Treatment Options for Distal Femoral Fractures

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ABSTRACT

Introduction: Due to their high complication rate and negative impact of those complications upon the knee and the whole lower limb, distal femoral fractures require optimal restoration of the functional anatomy and stable fixation thus allowing early recovery. This paper presents the experience of the authors regarding the indications and results of the most accepted surgical methods, including late complications affecting the knee.

Material and method: 36 patients with closed distal femoral fractures (21-81 yrs old) operated in Bucharest, Clinical Emergency Hospital, Orthopedics and Trauma Clinic, were retrospectively studied from the point of view of the fracture and implant type, functional results and complications.

Results: Most of the fractures were high energy comminuted fractures (27 cases), mainly with articular involvement. Retrograde nail was used in type A fractures, while plating (LCP) was the main indication for type C fractures. The functional outcome was correlated with the fracture type and the incidence of complications was higher in type A3, C2 and C3 fractures.

Conclusion: Anatomical reduction of the articular surface, restoration of functional anatomy and stable fixation are mandatory for an optimal knee function after distal femoral fractures. Failure to achieve them, due to the character of the fracture or to improper fixation, is followed by significant functional deficit, thus delaying the patients’ recovery.

Keywords: distal femoral fracture, articular fracture, angular stability plate, retrograde nail

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INTRODUCTION

Although their treatment evolved during the last years, distal femoral fractures still remain challenging injuries for orthopedic surgeons, due to their high complication rate and negative impact of those complications upon the function of the lower limb. The incidence of these fractures is around 37/100,000, representing 4-6% of all femoral fractures (1-2). Regarding the epidemiology, two pikes characterize these fractures, also differentiated by age, traumatic energy and, thus, fracture aspect: distal femoral fractures in young patients appear after high energy trauma, usually produced by a frontal collision mechanism, frequently within polytrauma, with comminuted aspect, whilst elderly sustain fragility fractures on osteoporotic bone, usually spiroid, due to low energy trauma, mainly falls (3). In both these categories, fixation is usually difficult in distal femoral fractures due to either involvement of the articular surface and comminution (in the first group), either poor bone stock in the second group, thus surgery has to be properly indicated and performed.

MATERIAL AND METHOD

The purpose of this study is to analyze the outcome of operated distal femoral fractures, as to establish valid recommendations in order to reduce the rate of complications and to improve the quality of life of the patients. The study retrospectively evaluates 36 patients with closed 33 A and C (AO/OTA classification) supra or/and intercondylar femoral fractures operated between 01.06.2010-01.06.2012 in a Level I Trauma Center (Clinical Emergency Hospital Bucharest) from the points of view of: age and gender, fracture characteristics, etiology, associated injuries, type of surgery, healing time, local and general complications. The reason for not choosing 33 B type fractures within this study is represented by the considerable differences regarding the incidence, the treatment and the outcome compared to the other two types of fractures.

The inclusion criteria were: patients over 18 yrs old, skeletally mature, with closed 33 A and C femoral fractures, for which Early Total Care was the method of treatment (primary internal stabilization of the fracture by intramedullary or paracondylar osteosynthesis) who completed the 48 months period follow-up after surgery, thus selecting only 36 patients matching these criteria.

RESULTS

The retrospective study included 16 females and 20 males with ages between 21-81 years old (mean age 42 years). The demography of the studied group, as well as the fracture types, according to AO classification system (4), are represented in Table 1.

This chart underlines the two peaks regarding the frequency of these fractures, as previously described; in the study group, high energy fractures were more frequent in young males, and low energy (fragility) fractures in older females, due to osteoporosis.

Due to the fact that significant elements differentiate closed from open fractures and since the purpose of this study is to evaluate solely the bone injury, open fractures were excluded from our analysis.

This graphics also shows that extra-articular fractures are frequent in osteoporotic bones (especially with spiroid aspect), whilst high energy trauma in younger patients produces articular fractures, especially comminuted; when extra-articular fractures appear in these patients, they are also comminuted.

This table must be correlated with the etiology of these fractures, as the traumatic mechanism is represented by:

- Road traffic accidents – 18 cases;
- Accidental fall from height - 9 cases;
- Accidental fall from standing - 9 cases, or, resuming, 27 fractures produced by a high energy trauma, and 9 cases by low energy trauma.

