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## Distal femoral fractures after knee arthroplasty

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**Abstract** In seven patients who sustained eight distal femoral fractures following knee arthroplasty all fractures were treated operatively. Seven with open reduction internal fixation and one with external fixation. Seven of eight fractures had an unsatisfactory result. This was due not only to bone quality and fracture comminution, but also to technical problems and choice of implant. Revision surgery is often required.

**Résumé** Nous avons réalisé une étude rétrospective comprenant huit fractures distales du fémur après mise en place de prothèse du genou chez sept patients. Toutes les fractures ont été traitées chirurgicalement, sept d'entre elles par fixation interne et une par fixation externe. Sept des huit fractures présentaient des résultats non satisfaisants; six ont été repris. Les fractures déplacées ou comminutives du fémur distal après prothèse du genou représentent une pathologie difficile, dont le traitement opératoire est souvent compliqué, non seulement par l'ostéoporose et la comminution de la fracture, mais également par des problèmes liés aux différentes techniques opératoires et aux types d'implants.

### Introduction

Treatment of fractures proximal to a total knee arthroplasty (TKA) remains controversial and both operative and non-operative methods have been proposed. Most authors report non-operative treatment a viable option for non-displaced fractures [4, 5, 9, 15] with up to 83% success rate [5]. Open reduction and internal fixation is considered for most of the displaced fractures, with good

clinical results in 64–90% [2, 5, 10–12, 18, 24]. Revision arthroplasty (about 5% of all cases) is a possible treatment alternative in certain situations, as with very distal fractures or component loosening, and excellent results have been reported (91%) [2, 5, 6]. External fixation has been considered after failed osteosynthesis, with good results at two years [3].

Allograft/prosthetic reconstruction and total femur replacement are occasionally considered in rare instances [13, 19]. Very good clinical results have recently been reported after stabilization of these fractures by intramedullary nailing in both antegrade and retrograde manner [11, 14, 16, 21, 23].

The purpose of this study is to present our experience with the operative management of distal femoral fractures after knee arthroplasty.

### Materials and methods

Seven patients with eight fractures of the distal femur proximal to a knee arthroplasty were treated surgically between 1988 and 1995. There were seven TKA and one unicompartmental in our series. Six of the seven knee replacements were primary, non-constrained tricompartmental resurfacing (22), and one was a GSB-constrained TKA. All components appeared well fixed at the time of femoral fracture. There were six women and one man in the series, with a mean age of 75 years (range 63 to 87 years). Three patients sustained their injury as a result of motor vehicle accidents, one by a violent fall, and the other four after low velocity trauma. In these latter four patients the bone quality was judged to be osteopenic. Three of the fractures were considered as late complications, occurring at a mean of 28 months after arthroplasty. One fracture occurred two months after insertion of a constrained TKA and was considered an early complication. Four of the patients had serious concomitant medical illnesses including depression, Parkinson's disease, hypertension, and coronary artery disease. Two patients had previous ipsilateral hip arthroplasties.

We classify fractures as either displaced or non-displaced, as originally proposed by Neer [17] and modified by Chen [5]. All fractures in our series were classified as Type II. This included any fracture with displacement, comminution, and/or an intra-articular component. Only one femur showed 3–4 mm of notching of the anterior cortex of the femur.

Seven fractures were managed by open reduction and internal fixation using AO/ASIF implants. These included five 95° condy-

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lar blade-plates (one in conjunction with PMMA), one buttress plate (augmented medially with a small second plate), and one dynamic compression plate (with autologous bone graft). One very distal fracture (TKA with notching of the anterior cortex) was treated with external fixation. All patients except one underwent clinical and radiological evaluation by the leading author. The clinical and radiological follow-up period averaged four years, with a range from one to eight years. In one case, follow-up data were obtained from outpatient notes.

Alignment of the knee joint was assessed on antero-posterior radiographs. All patients were evaluated using the score of Chen et al. [5]. A result is deemed as satisfactory if the fracture is healed, alignment is anatomic or near anatomic and permits satisfactory function, and the patient is satisfied. Patients are classified as having an unsatisfactory result if they present with malunion or nonunion, significant clinical deterioration compared to prefracture status, the need for further surgery, or death directly related to fracture treatment.

## Results

Two of the eight fractures healed within three months. However, knee function at follow-up of four and six years respectively was poor in both patients. In one case, the result was probably related to the progression of Parkinson's disease (at short-term follow-up the result had been rated as satisfactory). The other patient sustained simultaneous bilateral femoral fractures. The one on the right side followed a TKA (Fig. 1). The fracture on the left side (unicompartmental arthroplasty) occurred in association with an ipsilateral tibial plateau fracture (Fig. 2). An infection on the right side (TKA) resulted in an arthrodesis. The complications of the knee arthrodesis and the ipsilateral tibial plateau fracture resulted in a poor range of motion in the left knee at long-term follow-up.

