Treatment of femoral fracture above a knee prosthesis

18 cases followed 0.5–14 years

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We reviewed 16 patients who sustained 18 fractures above a total knee prosthesis. 5 fractures were undisplaced and were treated with either skeletal traction or a plaster cylinder. 3 did well, 1 patient suffered a cerebral vascular accident while still in plaster and 1 patient died of heart failure while on skeletal traction. 7 displaced fractures were treated initially with skeletal traction. 1 patient had a nonunion of the fracture and 2 a malunion and malfunction of the knee. 4 underwent various operations later because of malalignment and nonunion of the fracture with poor functional results. 6 displaced fractures were treated with immediate internal fixation. 5 recovered well and returned to pre-fracture activities. 1 patient's plate broke and further surgery was needed.

We conclude that displaced fractures above a knee prosthesis should be treated with immediate stable internal fixation and early mobilization. Nonoperative treatment was satisfactory only for minor undisplaced fractures.

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The management of femoral fractures proximal to a total knee replacement is controversial. Closed treatment includes either immobilization in a cast or skeletal traction for several weeks (Delport et al. 1984, Sisto et al. 1985, Merkel end Johnson 1986, Nielsen et al. 1988). Operative treatment generally includes either revision arthroplasty with modified prosthesis or internal fixation (Culp et al. 1987, Figgie et al. 1990, Healy et al. 1993).

We compared the results of closed and operative treatments in 16 patients who sustained 18 fractures above a knee prosthesis.

Patients and methods

Between September 1978 and March 1993, 16 patients sustained 18 fractures above a total knee prosthesis and were treated in our hospital. On review, 3 patients had died and 2 could not be found. For these patients we obtained information from the medical notes and the radiographs. 15 patients were women and 1 was a man. Rheumatoid arthritis was the reason for arthroplasty in 11 cases and arthrosis in 7 cases.

The mean age at the time of fracture was 77 (57–93) years and the time elapsed since arthroplasty was 5 (2 months–17) years and the follow-up period was 4 (1/2–14) years. 16 of the replacements were non-constrained (Manchester 4, Kinematic 7, Omnifit 2, Kinemax 2, Total Condylar 1) and 2 were constrained (Stanmore). They were all cemented.

Prior to the fracture, 10 knees had full extension, 4 had 5° lack of extension and 4 knees had a 10° lack of extension. Flexion varied from 60° in 1 knee to 120° in 2 knees.

16 fractures resulted from a minor injury. 1 rheumatoid patient sustained bilateral fractures after trivial falls at various times. Another patient with bilateral prostheses sustained a traffic accident and had fractures of both femora.

15 fractures were supracondylar and 3 went through the lower third of the femur. 10 fractures were transverse, 2 oblique and 6 spiral. 7 were comminuted. 5 fractures with an angular displacement of less than 5 degrees and no comminution were considered as undisplaced–stable. 13 fractures had either an angular displacement of more than 5 degrees or comminution or overlapping at the fracture site and were considered as displaced–unstable. Anterior notching of the femoral cortex was seen in 1 case.

The undisplaced fractures were treated nonoperatively. Skeletal traction was applied in 1 case for 3

Table 1. Clinical data. Cases 1–5: undisplaced fractures, closed treatment. Cases 6–12: displaced fractures, initially closed treatment. Cases 13–18: displaced fractures, operative treatment

