Comparison of Closed Versus Open Interlocking Nail Femur: A Retrospective Cohort Study in a Tertiary Care Hospital.

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ABSTRACT

Objective: To compare the results of closed interlocking nail shaft of femur versus open interlocking nail in terms of union, non-union and infection rate.

Methods: We conducted this retrospective Cohort study in Department of Orthopedics Jinnah Medical College Hospital Karachi and Dow University Hospital- Ojha Campus Karachi. The medical record of all patients meeting the inclusion criteria and operated for interlocking nails(closed/open) shaft of femur in the time period extending from 23rd February 2018 to 3rd March 2019 were included in our study. The demographic details, radiographs, operative notes and follow up records of both groups were noted. The post-operative results of union, non-union and infection at final evaluation at one year were compared in both groups. Chi square test was applied and *P* value calculated. *P* value < 0.05 was considered significant.

Results: The medical record of 116 patients with mean age 31.1±8 were examined. Closed interlocking nail (group A) was done in 62 patients with mean age 31.1±7.9 years(range 20 to 55 years) while fracture site was opened(group B) in 54 patients with mean age 31.2±8.2years(range 19 to 57 years. The average time of radiological union was 20.5 ±3 weeks in closed versus 26.3±6 weeks in open nailing(*P* value <0.05).The rate of union in group A was 95.1%(n=59) and 77.7%(n=42) in group B.(*P* <0.05) Delayed union was documented in 6(9.6%) patients in group A and 14(25.9%) in group B(*P*<0.05).Non-union was noted in 03(4.8%) patients in group A and 12(22.2%) patients in group B. Superficial infection was noted in 4(6.4%) in group A and 13(24%) patients in group B.(*P* <0.05)

Conclusion: Closed interlocking nail for fracture shaft of femur resulted in earlier union, better union rates and less infection rate than open interlocking nail. Every effort must be made to avoid opening fracture side in interlocking nail femur.

Keywords: Femur shaft**,** interlocking nail, delayed union, union, non union, infection.

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INTRODUCTION

The incidence of fracture shaft of femur is 10 to13 per 100000 population in European and American communities.[1-4] Young adults with high energy trauma like road traffic accidents are the usual victims of fracture shaft of femur.[5,6] Kuntscher, the pioneer of intramedullary nailing, used closed cloverleaf nailing for treatment of femur shaft fractures in 1940,[7] but high complication rates in the form of excessive radiation exposure, nail jamming, distal fragment splitting and failure to reduce the fracture accurately were frequently reported.[8] Hence Watson[9] introduced open reduction and nailing of fracture shaft of femur in 1950. However radiation hazards were significantly reduced with the invention of advanced image intensifier machines and development of Detensor interlocking nail system by Kuntscher in 1968 greatly popularized the closed interlocking nail.[10] The advantages of closed intra medullary nailing include preservation of soft tissue envelope, deposition of intramedullary bone grafting due to reaming and preservation of fracture hematoma with osteogenic properties.[11] Many studies reported superior results of closed intramedullary nailing than open in terms of union and low infection rate.[12,13] However in certain femoral fractures with complex geometry, comminuted fractures and older fractures closed reduction is often difficult and opening of fracture site is helpful. [14]Accurate fracture reduction and minimal mal alignment has been reported with open intramedullary nailing.[6] Although open interlocking nailing results in periosteal stripping and evacuation of hematoma at the fracture site, union is achieved by callus formation.[15]

The gold standard of treating fracture shaft of femur is closed reduction and interlocking nail under image intensifier in both of our institutions. However in certain cases closed reduction is failed and the surgeon has to open the fracture site for reduction and passage of the guide wire. We hypothesized that there was no statistically significant difference between the surgical outcome of closed versus open interlocking nailing in terms of union, non union and infection rate. If true, centres where facilities of image intensifier and traction table is not available can utilize open interlocking nail for treating femoral shaft fractures.The objective of our study was to compare the results of closed versus open interlocking nails for treating fracture shaft of femur in terms of union,non union and infection rate.