All other patients developed serious complications necessitating further surgery. There were two implant failures (condylar plates), one at two months and the other at 15 months postoperative. Both cases healed after a second open reduction and internal fixation with decortication and autologous bone grafting. Both of these knees showed good functional results at follow-up of two and eight years respectively.

The patient treated by external fixation for a very distal fracture had delayed healing at three months (Fig. 3). Revision TKA was performed without further complication and this patient had an excellent result at four year follow-up.

There were two deep infections. One occurred after osteosynthesis with a condylar blade-plate with PMMA augmentation (ipsilateral THA). Multiple debridements were unsuccessful and an above knee amputation was necessary to control the infection. The second infection occurred after revision (with an external fixator) of a failed condylar blade-plate for a comminuted fracture. Arthrodesis of the knee joint was necessary for infection control. At final follow-up there were no signs of persistent infection.

One femoral fracture, proximal to a lateral buttress plate (augmented with a small plate medially), occurred

nine months postoperative. The initial distal femoral fracture had healed uneventfully, and the subsequent fracture was located between the buttress plate and the stem of a THA. This new fracture healed after further plate fixation (DCP) and bone grafting.

At a mean follow-up of four years, a good clinical result was observed in only four of eight knees, with pain-free ambulation and joint mobility of at least Flexion/Extension 90/0/0. Postoperative tibio-femoral alignment was within normal limits in all but one patient. Overall, seven of eight patients (88%) had an unsatisfactory result according to the score of Chen. Six patients required reoperation and one showed a significant deterioration compared to prefracture status.

## Discussion

Distal femoral fractures following knee arthroplasty are not a frequent complication for the individual orthopaedic surgeon and present difficult management problems. Treatment methods have been discussed extensively in the literature and remain controversial. One of the main difficulties in evaluating different treatment techniques is due to the small number of cases in many studies. The purpose of our study was to focus on the overall morbidity of all patients operated upon at one center for this particular fracture (Type II according to Chen [5]: displaced and/or comminuted and/or intra-articular). We are not presenting any specific surgical technique as these procedures were performed by different surgeons without a uniform protocol. This may reflect the pattern of treatment at other hospitals.

Nonsurgical treatment is a viable option for the non-displaced fractures [4, 5, 9, 15]. However, controversy remains as to the best treatment for the more difficult displaced fractures [1, 2, 5, 10–12]. As far as operative treatment is concerned, many techniques are available. These include stabilization with 95° condylar blade-plates, buttress plates, dynamic compression plates, external fixation, intramedullary nailing, revision arthroplasty with and without allograft and massive prostheses. In the latest comprehensive review of the literature, Chen et al. [5], reviewed both operative and nonoperative treatment methods of periprosthetic ipsilateral supracondylar femur fractures. There were 75 Type II (displaced and/or comminuted and/or intra-articular), of which 33 were treated operatively and 42 nonoperatively. There was no statistical difference in the success rate between the two groups: 67% in the non-surgical group and 61% in the surgical group. By his criteria, 33% in the non-surgical group and 39% in the surgical group developed complications which included malunion, significant deterioration compared to prefracture status, the need for further surgery, or death.

In our series of seven patients with eight displaced fractures, there were varying etiologies for the injury, as well as differing bone qualities among the group. The eight fractures were treated operatively, all but one with



**Fig. 1a–c** Radiographs of **a** comminuted distal femoral fracture. **b** Failed osteosynthesis by condylar plate. **c** Late result after infection and multiple debridements-arthrodesis of knee

**Fig. 2a,b** Radiographs of fracture of medial femoral condyle and proximal tibia, a hemiarthroplasty of the knee in place. **a** Before osteosynthesis showing medial translation and intraarticular fracture line. **b** Consolidation in valgus position of  $17^\circ$  (anatomical, femoro-tibial angle at follow-up of eight years)

**Fig. 3a–c** Radiographs of fracture of distal femur. **a** After reduction and external fixation of posterior and valgus displacement. **b** At three months, external fixator removed, still posteriorly translated and unstable. Only minimal callus. **c** Revision arthroplasty at follow-up of 4 years. Good alignment and no signs of loosening of bone-cement-interface



plate fixation. Our results, following Chen's criteria, were disappointing. There was an 88% unsatisfactory result in view of the need for reoperation in six fractures, and one knee with clinical deterioration compared to pre-fracture status. The long term clinical outcome was good in only four cases (50%). There are reports of good results with plate fixation [12] and with the use of intramedullary nails [11, 14, 16, 21, 23]. There are also good and excellent results reported after revision arthroplasty with a long stem femoral component [2, 5, 6]. However, such a technique is indicated only for the very distal fracture or one with a loose femoral component (about 5% of cases).

We conclude that open reduction and internal fixation of comminuted and/or displaced distal femur fractures after knee arthroplasty is difficult and frequently complicated. The complications are not only due to bone quality (osteoporosis) and fracture morphology (comminution), but also to technical problems and choice of implant. Perhaps with specific choice of implant, the surgical results can be improved.

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