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Comparative analysis of two different surgical treatments: Distal femoral fractures

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Abstract

Introduction: The treatment of distal femoral fractures has been a controversial topic and it's recently evolved towards indirect reduction and minimally invasive techniques.

Objective: To compare the results of the surgical treatment of distal femoral fractures with a plate with screws for appendage compression functions with the minimally invasive stabilization.

Material and methods: Patients with distal femoral fractures treated surgically between January 2016 to January 2018 were assessed retrospectively. The subsequent variables were registered from each patient record: age, sex, form of fracture and mechanism of injury, type of implant used, operative time and postoperative bleeding. The Neer scale was accustomed compare the anatomical, radiologic and useful results of each techniques.

Results: The total number of patients was 59; thirty three males and twenty six females; mean age was 58 years. A plate with screws was employed in 36 patients for appendage compression purposes, and a minimally invasive stabilization system in 23. The cases managed with a minimally invasive stabilization system had a shorter operative time and less intraoperative bleeding. The results of the analysis victimization the Neer scale were similar for each modalities.

Conclusions: The patients with fracture of the distal third of the femur managed with a minimally invasive stabilization system had higher outcomes, that weren't vital within the Neer scale, mainly due to less pain intensity, early mobilization and less functional repercussions.

Keywords: Fracture, femur, knee, surgery, technic, comparative study

Introduction

There are no correct estimates of the prevalence and incidence of thighbone fractures around total knee arthroplasties [1]. Throughout the historic evolution of orthopaedic surgery the treatment of distal thighbone fractures has not achieved clinical results with a high quality love the remainder of the limb fractures. The presence of skinny cortices, pathology, wide medullary canals, and fracture comminution build it tough to get and maintain a stable fixation [2, 3]. The goal of the treatment of those fractures is that the anatomic reduction of the articular surface, restoration of the limb length, alignment and rotation, also as allowing associate degree early limb mobilization to avoid articular stiffness and also the loss of muscle mass [4]. The surgical procedure of long bone fractures has evolved emphasizing the minimization of the additional biologic damage caused by the surgical trauma. Indirect reduction techniques consisting of exerting traction through the soft tissues to achieve fracture reduction have been introduced and that they have step by step replaced the open reduction techniques. This indirect approach is known as internal biological fixation [5, 6].

Together with the previous, varied minimally invasive techniques are enforced recently. The implant called less invasive stabilization system (LISS) stands out among them and consists of a pre-contoured plate that will be percutaneously inserted when the closed reduction of the fracture [6, 7].

In the literature, osteopenia and gonarthrosis might complicate their management. Moreover, there's a high rate of open distal femur fractures [8, 9], the treatment of distal femur fractures has long been a arguable topic. Towards 1950-1960 the conservative approach was predominant [10], AO introduced the mounted angular plate for the treatment of distal femur fractures [11, 12].

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Distal thighbone fractures treated with internal fixation employing a 95° angular plate and a strengthened appendage plate [13].

The objective of this study is to present the results of the surgical treatment of supracondylar femoral fractures (types A, B, C) in keeping with the AO/ASIF classification using two treatment modalities: a plate with appendage compression screws and the less invasive stabilization system.

Material and methods

This observational, retrospective, cross-sectional study reviewed the clinical files of all patients who underwent surgery due to a distal femur fracture from January 2016 to January 2018. Before beginning the study, the Hospital Review Board approved this retrospective study and granted a release of consent. (Gandhi Medical faculty could be a medical faculty in Gandhi Medical college, Secunderabad, Telangana, India.)

The inclusion criteria were as follows: first of all, complete clinical records; second, patients with distal leg bone fracture together with all degrees of severity; third, the fractures should be surgically treated either with open reduction and a plate with appendage compression screws or through indirect reduction and a less invasive stabilization system; fourth, patients followed-up as outpatients for a minimum of six months. Patients but eighteen years elderly were excluded furthermore as those with Associate in Nursing interval between the fracture and therefore the surgery longer than one week, patients with a fracture treated at the start with a special kind of implant, and people with a diagnosing of periprosthetic fracture.

