Original Article

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Comparison of Early Outcome of the Close and Open Technique for the Treatment of Distal Femur Fractures

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ABSTRACT

Objective: To determine the early outcome of the close and open technique for the treatment of distal femur fractures, in terms of the union of the bones and complications.

Methodology: This comparative study was conducted in the Department of orthopedic Surgery, Pakistan Institute of Medical Sciences (PIMS), Islamabad, from September 2018 to March 2019. Patients aged 8 - 65 years, both genders with fractured close distal 1/3rd shaft of the femur and distal femur fracture on basis of orthopedic trauma association (AO/OTA) classification were included. Patients were divided into two groups according to treatment technique; Open technique group, treated by open reduction and internal fixation (ORIF) with locking compression plate (LCP), and Closed technique group treated by close reduction and internal fixation (CRIF) with retrograde intramedullary (IM) femoral nail that was based on the type of distal femur fracture.

Results: A total of 66 patients were studied; their overall mean age was 36.23±6.23 years. The average postoperative HSS knee score was 70.1±15.1 in the open technique group compared to 74.5±12.5 in the closed technique group without significant difference (p= 0.949). Overall bone union was in 32 (96.9%) in closed group and 30 (90.9%) in open group (p= > 0.05), two patients had infection and implant failure was in one patient only in open technique group, while p values were quite insignificant.

Conclusion: This study concluded that closed technique observed to be the somewhat better than the open technique in terms of an early and more bony union rate without infection and implant failure. Although the findings were statistically insignificant.

Key words: Femur distal fracture, ORIF, CRIF, Union, infection. Implant failure

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Introduction

Distal femoral fractures estimated for 3-6% of femoral fractures and about 0.4% of all fractures.[1,2] It demonstrates the typical bimodal distributions of ages, with younger male patients being more prone to high-energy injuries and older female patients being more likely to be involved in low-energy trauma such as falling from standing.[3] This effect is mixed with the incidence of osteoporosis for older people.[4] Moreover, the mortality rate for older people who experienced these traumatic injuries possibly as raised as 18.4% at one year, 39.1% at 3 years, and 48.8% at 5 years.[5]

The distal femoral fracture primarily occurs at the distal metaphysis of the femur. They are often comminuted in older people and extremely at the distal position.[6] There are different types of distal femur fractures including transverse fractures, comminuted fractures, intra-articular fractures. The AO/OTA system that is the well-

recognized classification system for fracture classified different patterns of fracture included type A (extraarticular or fracture outside the joint), type B (unicondylar/partial articular), and type C (bicondylar/complete articular). Additionally, this system classifies types A, B, and C into subtypes 1, 2, and 3 reflects the gradually rising extent of comminution.[7]

Clinically, a patient with a distal femoral fracture often presents with knee or thigh pain, unable to tolerate load on the affected lower extremity with related inflammatory signs and/or distortion following trauma.[8] Initially, a complete assessment of the skin should be carried out to ensure the likelihood of open fracture or soft tissue damage that may alter the surgery technique. Besides the assessment of the lower extremity, imaging modalities such as plain X-ray of the femur and knee should be done; Computed Tomography (CT) is utilized for recognition of type B or C fractures including a description of articular surface and extent of comminution. CT is also very helpful in the detection of a "Hoffa" fragment that is characterized by a coronal plane fracture, usually including the lateral condyle of the femur.[9]

Concerning treatment, a different alternative exists that includes a conservative approach to several surgical procedures that comprise open reduction internal fixation (ORIF), intramedullary nailing, and distal femoral replacement (DFR).[10] In contemporary, distal femur fractures are frequently managed with open reduction and internal fixation (ORIF) with the help of intramedullary nails (IMN), locking plates and condylar screws.[11] Major complications are associated with delayed healing of fractures such as non-union, infection, and implant failure. Thus, these complications have a considerable impact on a patient's quality of life and correspond to a significant treatment dispute due to its associated bone loss and soft tissue scarring.[12] Non-union of the femur is a rarely found complication, generally caused by diminished bone density or inauspicious fracture patterns.[13] Because of non-union, functional activity is limited, which leads to the development of psychological disturbances as a result of severe, persistent pain and, eventually, the abuse of alcohol and opiate analgesics.[14] On the other hand, a comparatively higher incidence of Surgical-site infection (SSI) is associated with open and closed surgical techniques, probably owing to soft-tissue trauma because of the accident, systematic co-morbidities, fracture severity, tissue damage during surgery, wound infectivity, other factors related to patient and surgical treatment.[15] SSI reflects widespread complications in several types of orthopedic operations for instance internal fixation of fractures,[16] severe osteoarthritis, arthroplasty in intra-articular fracture, ischemic osteonecrosis or carcinoma extraction,[17] congenital abnormalities, or congenital degenerative disorders.[18] In any case, SSIs lengthens the duration of hospital stay, increase the readmission rates and raise healthcare expenditure by thrice.[19] Additionally, in particular, infection after intra-articular fractures lead to developing joint rigidity, traumatic osteoarthritis, and the development of heterotopic ossification causes the functional activity to restrict.[20] Several studies have been conducted, but there is still much debate about which technique is superior.

