in elderly patients with multiple medical comorbidities. Whenever possible bone fixation instead of prostehtic revision give a low rate of complication and reoperation. The surgical treatments are complex, but with a well-performed surgical technique and an adequate rehabilitation program can result in satisfactory outcomes.
Level of evidence: IV, retrospective case series.

1. Introduction

Interprosthetic fractures occur between a total knee replacement and a femoral stem of either a hemiarthroplasty or total hip replacement. The number of interprosthetic fractures will increase as the number of joint replacements rises and the patients are getting older [1–5]. These are complex fractures that present many surgical challenges [1–3]. The surgical treatment depends on fracture location and the stability of the hip and/or the knee prosthesis.

If the implants are not loosened, then most authors recommend fixation with a locking plate construct, but this was mainly debated [4–6]. In fact, there is currently a paucity of literature looking at the outcomes of these fractures [4,5], particularly favoring bone fixation instead of prosthetic revision. Therefore, we performed a retrospective study to:

- determine fracture union in patients following surgical treatment of a femoral interprosthetic fracture;
- measure outcomes included mortality and complications.

We hypothesized that favoring bone fixation instead of prosthetic revision give an acceptable rate of reoperation.

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https://doi.org/10.1016/j.otsr.2018.08.022
1877-0568/

Table 1
Classification according to Pires et al. [6] classification and surgical treatment undertaken.

Patient	Sex	Mechanism	Age	Previous implant	Classification	Operation	Union	Reoperation
1	F	Fall	76	THR and TKR	IA	LISS plate	Nonunion	Revision ORIF due to plate breaking
2	F	Fall	84	THR and TKR	IA	LISS plate	Yes	No
3	F	Fall	87	THR and TKR	IA	LISS plate	Yes	No
4	M	Fall	85	THR and TKR	IA	LISS plate	Yes	No
5	F	Fall	91	THR and TKR	IB	LISS plate	Nonunion	Conservative
6	M	Fall	84	THR and TKR	IB	Revision hip	Yes	No
7	F	Fall	84	THR and TKR	IIA	LISS plate	Yes	No
8	F	Fall	74	THR and TKR	IIA	LISS plate	Yes	No
9	F	Fall	84	THR and TKR	IIA	LISS plate	Yes	No
10	F	Fall	90	TKR and THR	IIA	LISS plate	Yes	No
11	F	Fall	81	THR and TKR	IIA	LISS plate	Yes	No
12	F	Fall	95	Hemiarthropalsty and TKR	IIA	LISS plate	Nonunion	Conservative
13	F	Fall	65	TKR and THR	IIC	LISS plate	Yes	No
14	F	Fall	77	THR and TKR	IIC	LISS plate	Yes	No
15	F	Fall	85	TKR and THR	IIC	LISS plate	Yes	No
16	F	Fall	88	TKR and THR	IIC	Revision knee	Yes	Revision ORIF due to proximal fracture
17	F	Fall	81	THR and TKR	IIIA	LISS plate	Yes	No
18	F	Fall	79	Hemiarthropalsty and revision TKR	IIIA	LISS plate	Yes	No
19	M	Fall	89	Hemiarthroplasty and TKR	IIIA	LISS plate	Nonunion	Revision ORIF
20	F	Fall	80	Hemiarthopalsty and revision TKR	IIIA	LISS plate and fibula strut graft	Yes	No
21	F	Fall	81	THR and TKR	IIIA	Revision hip	Yes	No
22	F	Fall	82	TKR and THR	IIIC	Revision knee	Yes	No
23	F	Fall	72	THR and revision TKR	IIID	LISS plate	Yes	No

F: female; M: male; THR: total hip arthroplasty; TKR: total knee arthroplasty; LISS: less invasive stabilization system; ORIF: open reduction internal fixation.

2. Materials and methods

2.1. Patients

A retrospective case note review of all interprosthetic femoral fractures admitted to a single Trauma Centre between 1st January and 2008 and 31st March 2015. Patients were initially identified from ICD codes for all femoral fractures presenting to the department (S72.1, S72.2, S72.3, S72.4 S72.7, S72.8 and S72.9).

The inclusion criteria were any patient with a femoral fracture between a total knee replacement and a femoral stem from either a hemiarthroplasty or total hip replacement. The exclusion criteria were any patient with a different implant, or an intraoperative fracture.

A retrospective case note review was performed. A patient was determined to have capacity if they had an abbreviated mental test score of 7 or above or had given consent for surgery. The Charlson Co-Morbidity and Nottingham Hip Fracture scores were calculated. The Charlson Co-Morbidity score was designed and validated as a tool to assess 1-year mortality. A score is calculated based on patients' co-morbidities and age. A higher score indicated an increased risk of 1-year mortality [7]. The Nottingham Hip Fracture score is a validated scoring system that predicts 30-day mortality in hip fracture patients [8].

There were 24 patients with a mean age of 82.3 years (65–98). There were 4 males and 20 females. Prior to the interprosthetic fracture eight patients were independently mobile, four used 1 aid, three used 2 aids, and nine used a Zimmer frame or were wheelchair bound. Eighteen of the 24 patients had capacity to consent for surgery. Seventeen lived in their own home and 7 lived in institutional care. One patient was ASA 1, ten were ASA 2 and thirteen were ASA 3.