Regarding the age of the patients, all the 9 low energy fractures appeared in patients over
60 yrs, thus having osteoporosis as main cause, while from the rest of 27 patients, only 2 having over 60 yrs and the rest less than 60 yrs; in all the cases, the type of the force was the same, bending the distal femur, thus overwhelming the resistance of the bone.

The patients were fully evaluated, both for the fracture as well as for the associated injuries. Fracture assessment was performed using standard AP and lateral X-rays; whenever articular fracture could not be thoroughly evaluated by X-rays, CT was performed; in one case (type C1 fracture) due to significant anterior instability of the knee MRI was performed, showing ACL injury, which was tackled during fracture fixation.

The type of the implant used depended on the type of the fracture, as the purposes of the treatment were those described by the AO principles; so, in order to allow early mobilization of the patients, local anatomy was restored maintaining the blood supply and respecting the soft tissues. In distal femoral fractures, restoring local anatomy (4) refers to:

- The articular surface
- The length of the femur and rotation of the distal fragment (which generated to position of the patella)
- The angle between the diaphysis and the distal part of the femur.

In respect to these criteria, the implants used for the study group were as following: retrograde nail was used in 13 cases, for type A fractures (1-A1, 6-A2, 6-A3), DCs was used in 2 cases (1-A1, 1-C1), while plating (LCP) was the main indication for type C fractures (14 cases- 8-C2, 6-C3) since the existence of the articular fracture made a good result improbable after supplementary damage which might be produced by the nail, which could split the articular fragments.

As described, retrograde nail was used especially for type A fractures, because the most important thing for this nail to be used is to have (or to create) a unique distal fragment (6, 7). Due to the risk of displacing a non-displaced inter-condylar fracture or to produce one, using a retrograde nail is recommended when the distal fragment is intact and long enough for at least two screws to be introduced in order to lock the nail; this is absolutely necessary in order to maintain the reduction, otherwise the axis of the distal fragment will not be or will not remain in line with that of the diaphysis (8).

The following case presents a supracondylar fracture for which a retrograde nail was used; pre-operative initial X-rays (after closed reduction – Figure 1 a) suggest that the distal fragment is intact, so a retrograde nail was used to stabilize the fracture.

Post-operative reduction was excellent, both on AP and lateral views (Figure 1 b) so early functional recovery was started. It is to be underlined that optimal nail stabilization with two screws distally and three proximally (to prevent the “bell tongue” phenomenon) achieved optimal stability and maintenance of the reduction. The outcome of the patient was very good, both clinical and radiological, with callus image 5 months after surgery. The conclusion of this case is that retrograde nailing is useful in type A fractures to maintain a proper reduction, when properly inserted.

Although it is less used since angular stability plates appeared, DCS usage in a distal femoral fracture is demonstrated by the following case: male, 24 yrs old, with a distal femoral fracture type A 1, after a road traffic accident. After local and general evaluation, open reduction and internal fixation with DCS was performed.

As presented in Figure 2 a,b, anatomical reduction was achieved, and a proper and stable fixation was assured by the optimal numbers of screws on each side of the fracture, thus allowing us to start recovery therapy early post-operative, first passively (using a Continuous...
Passive Motion System), then actively. Under these circumstances, optimal functional results are presented in Figure 3c.

Another type of implant was represented by angular stability condylar plates (Locked Compression Plates LCP) (9-11) which were used in two ways:

- In most of the cases, Minimal Invasive Plate Osteosynthesis (MIPO) principles were applied and the LCP was used as a Less Invasive Stabilizing System (LISS), diminishing soft tissue injury (16 cases).
- The same LCP were used opening the fracture site when open reduction was necessary (1 case) or grafting was requested due to fracture comminution (5 cases, in fractures type A 3, C2 and C3). The graft used was only cortical, prelevated from the iliac crest (1 case), only cancellous (from the proximal tibia metaphysis) in 1 case and both cortical and cancellous (3 cases). Indication for grafting was established based on the degree of comminution and the possibility of restoring the bi-cortical integrity, no matter the angular stability system used.

The results of the treatment were evaluated regarding the function of the knee (using the Knee Society Score KSS) and the incidence of local and general complications. The Knee Society Score classifies the function of the knee using both subjective and objective criteria for which a certain number of points are allocated, including negative points for the pathological aspects. The final result depends on the sum for all the evaluated aspects, as it follows:

- Excellent- 80-100 points
- Good- 70-79 points
- Medium - 61-70 points
- Poor - under 60 points

In the study group, the results were:
- Excellent - 25 patients, 70%
- Good - 6 patients, 16.6%
- Medium - 3 patients, 8.33%
- Poor - 2 patients, 5.55%, which shows that the efforts made to reduce and fix the fracture were successful.