Applying these choice criteria, a complete of fifty nine patients were known and set up the sample. the subsequent variables of every patient record were analyzed: Age, sex, mechanism of fracture, kind of fracture per the AO/ ASIF classification [14], surgery modality, operative time and volume of intraoperative harm. On the opposite hand, throughout the follow-up at operative weeks three, 6, nine and twelve the subsequent variables were recorded: Pain prevalence and severity, vary of motion of the ginglymus, radiologic proof of healing, and complications. On the other hand, the results obtained at postoperative month 6 were assessed using the modified neer scale [15].

The statistical analysis consisted of descriptive statistics (percentage, range, mean, standard deviation using Origin Pro 7.6 statistical software), using the standard methods. The comparison of variables between both treatment modalities was done using the chi-square test for the categorical variables and the Student t-test for the independent samples in the case of numerical variables. The comparison of ordinal variables of the neer scale was performed using the Kruskal-Wallis test.

Results

The review included a total of 59 patients, 57.6% of whom were males (33/59) and 44% females (26/59). Patient age ranged between 18 and 78 years, with a mean age of 58 years; the distribution in age groups is shown in chart 1.

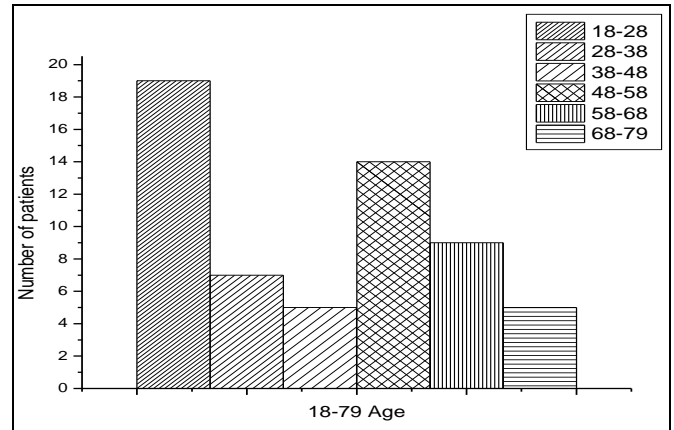


Chart 1: Distribution of patients by age group.

A high-energy mechanism was reported as the cause of fracture in 71% of cases (42/59), and a low energy mechanism was reported in 28.8% (17/59). None of the patients had bilateral fracture, so according to the AO/ASIF classification, among the 59 fractures the predominant type was 33A 1.1, reported in 31% of cases (18/59), followed by types 33A 1.2, with a frequency of 15% (9/59) and 33C 1.1, also with a frequency of 14% (8/59). The distribution of fractures according to their frequency based on the types included in this classification is summarized in table 1.

Table 1: Distribution of distal femur fractures according to the AO/ASIF classification.

Type	Number of fractures	Relative frequency (%)
33 A 1.1	18	31
33 A 1.2	9	15
33 C 1.1	8	14
33 A 2.1	5	8
33 A 2.2	4	7
33 A 3.3	3	5
33 A 1.3	3	5
33 B 1.2	2	3
33 C 1.3	2	3
33 A 2.3	2	3
33 A 3.1	1	2
33 B 1.1	1	2
33 C 1.2	1	2
Total	59	100

Of the total number of fractures, 76% (45/59) were closed and 24% (14/59) were open. According to the gustilo classification [16], 5 /16 open fractures were type I, 2/16 was type II and 9/16 were type IIIA. Fifty-four percent of the fractures (32/59) involved the right pelvic limb and 46% (27/59) the

left one.

According to the surgical treatment modality for fracture fixation, in 36/59 patients (61%) an implant consisting of a plate with condylar compression screws was used (Group I), and in 23/52 patients (39%) the less invasive stabilization

system was used (Group II).

When comparing the overall characteristics of the patients in each group, no significant differences were found in age and

sex. However, a significant predominance was found in the proportion of fractures caused by a high energy mechanism in Group I patients (Table 2).