Hence, this study has been conducted to determine the early outcome of the close and open technique for the treatment of distal femur fractures, in terms of the union of the bones and complications.

Methodology

This comparative study was conducted in the Department of orthopedic Surgery, Pakistan Institute of Medical Sciences (PIMS), Islamabad, from September 2018 to March 2019, after taking approval from the hospital ethics committee. Patients with fractured close distal 1/3rd shaft of the femur and distal femur fracture according to the orthopaedic trauma association (AO/OTA) classification were included. Patients with inflammatory changes in and around the knee joint, infection within fractures, old mistreated fractures, rigid knee joint, patients with severe systemic diseases, obese patients, and pathological fracture were excluded. A written informed consent was obtained from every patient about the surgery, following initial management and pre-operative preparation. Patients were divided into two groups according to treatment technique; the open technique group, treated by open reduction and internal fixation (ORIF) with locking compression plate (LCP), and Closed technique group treated by close reduction and internal fixation (CRIF) with a retrograde intramedullary (IM) femoral nail that was based on the type of distal femur fracture.

All the patients were advised to have postoperative follow-up in the outpatient department (OPD) on the 2nd, 8th, and 12th postoperative week to evaluate the bone union radiologically (bridging callus formation), infection, implant failure and knee joint functional

outcome with the Hospital for Special Surgery (HSS) knee score at the 12th postoperative week. The data were statistically analyzed by SPSS version 20. Quantitative variables, e.g., age and HSS knee score, were documented as mean and standard deviation. Qualitative variables such as gender, fracture type and fracture complication were documented as percentages and frequencies. The Chi-square test and t-test were applied to contrast the outcomes of the closed and open technique and HSS score categories in both procedures. P-value < 0.05 was taken as statistically significant.

Results

A total of 66 cases with distal femur fractures were selected, their overall mean age was 36.23+6.23 years, particularly mean age in open technique group was 41.5 + 23.5 years and 29.8 + 11.8 years in close technique group. Males were most common in both groups as 22 (66.7%) in open technique group and 25 (75.7%) in closed technique group. Although the type of fractures based on AO/OTA classification presented in table I.

Table I: Demographic characteristics of patients treated with open and closed technique. (n=66)

Variables			Open technique (n=33)	Closed technique (n=33)
Age (mean ±SD)			41.5 ± 23.5 years	29.8 ± 11.8 years
Gender	Male		22 (66.7%)	25 (75.7%)
	Female		11 (33.3%)	8 (24.2%)
Types of femur fracture	Type A distal	A-1	9 (27.3%)	15 (45.4%)
		A-2	4 (12.1%)	9 (27.3%)
		A-3	2 (6.1%)	5 (15.1%)
	Type B distal	B-1	1 (3.0%)	0 (0%)
		B-2	4 (12.1%)	0 (0%)
		B-3	0 (0%)	0 (0%)
	Type C distal	C-1	7 (21.2%)	0 (0%)
		C-2	6 (18.2%)	0 (0%)
		C-3	0 (0%)	0 (0%)
	Distal 1/3rd shaft of femur fracture		0 (0%)	1 (3.0%)
	Segmental fracture (Type A-1 with midshaft or subtrochanteric femur fracture)		0 (0%)	3 (9.1%)

Overall bone union was 32 (96.9%) in closed group and 30 (90.9%) in open group (p= > 0.05), two patients had infection and implant failure was in one patient only in open technique group, while p values were quite insignificant as shown in table II.

Discussion

Distal femoral fractures predominantly influence the knee's functionality because failing to restore the distal femur's functional angles directly affects the joint's stability and mobility.[21] The present study has been conducted to evaluate the best technique to re-establish the functional strength after the management of a distal femur fracture and its associated complications that occurs during the healing process. In this study, the mean age of the patients was 41.5 ± 23.5 years in open technique group while 29.8 ± 11.8 years in close technique group, and males were in the majority in both the open and closed technique groups as 22 (66.7%) and 25 (75.7%) respectively out of 33 cases in each group. Similarly, Haq SN et al[22] reported that the mean age of the patients was 31.1±7.9 years in close nailing group and 31.2±8.2 years was in open technique groups and they also found males in majority in both groups. On the other hand, Napar AR et al[23] found mean age of the patients 31.24 ± 6.58 years and 84.12% were males out of all study subjects. The distal femoral fractures mainly affect young males. This may be because young males are more involved in outdoor activities; however, this makes them more likely to be injured in accidents.