No.	Sex	Age	Diagnosis	Prosthesis	Time from TKR (mo)	Follow-up (mo)	Treatment (Numbers are weeks)	ROM pre-injury (degree)	ROM post treatment (degree)
1	F	65	RA	Manchester	41	137	Plaster of Paris cylinder (POP)	0–80	0–80[a]
2	F	71	RA	Manchester	115	63	POP	0–80	0–80[a]
3	M	75	OA	Kinemax	29	5	POP	0–120	0–100
4	F	93	OA	Manchester	163	6	POP	5–110	5–60[b]
5	F	72	RA	Total Cond.	142	25	Skeletal traction	10–100	[c]
6	F	81	RA	Kinemax	2	35	Traction 6 and POP 8 [d]	10–80	30–45[d]
7	F	77	OA	Manchester	156	45	Traction 14 and POP 6 [e]	0–120	0–20 [e]
8	F	57	RA	Omnifit	2	36	Traction 12, POP 16. Pseudarthrosis	0–90	0–50
9	F	75	RA	Kinematic	35	54	Traction 4. Infected ORIF. Arthrodesis	10–70	
10	F	68	RA	Stanmore	13	168	Traction 3. ORIF failed. Revision arthroplasty. Arthrodesis 10 years later.	5–100	10–70
11	F	70	RA	Kinematic	53	13	Traction 3. ORIF plating	5–80	20–50
12	F	82	OA	Kinematic	97	6	Traction 17. IM nailing + grafting	5–60	10–30
13	F	82	OA	Kinematic	64	6	Richard's supracondylar device	5–80	5–70
14	F	70	OA	Omnifit	14	10	Richard's supracondylar device	0–110	5–80
15	F	84	OA	Kinematic	6	62	IM nailing + cerclage wire	0–90	10–80
16	F	71	RA	Kinematic	84	17	IM nailing	0–110	0–90[f]
17	F	71	RA	Kinematic	72	17	IM nailing	0–100	0–90[f]
18	F	90	OA	Stanmore	48	80	ORIF plating. Fracture of plate. External fixation + grafting. Nonunion. Arthrodesis	10–80	

TKR total knee replacement, ROM range of movement, RA rheumatoid arthritis, OA osteoarthrosis, ORIF open reduction and internal fixation, IM intramedullary.
[a] The same patient sustained fractures above her bilateral knee replacements after minor injuries, at different times.
[b] The patient sustained a cerebral vascular accident while in plaster cast.
[c] The patient died of heart failure while on skeletal traction 3 weeks after the injury.
[d] The same patient sustained an ipsilateral tibial fracture. POP 8 weeks and splint 18 weeks. Malunion.
[e] The same patient sustained an ipsilateral tibial fracture. POP 20 weeks and splint 12 weeks. Malunion.
[f] The same patient sustained fractures above her bilateral total knee prosthesis after a road traffic accident.

weeks while a plaster cylinder alone was used in the remaining 4 cases for 6–8 weeks. 7 of the displaced fractures were treated initially with skeletal traction, while 6 were treated operatively within 10 days. Intramedullary nails were used in 3 cases, Richard's plate and screws in 2 cases and fixation with plate and screws in 1.

The treatment groups were divided not only into operative and nonoperative: attention was also given to the nature of the fracture. Group A consisted of 5 cases with undisplaced fractures and closed treatment. Group B consisted of 7 cases with displaced fractures and more than 3 weeks on skeletal traction. Group C consisted of 6 cases with displaced fractures and operative treatment within 10 days.

The union of the fracture was assessed. We also compared the range of knee motion and the level of activities before the fracture and following the treatment.

Results (Table 1)

Group A: 5 undisplaced fractures treated nonoperatively. 1 patient sustained 2 fractures at different times that were treated in plaster and united after 9 and 12 weeks without complications. The range of motion in both knees remained the same. The period of hospitalization was 3 months for the first fracture and 4 months for the second.

1 patient was treated with a cylinder plaster for 6 weeks and with a hinged splint for a further 6 weeks. The fracture united and he regained knee motion and function. The hospitalization for this patient was 1 week.

The next patient was not admitted to the hospital but was treated with a cylinder plaster for 6 weeks. The patient sustained a severe cerebral vascular accident after a few days and the efficacy of the treatment could not be evaluated.

The last patient in this group died of heart failure 3 weeks after the accident, while she was still on skeletal traction.