METHODS

This retrospective Cohort study was conducted in Department of Orthopedics Jinnah Medical College Hospital Karachi and Dow University Hospital- Ojha Campus Karachi. The medical record of all the patients operated for interlocking nails shaft of femur from 23rd February 2018 to 3rd March 2019 were collected for study purpose. All adults patients with either gender, closed femur shaft fractures, operated within two weeks either closely(group A) or by opening the fracture site(group B) and operated by the same teams of experienced surgeons were included in our study. Patients of polytrauma, multiple fractures, segmental fractures, bilateral femoral fractures, floating knee patients, pathological fractures and patients with incomplete documentations were excluded from our study. The study protocols were approved by Ethical Committees of both hospitals. The demographic details, radiographs, operative notes and follow up records of both groups were noted. Fractures were classified radiologically as proximal third, middle third and distal third and by Winquist and Hansen.[16] The record revealed standard and uniform per operative and post operative antibiotics, follow up and rehabilitation protocols for all the patients.All patients were operated on traction table and under image intensifier with general or spinal anaesthesia. An antegrade interlocking nail of adequate length and diameter was inserted through piriformis fossa after reaming and locked either statically or dynamically depending upon fracture location and comminution. The interlocking nail was done either closely or by opening the fracture site after failure to pass the guide wire closely. Post operative rehabilitation protocols included isometric quadriceps exercises on first post operative day and partial weight bearing or complete weight bearing depending upon individual fracture pattern and mode of dynamization and appearance of callus. Monthly clinical record was examined and compared for duration of surgery, average duration of union, delayed union(inadequate callus at 16^{th} week post operatively),dynamization, fracture union and complication at final evaluation and comparison of surgical outcome of both groups was done at one year. This study has been reported according to the STROBE guidelines.[17]

The data was analyzed with SPSS version 20 and presented as frequency, percentage and standard deviation. Important variable in both groups like time of union, union rate, non union and infection rate in both groups were compared and *P* value was calculated for statistical significance (*P* value< 0.05) were significant).The data was presented in tables where necessary.

RESULTS

A total of 116 patients with mean age 31.1±8 were included in our study. Majority(75.8%,n=88) of fractures were due to Road traffic accidents followed by fall (18.9%,n=22) and physical assault (5.1%,n=6).Right femur was fractured in 89(76.7%) while left side was affected in 27(23.2%). Records revealed that closed interlocking nail(group A) was done in 62 patients with mean age 31.1±7.9 years(range 20 to 55 years) while fracture site was opened(group B) in 54 patients with mean age 31.2±8.2years(range 19 to 57 years).In group A male patients were 45(72.5%) and female 17(27.4%) while in group B male patients were 41(75.9%) and female 13(24%).The anatomical location of fracture and its configuration as per Winquist and Hansen classification is shown in table I. It was noted that equal number of patients(n=28) in both groups had middle third fracture while the predominant type of fracture in both groups were Winquist and Hansen type 0(38 versus 39). Majority (72.5%,n=45) of fractures in group A were fixed on average 5±2 days after sustaining the fracture while 43(79.6%) patients in group B were fixed on average 11±5 days. The surgical and radiological outcome of both groups are compared in table I. Majority(95.1%,n=59) of the patients in group A were united at one year follow up while 42(77.7%) patients in group were united(<0.05).Non union was noted in 3(4.8%) patients in group A and 12(22.2%) patients in group B(<0.05).Superficial surgical site infection was documented in 4(6.4%) patients in group A and 13(24%) patients in group B(<0.05).However the infection responded to antibiotics, dressings and debridement without needing nail removal or major surgery in both groups.No mortality was noted.

Table I: The anatomical location of fracture shaft of femur and its configuration as per Winquist and Hansen classification.

S.No	**Fracture location/Pattern**	**Group A (Closed interlocking Nailing) n=62**	**Group B (Open Interlocking Nailing) n=54**
1	Proximal third fracture	17(27.4%)	16(29.6%)
2	Middle third Fracture	28(45.1%)	28(51.8%)
3	Distal Third Fracture	17(27.4%)	10(18.5%
4	Winquist and Hansen type 0	38(61.2%)	39(72.2%)
5	Winquist and Hansen type I	11(17.7%)	09(16.6%)
6	Winquist and Hansen type II	04(6.4%)	06(11.1%)
7	Winquist and Hansen type III	09(14.5%)	00

Table II: Comparison of Surgical/radiological outcome of both groups.