In this study 90.9% cases showed union in open technique and 96.9% in closed technique, the closed technique shown some more union rate while statistically insignificant (p=0.306). Consistently Telgheder et al[24] reported that the rate of the bony union was 89.1% in the open technique group, which was slightly lower compared to the close technique group as 92.9% (p-0.378). In the comparison of findings Tahir M et al[25] also conducted the study to assess the functional and clinical effects of open and closed fixation for femoral shaft fractures. They investigated 398 patients who had

Table II: Comparison of union, HSS knee score, and complications between the two study groups.

Variables		Open technique (n=33)	Closed technique (n=33)	p-value*	OR (95% CI)
Union of bone	8 weeks	10 (30.3%)	14 (42.4%)	0.305	0.5 (0.214 – 1.626)
	12 weeks	20 (60.6%)	18 (54.5%)	0.617	1.2 (0.482 – 3.4102)
	Overall union at 12 weeks	30 (90.9%)	32 (96.9%)	0.306	3.2 (0.315 – 32.477)
HSS knee score (Mean ± SD)		70.1 ± 15.1	74.5 ± 12.5	<0.949	------
Complications	Infection	2 (6.0%)	0 (0%)	0.2869	5.3175 (0.245 - 115.138)
	Non-union	3 (9.1%)	1 (3.03%)	0.3252	3.2 (0.3153 - 32.476)
	Implant failure	1 (3.03%)	0 (0%)	0.4942	3.0923 (0.1215 - 78.709)

undergone intramedullary nailing fixation of non-pathological fracture of the femur shaft and consistently they found 94.5% union in the fractures following close nailing and 91.6% of individuals had a union in their fracture after open nailing, without significant difference (*p* 0.495). In the favor of this series Gourishankar D et al[26], also found almost similar findings in accordance to bony union, while inconsistently, Haq SN et al[22] reported that there was a 77.7% union rate in open technique group, which was significantly lower than closed technique group as 95.1% (P <0.05). This difference may because of difference in study sample sizes and selection criteria.

In this study, infection occurred in 2 (6.0%) of the cases, non-union occurred in 3 (9.1%), and implant failure occurred in 1 (3.03%) of the cases in the open technique group, while no cases with infection or implant failure were found in the closed technique group, and only 1 was found with non-union. However, Gourishankar et al[26] demonstrated that bony union in shorter time besides lower infection incidence was observed in those patients with fractures of femoral shaft who were treated with close fixation in comparison with the open technique. The present study was in agreement with the above-mentioned study and revealed that femur fractures treated with close reduction method were superior over those treated with open reduction owing to the low incidence of infection with the admirable union. In the line of this series Napar AR et al[23] et al revealed that the surgical site infection rate was lower 5 (5.88%) in closed group compared to the open group as 9 (10.58%), further more they found higher rates of mal-union, delayed union and non-union in open group compared to close group, while like this study their findings regarding complications were also statistically insignificant (p->0.05). However, Salawu ON et al[27] also found similar findings. Regardless of current innovation of treatment, undesirable effects of infection, malunion, and poor functional activity can prevail in a distal femur fracture. Therefore, cautious management of the traumatic site by an appropriate approach either closed or open technique might reduce the probability of adverse complications. There are still controversies in technique selection, as some authors reported that individuals with various comorbidities have a considerably increased risk of postoperative complications. Although in this study we excluded the co-morbid patients who were obese body mass index (BMI) that was greater than 40 kg/m2, and suffered from several comorbidities. We were unable to make a final, conclusive decision about any particular technique, however, because we also had several limitations, including a small study sample size. However, it is suggested that further more large-scale studies be carried out, in order to determine whether or not there is a difference in the outcomes of such techniques.

Conclusion

As per the study conclusion, both techniques showed the best efficacy in clinical outcomes, while the closed technique observed to be the somewhat better than the open technique in terms of early and more bony union rate without infection and implant failure. Although the findings were statistically insignificant. Moreover, the functional outcome of the knee joint was also distinctly improved in the closed technique. Further large-scale studies are recommended to prove the further excellent technique.

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