Group B: 7 displaced fractures first treated nonoperatively. 2 of the 7 patients in this group had only closed treatment (skeletal traction for 6 and 14 weeks, followed by a cylinder plaster) and suffered a malunion of their fractures, one with posterior displacement and the other with hyperextension, after 4 and 7 months. Both patients suffered fractures of the

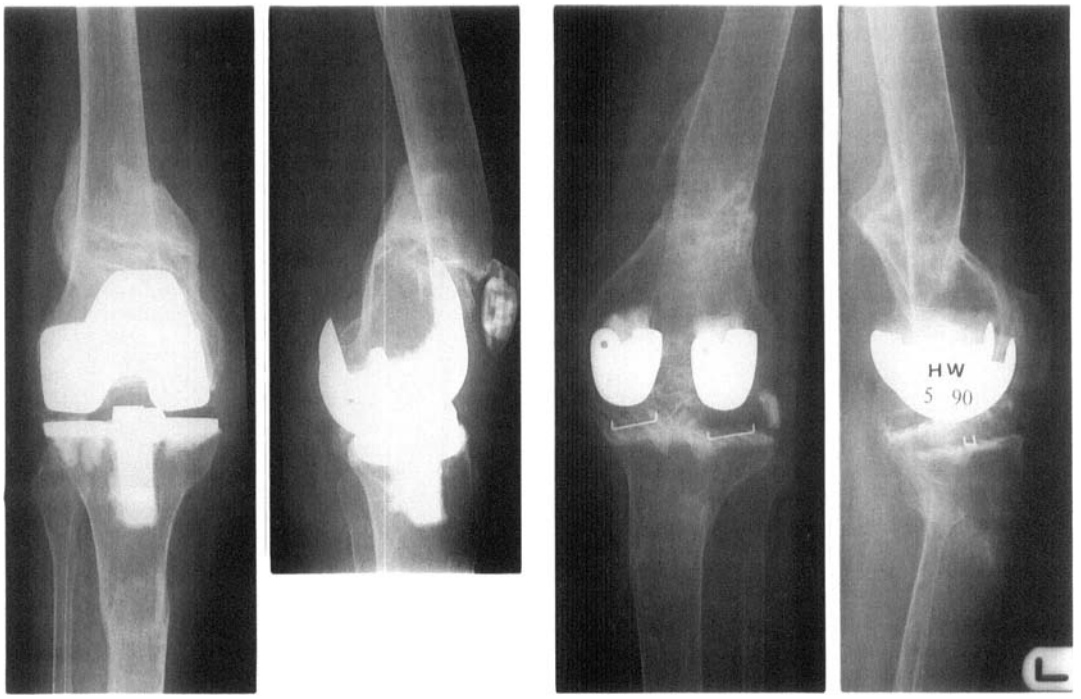

Figure 1. Case 6 (left) and Case 7 (right). Malunion in 2 displaced fractures which were treated nonoperatively. The tibial fracture in both cases occurred soon after mobilization started.

ipsilateral tibia during the early period of mobilization (Figure 1). The rehabilitation of these patients was delayed. After the treatment, the range of motion in the knee was 30°–45° in the first case and 0°–20° in the other while, before the accident, the range of movement was 10°–80° and 0°–120°. The first patient, who had been able to walk with 2 sticks around the house before the fracture, became bound to a wheelchair. The second patient, who had been able to walk unaided for long distances pre-fracture, had great difficulty in walking with 2 sticks.

The 5 other patients in this group had fractures that did not heal well. 1 patient, who declined to undergo surgery, has a painful pseudarthrosis. The range of movement in her knee is 0°–50° (0°–90° before the fracture). This patient spends most of her time in a wheelchair while, before the fracture she could walk long distances with 1 stick.

1 patient underwent internal fixation of the fracture with plate and screws and bone graft at 4 weeks, but an infected nonunion then occurred. Finally, the knee prosthesis was removed and an arthrodesis was performed 5 months after the fracture occurred.

1 patient had her fracture internally fixed at 3 weeks with only lag screws and bone graft. No union occurred and a revision arthroplasty of the knee was performed using a special femoral component with a long stem. 10 years later, this prosthesis was removed because of loosening, and an arthrodesis was then performed.

1 patient underwent internal fixation with plate and screws at 3 weeks. A good union of the fracture was achieved, but the patient did not walk again although she was mobile with a Zimmer frame before the accident. The knee movements ranged from 20° to 50° (5°–80° before the fracture).

1 patient was operated on using an intramedullary nail and a bone graft at 4 months. The fracture united but the knee movements are 10°–30° and the patient cannot walk because of generalized muscle weakness, arthritic hip and stiffness of the knee.