No patient had a Nottingham Hip Fracture Score of 0–1. Four patients had a score of 2–3, 14 a score of 4–5 and six a score of greater than 5. No patients had a Charlson co-morbidity score of 0 or 1, two had a score of 2 or 3, 16 a score of 4 or 5, and six patients had a score of 6 or more.

The initial operative procedure was a total hip replacement (THR) and total knee replacement (TKR) in 19 patients (79.2%), 1 THR and revision TKR (4.2%), 4 (16.7%) hip hemiarthroplasty and either a primary or revision TKR. Twenty-three of the femoral stems were cemented and 1 was uncemented. All the knee prosthesis were cemented.

Fractures were classified according to the Pires et al. [6] classification system (Table 1). A type I fracture is an interprosthetic fracture located around the hip prosthesis. A type II fracture is located around the knee prosthesis and a type III fracture is an interprosthetic fracture with a long femoral stem of the knee prosthesis. These are then subclassified based on stem stability and bone viability.

3. Methods

Nineteen patients (79.2%) underwent open reduction internal fixation with the use of locking plates. All of these were single lateral plates except for 1 procedure that also required a fibula strut graft. Two patients (8.3%) underwent revision knee replacements and three (12.5%) underwent a revision hip replacement. These patients all had cable fixation at the time of surgery.

3.1. Methods of assessment

The diagnosis of fracture union was defined as the presence of bridging callous on two perpendicular radiographs. All patients had at least 2 years clinical follow-up for union and complications. The median time to surgery was 84 hours with a range of 15–367 hours.

3.2. Statistics

According to the small number of patients included and the heterogeneity of treatments, only descriptive statistics are used (median, proportion and percentages).

4. Results

The median length of hospital stay was 16 days (4–38). One patient (4.2%) died within 30 days following fracture and another

patient died within a year following fracture. Three patients (12.5%) died in the 2 years following fracture.

Three (12.5%) patients suffered a complication that required further surgery within 2 years following an interprosthetic fracture. One patient suffered a broken plate following a nonunion that required revision plating. A further patient developed a nonunion that required revision plating. One other patient suffered a fracture proximal to a revision knee replacement, after union had occurred. Two other patients developed a nonunion that were treated conservatively due to extensive medical co-morbidities. Treatment involved protected weight bearing. Therefore, out of 23 patients that survived more than 30 days, 19 had successful union (82.6%).

5. Discussion

There are 766,636 primary hip replacements and 871,472 primary knee replacements recorded in the National Joint Registry for England, Wales, Northern Ireland and the Isle of Man [9]. Therefore, the risk of patients suffering an interprosthetic fracture will only increase as more joint replacements are performed in an ageing population. Despite this, there is currently limited literature on the management of interprosthetic fractures [4]. The current study favoring bone fixation instead of prosthetic revision provides an acceptable union rate [19/23 (82.6%)] and a low reoperation rate [3/24 (12.5%)] with a low 2-year mortality rate [5/24 (20.8%)].

The surgical treatment of these fractures depends on the fracture characteristics. Fractures that involve a loose implant may require revision arthroplasty [5]. This occurred in 5 of the 24 patients in this study. If the implants are well fixed then locking plate fixation is the preferred treatment modality [4,5]. Locking plates allow stability in osteoprotic bone, allow fracture healing and prevent varus collapse [5]. A difficulty with fixation is ensuring that there is overlap of the prosthesis by at least 2 cortical diameters to prevent the development of a stress riser and potential for failure of fixation. New generation plates that allow polyaxial screws have improved the ability to achieve this and successfully treat these fractures without producing a stress riser.

The union rate in this study was over 80%. The majority of previous studies have all found union rates of over 80% with only two studies reporting lower rates [10]. A criticism of the majority of these studies are that they are small single centre case series [10–15].

There is currently no universally agreed classification or treatment algorithm for interprosthetic fractures [4]. Many classifications have been proposed. Soenen et al. [16] proposed a modification of the Vancouver classification. Pires et al. [6] proposed another classification, which was used in the present study. This classification system for interprosthetic femoral fractures has shown adequate inter-observer reproducibility [5,17]. Therefore, we recommend applying the proposed classification system in clinical practice.

A limitation of this study is the retrospective data collection, but the low occurrence of this fracture makes debatable a prospective data collection. A further limitation is the small numbers of interprosthetic fractures, with only 24 being reported in 7 years. However, this is one of the largest series in the literature. Further multicentre studies should be undertaken to assess risk factors for nonunion in these patients.

6. Conclusions

Interprosthetic fractures are complex fractures occurring in elderly patients with multiple medical comorbidities. Whenever possible bone fixation instead of prostehtic revision give a low rate of complication and reoperation. The surgical treatments are complex, but with a well-performed surgical technique and an adequate rehabilitation program can result in satisfactory outcomes.

Funding

No financial support.

Contribution of authors

Toby Jennison initiated the study, and supervised edition of the paper, Rathan Yarlagadda collected data and performed edition of the manuscript.

Disclosure of interest

The authors declare that they have no competing interest.

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