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Comparative evaluation of surgical management using minimal invasive stabilization of the distal femoral fracture using screws and plates for appendage compression

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***Abstract*---**Background: Management of the fracture of the femur has also been a controversial subject in the literature, and recently, this management has been attributed to the minimally invasive techniques and indirect reduction. Aims: The present clinical study was conducted to comparatively evaluate the results following surgical management using minimal invasive stabilization of the distal femoral fracture using screws and plates for appendage compression. Material and methods: The present study included and retrospectively analyzed subjects with the fracture of the distal femur. From their past medical records, variables assessed were postoperative bleeding, operating time, implant type used, mechanism of injury, fracture form, gender, and age. For comparison of the useful, radiological, and anatomic outcomes of each technique, the Neer scale was used. Results: At 1-month flexion mean was higher in group I with 33.28±4.63 compared to Group II here flexion was 29.91±2.96. This was statistically non-significant with p=0.96. At 3 months, flexion was non-significantly higher in Group II with a mean of 98.86±16.66 compared to group I where it was 96.51±6.94 with p=0.81, and at the 3 months assessment, mean flexion was non-significantly higher in group II with

the value of 113.23±18.94 compared to 104.57±12.23 in Group I with p=0.54. For the bone healing, in Group I, at 1-month null grade was seen in 7 subjects and incipient in 26 subjects, at 2 months, null, incipient, and completed grade was seen in 8, 16, and 17 subjects respectively, at 3 months, incipient and completed grade was seen in 2 and 23 subjects respectively, and at 6 months delayed healing was seen in 3 subjects. In Group II, at 1-month null grade was seen in 12 subjects and incipient healing in 12 subjects, at 2 months, I, I-II, and II grade was seen in 6, 8, and 15 subjects respectively, at 3 months, incipient and completed grade was seen in 3 and 20 subjects respectively, and at 6 months delayed healing was seen in 2 subjects. Conclusion: The present study concludes that high and better outcomes are seen with minimally invasive stabilization in the subjects with the fracture of the distal third of the femur that was not vital on the Neer scale owing to less functional impact, early mobilization, and lower pain intensity.

***Keywords*---**distal femur fracture, femur fracture, knee, minimally invasive surgery.

Introduction

Fracture of the thigh bones and their incidence and prevalence has been estimated with accuracy along with the total number of arthroplasties being done. Assessing the complete evolution of the orthopedic surgeries in the historical perspectives, the management of the distal fractures of the thigh bones have no established clinical results with the limb fractures remainder. Attainment and maintenance of the stable fixation are difficult in the distal femur fracture owing to the fracture comminution, wide medullary canals, pathology, and skinny cortices.[1] The main aim of the management of the distal femur fracture lies in allowing the early limb mobilization for prevention of the muscle mass and articular rigidity, rotation, and alignment, limb length restoration, an anatomical reduction of the articular surfaces of the bones. Fractures of the long bones are recently been advocated and advanced to be managed by the surgical intervention owing to the reduction of the additional biological damage seen due to the trauma caused by the surgery.[2]

Indirect reduction of the distal femur fractures was introduced and comprised of exercising traction via soft tissues to attain the reduction of the fracture, and this was later replaced by step-by-step open reduction techniques. Internal biological fixation is a term given to this indirect approach. Recently, in addition to these approaches, minimally invasive techniques were introduced to manage the distal femur fracture. LISS (Less Invasive Stabilization System) is an implant used in the minimally invasive technique that has a pre-contoured plate placed percutaneously in the closed fracture. However, these fractures are associated with a few complications like gonarthrosis and osteopenia.[3]

In addition, the incidence of the fracture of the distal femur is high and the management of these fractures is been a controversial subject for a long time. In

the era of 1950 and 1960s, a conservative approach was been prominent. AO (Arbeitsgemeinschaft für Osteosynthesefragen) introduced the management of the distal femur fracture using the mounted angular plates. Thigh-bones distal fracture managed with the reinforced appendage plate and 95 ° angular plate with internal fixation have also been done.[4] The present clinical study was conducted to comparatively evaluate the results following surgical management using minimal invasive stabilization of the distal femoral fracture (type A, B, C) using screws and plates for appendage compression based on ASIF/AO classification.

Materials and Methods

The present observational retrospective clinical study was conducted to comparatively evaluate the results following surgical management using minimal invasive stabilization of the distal femoral fracture (type A, B, C) using screws and plates for appendage compression based on ASIF/AO classification. The study was carried out at Department of Orthopedics, Government Medical College Rajouri, Jammu and Kashmir after obtaining clearance from the concerned Ethical committee. The study population was comprised of the subjects visiting the Department of the Orthopedics of the Institute.The inclusion criteria for the study were subjects having a fracture of the distal femur irrespective of the severity, complete medical records, fracture managed surgically by indirect reduction and a less invasive stabilization system, or either with open reduction and with an appendage compression screw, and subjects having complete follow-up records. The exclusion criteria for the study were subjects of age less than 18 years, subjects where surgery was delayed by more than 7 days, subjects with a diagnosis of periprosthetic fracture, and fractures managed with the special implant.