The mean hospitalization period of patients with displaced fractures whose initial treatment was nonoperative was 6 (4–10) months.

Group C: 6 displaced fractures treated operatively. 5 of the 6 fractures that were treated operatively within 10 days after the accident achieved union (Figure 2). Radiographic union occurred after 3–4 months. The hospitalization period was 2 (1–4) months.

3 fractures were operated on with intramedullary nailing and 2 with Richard's supracondylar plate and screws. The mean lack of extension in the knee after treatment was 5° (2° before the fracture), while the

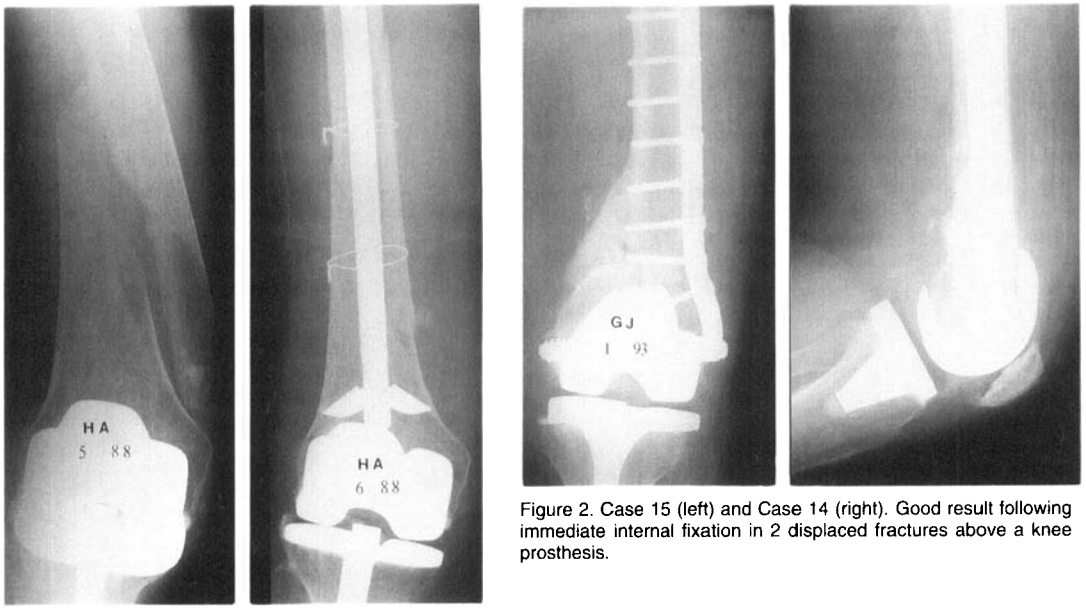

Figure 2. Case 15 (left) and Case 14 (right). Good result following immediate internal fixation in 2 displaced fractures above a knee prosthesis.

mean flexion was 80° (96° before the fracture). These patients resumed about the same level of activity as before the fracture occurred.

The sixth patient, who received immediate operative treatment of the fracture with plate and screws, suffered a breakage of the plate at 2 months, that was probably due to premature weight bearing. Closed treatment with a plaster cylinder failed. An external fixator was then applied, but without success. An arthrodesis of the knee was performed 15 months after the fracture.

Discussion

This is a retrospective study. We must mention that the patients were treated by various surgeons at different times and the method of treatment was selected individually by the surgeon who at the time was treating the patient.

Notching of the anterior cortex has been reported as a predisposing factor for a fracture above a knee prosthesis (Merkel and Johnson 1986, Aaron and Scott 1987, Culp et al. 1987, Nielsen et al. 1988, Healy et al. 1993). Those studies do not reveal how many patients had the anterior cortex notched at the time of the knee-replacement operation and the percentage who later suffered a fracture at the notched site. However, Ritter et al. (1988) found that femoral notching alone did not appear to be a predisposing factor in a femoral fracture above a knee prosthesis in their patients. We saw only one notched anterior femoral cortex.