Table 2: Patient characteristics and mechanism of injury.

	Group I	Group II	P - Value
N	36	23	
Age	51.2±16.52	50.5± 19.36	0.65*
Gender	Males 21/36	Males 16/23	
	Females 15/36	Females 7/23	0.92†
Mechanism of injury	High energy 29/36	High energy 15/23	
	Low energy 7/36	Low energy 8/23	0.06†

* Student t-test; † Chi-square

The distribution of fractures according to the AO/ASIF classification for each treatment modality is summarized in table 3.

Table 3: Distribution of fractures by group according to the AO/ASIF classification

Type	Group I	Group II
33 A 1.1	11/36	6/23
33 A 1.2	7/36	4/23
33 C 1.1	5/36	3/23
33 A 2.1	3/36	3/23
33 A 2.2	2/36	1/23
33 A 3.3	3/36	1/23
33 A 1.3	1/36	1/23
33 B 1.2	1/36	
33 C 1.3	2/36	1/23
33 A 2.3	1/36	1/23
33 A 3.1		
33 B 1.1		1/23
33 C 1.2		1/23

A longer duration of the surgical procedure was seen in Group I, with a mean of 2hrs 20minutes, compared with Group II, with a mean duration of 1hr 40 minutes, with a statistically significant difference. The intraoperative bleeding volume was greater in the cases in which the implant consisting of a plate with condylar compression screws was used (mean bleeding: 756 cc), compared with Group II, which had a mean

bleeding volume of 320 cc, with a statistically significant difference between them.

In 52% of the cases (19/36) in Group I a graft was used. No graft was used in Group II because the fracture site was intact. When the degrees of flexion obtained at postoperative months 1, 2 and 3 were compared, no significant differences were seen between both treatment modalities (Table 4).

Table 4: Evaluation of postoperative flexion (Degrees)

	Group I	Group II	p Value
Flexion at one month	33.26 ± 4.65	29.89 ± 2.98	0.98†
Flexion at two months	96.49 ± 6.96	98.84 ± 16.68	0.83†
Flexion at three months	104.55 ± 12.25	113.21 ± 18.96	0.52†

† Chi-square

The degree of bone healing was assessed at postoperative months 1, 2 and 3 for each of the groups; it is summarized in table 5.

Table 5: Evaluation of bone healing in both groups

	Group I		Group II	
	Grade	N	Grade	N
Healing at one month	Null	6/36	Null	11/23
	Incipient	25/36	Incipient	11/23
Healing at two months	Null	7/36	I	5/23
	Incipient	15/36	I-II	7/23
	Completed	16/36	II	15/23
Healing at three months	Incipient	3/36	Incipient	3/23
	Completed	23/36	Completed	20/23
Healing at six months	Delayed	3/36	Delayed	2/23

Patients in whom a plate with condylar compression screws was used stopped using crutches and used a cane or a walker at a mean of 20 weeks after surgery. A statistically significant difference was seen when this figure was compared with the group of patients in whom the less invasive stabilization system was used, who used a cane or a walker at a mean of

9.6 weeks ($p=0.01$).

The Neer scale showed that excellent results were obtained in 59% of patients in Group I (21/36). The functional results in 9/36 patients were affected by the need to use a cane or a walker due to the severity of their pain. Additionally, 4/36 patients had a valgus deformity of less than 5°, and two

patients had a 10° rotational deformity together with a 10° valgus deformity. The results in 70% (16/23) of the patients in Group II were excellent; 6/23 patients had functional restriction due to the severity and ongoing nature of their pain. One patient (1/23) had a valgus deformity of less than 5°.

Discussion

Fractures of the distal femur are important injuries that regularly result in permanent disability. The magnitude of the functional loss results from the combination of injuries at the level of the distal femur, the articular cartilage and the surrounding soft tissues^[17].