The study included a total of 68 subjects that comprised the sample size as they met the inclusion criteria being set for the study. For all the included subjects, the data retrieved from the past medical records were intraoperative harm volume, operating time, surgical modality, ASIF/AO fracture classification type, mechanism of fracture, gender, and age of the subjects. The follow-up of the study subjects was done at 3, 6, and 12 weeks after surgery. The variables assessed at the follow-up were complications, healing evidence radiographically, varying ginglymus motion, pain severity, and pain prevalence. Modified Neer scale[5] was used to assess the results of the 6th month postoperative. The collected data were subjected to the statistical evaluation using SPSS software version 21 (Chicago, IL, USA) and one-way ANOVA and t-test for results formulation. The data were expressed in percentage and number, and mean and standard deviation. The level of significance was kept at $p<0.05$.

Results

The present observational retrospective clinical study was conducted to comparatively evaluate the results following surgical management using minimal invasive stabilization of the distal femoral fracture (type A, B, C) using screws and plates for appendage compression based on ASIF/AO classification. The study included a total of 68 subjects from both genders having the distal femur fracture managed surgically by indirect reduction and a less invasive stabilization system

or either with open reduction or with an appendage compression screw. The demographic and disease characteristics of the study subjects are listed in Table 1. There were 41 subjects in Group I and 27 subjects in Group II. In Group I, there were 24 males and 17 females, the mean age of the subjects was 51.4±16.54 years, and the injury mechanism was low energy in 10 subjects and high energy in 31 subjects. In Group II, there were 18 males and 9 females, the mean age of the study subjects was 50.7±19.38 years, and the injury mechanism was low energy in 11 subjects and high energy in 16 subjects (Table 1).

On assessing the fracture distribution based on the ASIF/AO classification in the study groups, it was seen that among the study subjects, type 33 A 1.1 fracture was seen in 12 subjects of Group I and 7 subjects of Group II, 33 A 1.2 in 8 and 5 subjects of Group I and II respectively, 33 C 1.1 in 6 and 4 subjects of Group I and II respectively, 33 A 2.1 in 4 subjects of both the groups, 33 A 2.2 and 33 A 3.3 in 3 and 1 subject of Group I and II respectively, 33 A 1.3 in 1 subject of both the groups, 33 B 1.2 in 1 subject of Group I, 33 C 1.3 in 2 and 1 subject of Group I and II respectively, 33 A 2.3 in 1 subject of both groups, 33 B 1.1 and 33 C 1.2 in 1 subject each of Group II, and 33 A 3.1 was not seen in any subject of any group, whereas, it was seen in 1.47% (n=1) subject among 68 subjects of the study as shown in Table 2.

Concerning the flexion outcomes in the two groups of study subjects at different time intervals, it was seen that at 1-month flexion mean was higher in group I with 33.28±4.63 compared to Group II here flexion was 29.91±2.96. This was statistically non-significant with p=0.96. At 3 months, flexion was non-significantly higher in Group II with a mean of 98.86±16.66 compared to group I where it was 96.51±6.94 with p=0.81, and at the 3 months assessment, mean flexion was non-significantly higher in group II with the value of 113.23±18.94 compared to 104.57±12.23 in Group I with p=0.54 (Table 3). For the bone healing, in Group I, at 1-month null grade was seen in 7 subjects and incipient in 26 subjects, at 2 months, null, incipient, and completed grade was seen in 8, 16, and 17 subjects respectively, at 3 months, incipient and completed grade was seen in 2 and 23 subjects respectively, and at 6 months delayed healing was seen in 3 subjects. In Group II, at 1-month null grade was seen in 12 subjects and incipient healing in 12 subjects, at 2 months, I, I-II, and II grade were seen in 6, 8, and 15 subjects respectively, at 3 months, incipient and completed grade was seen in 3 and 20 subjects respectively, and at 6 months delayed healing was seen in 2 subjects (Table 4).

Discussion

The present observational retrospective clinical study was conducted to comparatively evaluate the results following surgical management using minimal invasive stabilization of the distal femoral fracture (type A, B, C) using screws and plates for appendage compression based on ASIF/AO classification. The study included a total of 68 subjects from both genders having the distal femur fracture managed surgically by indirect reduction and a less invasive stabilization system or either with open reduction or with an appendage compression screw. There were 41 subjects in Group I and 27 subjects in Group II. In Group I, there were 24 males and 17 females, the mean age of the subjects was 51.4±16.54 years,

and the injury mechanism was low energy in 10 subjects and high energy in 31 subjects. In Group II, there were 18 males and 9 females, the mean age of the study subjects was 50.7±19.38 years, and the injury mechanism was low energy in 11 subjects and high energy in 16 subjects. These demographics were comparable to the studies of Jeon JH et al[6] in 2004 and Schutz M et al[7] in 2005 where authors assessed subjects of comparable demographics as of the present study.