Several authors have recommended that operative treatment should be performed only when closed techniques cannot maintain a satisfactory alignment (Hirsh et al. 1981, Delport et al. 1984, Sisto et al. 1985, Merkel and Johnson 1986, Nielsen et al. 1988). Other authors report that patients with displaced fractures recover best after treatment with immediate stable internal fixation and early mobilization (Culp et al. 1987, Bogoch et al. 1988, Roscoe et al. 1989). Recently, Healy et al. (1993) reported excellent results in 20 cases of fractures above a knee replacement which were treated operatively.

In our series, fractures treated nonoperatively healed well when the fracture was undisplaced. However, severe complications related to immobilization may occur. Displaced fractures treated nonoperatively resulted in nonunion, malunion and loss of knee motion and function. Displaced fractures treated with early internal fixation and mobilization united in a good alignment; the knees regained motion and the patients returned to their normal activities.

Primary arthrodesis or revision of the prosthesis has also been recommended in difficult cases (Figgie et al. 1990). Our opinion is that both solutions should be reserved for the failure of internal fixation.

Intramedullary nailing has been recommended for the treatment of these fractures under specific conditions (Hanks et al. 1989). We found interlocking nailing to be a good option for the treatment of displaced fractures proximal to a knee prosthesis. In our

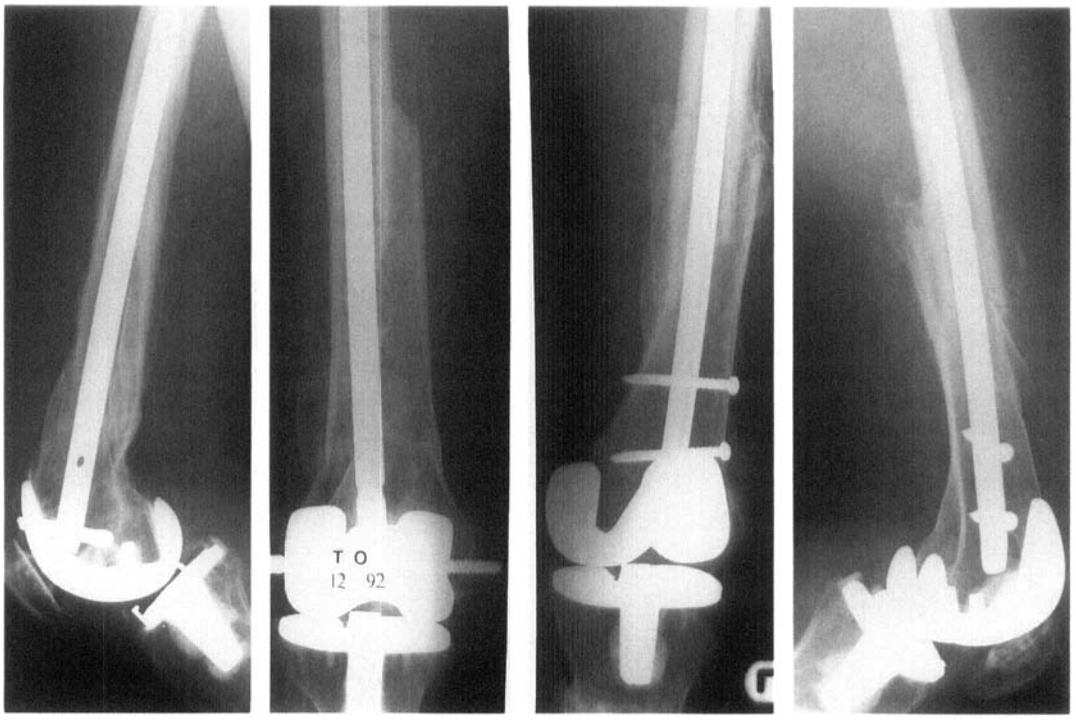

Figure 3. Cases 16 and 17. Bilateral fractures in the same patient after a road traffic accident. Good result following intramedullary nailing. At the right side, the nail has been sawn off to facilitate the insertion of at least one screw.

limited experience (3 cases), the fractures healed normally in a short period without disturbing the prosthesis. Intramedullary nailing minimizes the infection rate because it is a closed method with only a small incision at the knee for the distal locking screw. The nail can be sawn off to make room for at least one screw to be inserted distally to the fracture (Figure 3).

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