But analyzing these results, the first problem would be to identify the factors which influence the results. From the following: age, gender, time from trauma to surgery, type of implant, type of fracture and the incidence of complications our analysis showed that, within the study group, the functional score was significantly influenced by the type of fracture (Table 2) and the appearance of complications.

This graphics show that the functional result is directly correlated with the aspect of the fracture, as the more severe the fracture is, the more difficult reduction and stabilization are and the more probable is for a functional deficit to result.

The general complications directly correlated to the fracture were represented by 3 thrombo-embolic events, 2 patients developed Deep Venous Thrombosis (DVT) 3 and 6 weeks after trauma and 1 patient developed Pulmonary Embolism (PE) 48 hours after surgery; Heparin treatment was efficient, the patient survived with no respiratory distress.

The local complications were represented by:
- Joint stiffness - 4 cases
- Knee arthritis - 2 cases
- Malunion - 1 case
- Septic superficial complications (no implant removal) - 2 cases
- Deep septic complications - 1 case acute post-operative sepsis; antibiotic treatment for 6 weeks was performed, the outcome was positive, with no implant removal. In all these cases, the functionality of the knee was also affected, with a correspondent impact upon the KSS.

As expected, the local complications, joint stiffness and arthritis appeared after type C fractures, as initial injuries of the articular fractures and comminution significantly impair the outcome, regardless of the type of implant.

It is also to be underlined that the best results, as expected, where closely related to a stable anatomical reduction, requiring optimal

| Table 2: Functional result / type of fracture. |
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preoperative planning. From this point of view, proper evaluation (by CT scan with 3D reconstruction) is recommended whenever X-rays views give not enough information about the fracture, especially in articular fractures. Once established the fracture pattern, the type of implant to be used can be chosen. The most difficult cases, from this point of view, where those with comminuted fractures, when angular stability implants used after a proper reduction provided the best results. An example is the following case, with bilateral comminuted supra-intercondylar fractures, operated with angular stability plates (Figure 3 a,b).

The radiological and functional results 2 years after surgery shown in Figure 5 a,b sustain the importance of proper reduction and stable fixation, otherwise surgery will not have fulfilled its purpose. Only if functional anatomy of the knee is restored and maintained, bleeding from the fracture site will stop, so the risk of fibrosis diminishes, and recovery can be started early, thus preventing local complications due to prolonged immobilization.

DISCUSSION

Distal femoral fractures affect primarily the function of the knee, even in cases when the fracture is extra-articular, because failure to restore the functional angles of the distal femur directly impairs the joint motion and stability. That is why the main objectives for the surgical treatment of these fractures are similar to any other articular fracture: restore articular surface, the bone contact, the metaphyso-diaphyseal angle, the rotation of distal femur and the stability of the knee, each of these regarding specific measures. Due to these tasks, when treating such a fracture, orthopedic surgeons must establish first what is damaged (that is correctly classifying the fracture) and then how it can be fixed. Proper chose of implant must take into consideration not only the indications of the implants, but especially their limits, since the situations when complications are attributed to the implants might be, in fact, cases of miss-usage of a certain device. The outcome of these fractures depends primarily on the characteristics of the fracture (the more comminuted the fracture is, the more severe complications are to be expected), type C being the most difficult to treat. Bone quality influences the outcome since osteoporotic fractures have a poor prognosis and request for special implants with angular stability. Previous knee joint pathology usually enhances the chance of post-traumatic osteoarthritis, especially if reduction and fixation fail to restore functional anatomy.

CONCLUSION

Distal femoral fractures resulting from bending forces have two peaks of increased frequency, with different etiologies: on one side, high energy fractures, often comminuted, in young patients, on the other side, low energy fractures in osteoporotic elder patients. As underlined by the AO theory, treating these fractures must focus on early recovery after stable fixation of the restored functional anatomy. Pre-operative planning (including CT scan with 3D reconstruction when articular surface is involved) allows proper implant choosing, with stronger indication for retro-nails in type A fractures and angular stability plates in type C. Bone grafting is recommended whenever proper cortical support cannot be achieved, since failure to reconstruct can be followed by non union and implant failure. Functional results are influenced by the articular injure, since any cartilage damage produced by the initial trauma will increase the risk of further degenerative changes.

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