S.NO	**Surgical/Radiological Outcome**	**Group A(Closed interlocking nailing) n=62**	**Group B(Open Interlocking Nailing) n=54**	***P* value**
1	Average duration of radiological union	20.5 ±3 weeks	26.3±6 weeks	<0.05
2	Delayed union	6(9.6%)	14(25.9%)	<0.05
3	Union	59(95.1%)	42(77.7%)	<0.05
4	Non union	03(4.8%)	12(22.2%)	<0.05
5	Dynamization	04(6.4%)	06(11.1%)	>0.05
6	Infection	4(6.4%)	13(24%)	<0.05
7	Shortening	3(4.8%)	2(3.7%)	>0.05
8	Malalignment	2(3.2%)	1(1.8%)	> 0.05
9	Average duration of surgery	65 minutes	95 minutes	>0.05
10	Screw breakage	4(6.4%)	2(3.7%)	>0.05

DISCUSSION

The average radiological union time in our study was 20.5±3 weeks in closed interlocking group and 26.3±6 weeks in open interlocking group. The relatively prolonged healing time in open nailing group in our study is in accordance with other studies in literature. [14,17-19] Seetharmaiah and colleague[6] compared 57 closed interlocking nail femur with 49 open nailing and found average radiological union time of 22.6 weeks in closed nailing versus 24.21 in open nailing, shortening in 7(12.2%) patients in closed versus 5(10.2%) in open nailing and 4(8.1%) patients with superficial infection in each group. They assessed the functional outcome with Thoreson's criteria and noted excellent outcome in 68.4% patients, good in 24.5% and fair in 7% patients with closed nailing.Open nailing yielded excellent functional outcome in 55.1% patients, good in 28.5% and fair in 16.3% patients. Tahririn [11] treated 23 patients with closed nailing and 24 with open nailing using mini incision(2.5cm)at the fracture site. The average union time was 13±2.4 in closed nailing and 17.7±2.3 in open nailing(P value 0.001).The only complication was non union in one of the patients in open nailing group. These authors concluded that patients with poly trauma and centers lacking fracture table or image intensifier can be treated effectively with open nailing using mini incision. In our study, however we could not analyzed the size of incision at the fracture site but we assumed that incision of adequate length must have been used for fracture reduction and passage of guide wire.

In our study union was achieved in 95.1%(59) patients in closed nailing and 77.7%(42) in open nailing. Meena[19] documented union rate of 93% in closed nailing and 87.9% in open nailing. Gharehdaghi[20] noted union rate of 95.4% in closed nailing and 93.2% in open nailing.

The operative notes indicated that closed nailing took average 95 minutes while open nailing took 65 minutes to complete. Kisan [14] noted that closed nailing took 66 minutes and open nailing 84 minutes to complete. Chaudhary[21] reported that time taken by closed nailing was 71 minutes and open nailing was 97 minutes. The exact cause of this increase duration of surgery in open nailing was not known in our study. But we can assumed that since majority of fractures in group B were fixed on average 11±5 days after sustaining the fracture, closed reduction and passage of guide wire would have been difficult even after repeated attempts causing exhaustion of the surgeon and ultimately opening of the fracture site. Although the exact timing of interlocking nail in femur shaft fracture is still controversial [22,23] but studies have shown that femur interlocking nail in less than 24 hours after sustaining the fracture is associated with less chances of pulmonary embolism and reduced mortality. [24,25] Kimmatkar N [26] was of the opinion that the type and pattern of femoral shaft fractures, available instruments and experience of the operating surgeon should decide for closed or open nailing. However, he advocated that poly trauma patients with femur shaft fracture should undergo closed nailing while open nailing was an alternative to closed nailing in patents in whom closed reduction was failed.

A comparison of complications of both groups of our study revealed that non union was present in 3(4.8%) patients in closed nailing versus 12(22.2%) patients in open nailing and superficial infection in 4(6.4%) versus 13(24%) patients. Perhaps the increased duration of surgery in group B and opening and manipulation of the fracture site might be responsible for increased infection in this group.Chaudhary[21] noted superficial infection in 4 patients in closed nailing versus 10 patients in open nailing and an equal number of patients(2 each) with non union in closed versus open nailing and. Kumar[27] noted superficial infection in 1(4%) patient in closed group versus 2(8%) patients in open group,deep infection in 1(4%) patient in closed group and none in open group. These authors concluded that post operative complications in both groups were statistically insignificant.

Our study had few limitations. A randomized design with a larger sample size would be more appropriate to verify our results. We were not able to compare per operative blood loss in both groups. Risk factors for infection and non union could not be analyzed.Association of type of fracture and mode of dynamization with union,non union and infection rate could not be assessed. We therefore recommend further studies to address all these limitations.

CONCLUSION

Closed interlocking nail for fracture shaft of femur resulted in earlier union, better union rates and less infection rate than open interlocking nail. Every effort must be made to avoid opening fracture side in interlocking nail femur.

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