These fractures might comprehend the femur shaft with limited effects on the knee, or they may occur at the level of the supracondylar metaphysis and remain as extra-articular, although sometimes they go all the way to the attachments of the collateral ligaments (epicondyles). In other cases the fracture may compromise a single condyle (monocondylar fractures) with the other condyle and the shaft remaining intact. Often times the fracture is located at the supracondylar level, but it may extend inferiorly towards the articular surface with different degrees of comminution, as in supracondylar-intercondylar fractures^[18].

Recently, the treatment of those fractures has evolved towards a balance between the mechanical stability of the fragments and also the biological viability, perceive the principles of the anatomic reduction of the body part surfaces and also the restoration of the leg bone length, in addition as of the articular alignment and rotation^[4, 19].

There are two well recognized patterns related with the mechanism of injury: high energy injuries in young patients and low energy injuries in older patients. It's acknowledged that 45% of the distal femur fractures occur as a result of minor trauma in osteoporotic bones, typically times when an elderly patient falls on a flexed knee^[20].

In this paper we found that in patients treated with a plate with condylar compression screws, a high energy mechanism of fracture was predominant. Even though this may reflect a difference in the severity of injuries between the groups and may be a characteristic inherent to retrospective studies, so far there are no reports distinguishing between the treatment choice according to the mechanism of fracture and the results gathered for analysis purposes^[21]. For this reason we consider that this reflects the transition towards a predominant management of distal femur fractures with less invasive techniques in patients with osteopenia in whom a low energy mechanism of fracture is involved. This is recommended by some authors, including Wong *et al.*, who published a series of 16 elderly patients with a mean age of 75 years, with a distal femur fracture, who were managed using a less invasive stabilization system. In their paper only two patients had loosening of the proximal fixation and in all cases healing was complete and was verified at postoperative week 30 as a mean. Therefore, these authors stated that this system was very effective for the treatment of this type of fractures in osteopenic bones^[22].

The experiences of assorted authors have shown a shorter operative time and fewer injuries once the less invasive stabilization system was used compared to the plate with condylar compression screws. It's so no surprise that our study showed an equivalent. In fact, such comparative knowledge was obtained even with the minimally invasive placement of a plate with outgrowth compression screws^[23]. An important data point found during this paper was the

shorter time needed for the first mobilization of patients in whom the less invasive stabilization system was used, because the latter favors the first quality of patients for walking and flexing the knee, therefore avoiding the delay in convalescent the ranges of motion that results from muscle weakness.

On the opposite hand, 2/36 fractures with delayed healing were rumored within the patients treated with a plate with outgrowth compression screws, and 1/23 fractures with delayed healing within the cluster of patients treated with the less invasive stabilization system. Regarding consolidation, Jeon *et al.*^[23] rumored complete healing in ninety four of patients in sixteen fractures of the distal leg bone treated with a plate with outgrowth compression screws.

When the results were compared using the neer scale, no statistically significant difference was shown between both treatment modalities. However, it was seen that the prompt patient mobilization, the lesser soft tissue morbidity and the lower pain intensity are important factors for better patient outcomes with the less invasive stabilization system.

Conclusions

Overall, the treatment of distal femur fractures represents a special challenge for the orthopedist surgeon due to all the factors taken into account -such as the type of fracture, the bone quality, the time course and the overall status of the patient to obtain an appropriate postoperative course.

The plate with condylar compression screws involves a greater invasion of the soft tissues, which leads to more bleeding and the need for bone deperiostization for its placement. This increases the risk of postoperative complications in the elderly patients with a thin metaphyseal cortex and osteoporotic bone. Thus the use of the less invasive stabilization system is being preferred for the distal femur fractures that are usually caused by low energy mechanisms and where one expects to find osteopenic bone.

No significant differences were found in the degree of bone healing or in the recovery of the ranges of motion between both modalities.

During the overall evaluation of the results using the Neer scale, no significant difference was found based on the implants used. However, a significantly earlier mobilization was observed in the patients treated with the less invasive stabilization system, thus avoiding the possible complications that occur in patients who remain in complete rest for long periods of time.

The major factor influencing the results was the presence and severity of pain, which had direct repercussions on the patients' rehabilitation and their resumption of their activities.

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