For the assessment of the fracture distribution based on the ASIF/AO classification in the study groups, it was seen that among the study subjects, type 33 A 1.1 fracture was seen in 12 subjects of Group I and 7 subjects of Group II, 33 A 1.2 in 8 and 5 subjects of Group I and II respectively, 33 C 1.1 in 6 and 4 subjects of Group I and II respectively, 33 A 2.1 in 4 subjects of both the groups, 33 A 2.2 and 33 A 3.3 in 3 and 1 subject of Group I and II respectively, 33 A 1.3 in 1 subject of both the groups, 33 B 1.2 in 1 subject of Group I, 33 C 1.3 in 2 and 1 subject of Group I and II respectively, 33 A 2.3 in 1 subject of both groups, 33 B 1.1 and 33 C 1.2 in 1 subject each of Group II, and 33 A 3.1 was not seen in any subject of any group, whereas, it was seen in 1.47% (n=1) subject among 68 subjects of the study. These results were consistent with the studies of Heiney JP et al[8] in 2009 and Valles Figueroa JF et al[9] in 2010 where comparable fracture distribution was seen in the studies of authors as in the present study.

For the flexion outcomes in the two groups of study subjects at different time intervals, it was seen that at 1-month flexion mean was higher in group I with 33.28±4.63 compared to Group II here flexion was 29.91±2.96. This was statistically non-significant with p=0.96. At 3 months, flexion was non-significantly higher in Group II with a mean of 98.86±16.66 compared to group I where it was 96.51±6.94 with p=0.81, and at the 3 months assessment, mean flexion was non-significantly higher in group II with the value of 113.23±18.94 compared to 104.57±12.23 in Group I with p=0.54. For the bone healing, in Group I, at 1-month null grade was seen in 7 subjects and incipient in 26 subjects, at 2 months, null, incipient, and completed grade was seen in 8, 16, and 17 subjects respectively, at 3 months, incipient and completed grade was seen in 2 and 23 subjects respectively, and at 6 months delayed healing was seen in 3 subjects. In Group II, at 1-month null grade was seen in 12 subjects and incipient healing in 12 subjects, at 2 months, I, I-II, and II grade were seen in 6, 8, and 15 subjects respectively, at 3 months, incipient and completed grade was seen in 3 and 20 subjects respectively, and at 6 months delayed healing was seen in 2 subjects. These results were in agreement with the findings of the Parren SM[10] in 2002 and Weight M et al[11] in 2004 where comparable flexion and healing was seen after distal femur fracture management as reported in the present study.

Conclusion

Within its limitations, the present study concludes that those high and better outcomes are seen with minimally invasive stabilization in the subjects with the fracture of the distal third of the femur that was not vital on the Neer scale owing to less functional impact, early mobilization, and lower pain intensity. The present study had a few limitations including a small sample size, shorter monitoring period, and geographical area biases. Hence, more longitudinal studies with a

larger sample size and longer monitoring period will help reach a definitive conclusion.

Conflicts of interest: nil

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Tables

Characteristics	Group I	Group II	p-value
Number (n)	41	27	
Gender			
Males	24	18	0.94
Females	17	9	

Mean age (years)	51.4±16.54	50.7±19.38	0.68
Injury mechanism			
Low energy	10	11	0.07
High energy	31	16	

Table 1: Demographic and disease characteristics of the study subjects

Type	Number n (%)	Group I (n=41)	Group II (n=27)
33 A 1.1	19 (27.94)	12	7
33 A 1.2	10 (14.70)	8	5
33 C 1.1	9 (13.23)	6	4
33 A 2.1	6 (8.82)	4	4
33 A 2.2	5 (7.35)	3	1
33 A 3.3	4 (5.88)	3	1
33 A 1.3	4 (5.88)	1	1
33 B 1.2	3 (4.41)	1	
33 C 1.3	3 (4.41)	2	1
33 A 2.3	2 (2.94)	1	1
33 A 3.1	1 (1.47)		
33 B 1.1	1 (1.47)		1
33 C 1.2	1 (1.47)		1
Total	68 (100)		

Table 2: Fracture distribution based on ASIF/AO classification in the study groups

Flexion outcomes	Group I	Group II	p-value
1 month	33.28±4.63	29.91±2.96	0.96
2 months	96.51±6.94	98.86±16.66	0.81
3 months	104.57±12.23	113.23±18.94	0.54

Table 3: Flexion outcomes in the study subjects following fracture management in the two groups

Bone Healing	Group I		Group II	
	Grade	n=41	Grade	n=27
1 month	Null	7	Null	12
	Incipient	26	Incipient	12
2 months	Null	8	I	6
	Incipient	16	I-II	8
	Completed	17	II	15
3 months	Incipient	2	Incipient	3
	Completed	23	Completed	20
6 months	Delayed	3	Delayed	2

Table 4: Assessment of bone healing in the two groups of the study subjects at different time intervals