

Original Article**A prospective study of closed and open reamed intramedullary nailing of 136 femoral shaft fractures in adults***Mohammad Gharehdaghi*, Hasan Rahimi*, Mahmoud Bahari**, Javad Afzali*****Abstract**

BACKGROUND: Femoral shaft fractures are major causes of mortality and morbidity and are managed with intramedullary nailing (IMN). In this study we compared the results of open and closed nailing in femoral shaft fractures.

METHODS: Between 1993 and 2001 we managed 136 femoral shaft fractures by IMN (81 closed and 55 open nailings) in 120 patients with mean age of 36.2 years. The mean time of follow up was two years. Radiologic and clinical results were analyzed with SPSS software using student-t and Fisher test.

RESULTS: 93.2% healed within six months. 2.9% required dynamization; total union rate was 96%. Full weight bearing was permitted between 5-16 weeks (mean of 10.62 weeks) in the closed method, and 10-20 weeks (mean of 12.83 weeks) in the open method ($P < 0.001$). Complications included 4.41% nonunions, 2.9% shortening, 10.8% limited range of movement, 1.47% deep infection, and 6.6% malunion. Nonunion was observed in 2 cases in closed and in 4 patients in open method ($P = 0.039$). Closed series showed higher rate of malunion ($P = 0.181$, $P = 0.221$).

CONCLUSIONS: In closed method attention should be paid to malalignment while locking the nail.

KEY WORDS: Reamed intramedullary nailing, femoral nailing, closed intramedullary nailing, open intramedullary nailing, fracture.

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Medullary nailing is the treatment of choice for diaphyseal femoral fractures. Reamed nailing is performed immediately after injury for most closed and open fractures with the exception probably of grade III B and III C open injuries¹⁻⁶.

Since 50 years ago and Kuntscher's pioneering work on IM fixation, many refinements have been made in nailing techniques and the implants used. However, the basic concepts of Kuntscher's description remain unchanged. Most femoral nailing systems in use today allow placement of a cannulated nail across the fracture over a guide wire, just as Kuntscher's

recommended⁷. The purpose of this prospective study was to assess the results of IMN operation in the fracture of the femoral shaft in adults by open and closed methods.

Methods

Between 1993 and 2001, we enrolled 120 patients (136 femoral reamed nailing cases) operated on by one of us at Emam Reza, Kamyab, and private hospitals in Mashhad northeastern Iran. Twenty-eight patients (20.9%) had open fractures. All of the patients had fresh Fractures without pathologic conditions. We used AO classification for femoral fractures.

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Associated injuries were seen in 52 cases, including 28 polytraumatized cases with ISS 13-34. The patients were aged 13-78 years (mean age: 36.2 years). The patients were operated on within 48 hours of admission, except for 7 cases due to unstable general conditions with a maximum delay of 18 days. Nailing was performed in the lateral position without fracture table by manual traction on the flexed knee and hip; we preferred supine position for polytraumatized patients and cases of bilateral femoral fracture.

Open reduction, preferably by a limited incision and suturing before reaming if possible, and reamed nailing were performed for 55 cases (40.4%). These were 28 open fractures, 27 fractures irreducible by closed techniques, and 11 cases that required wiring of fragments. Closed nailing was performed in 81 cases (59.6%). 124 cases (91%) were statically locked and dynamic locking was performed for 24 patients (17.4%). Twenty-eight multiple-injured patients with a total of 34 femoral fractures were treated with external fixator, which was followed by conversion to nailing. Serial radiographies were performed at 3, 6, 12 weeks, and 6 months; additional radiographies were performed as

needed postoperatively. Knee, ankle, and hip motions were began by CPM and protected weight bearing was started on the second day postoperatively and increased gradually to full WB depending on x-ray findings of callus formation. The patients were followed for two years. Results of open and closed I.M.N were assessed over a mean follow-up period of two years. The time of full weight bearing and complications of nonunion and external rotation deformity were compared and analyzed using SPSS with Chi-square, t-independent and Fisher tests.

Results

126 patients (93.2%) healed within six months. Four required dynamization and healed within 12 months; total union rate was 96%. The mean hospital stay was 9.12 days (3-30 days). Range of knee flexion was full in 132 (89.2%), 0-120 in 15 (10.1%), and 0-30 degrees in one (0.7%) who had associated knee dislocation. Full weight bearing was permitted between 5-16 weeks (10.62) in the closed method (81 cases), and 10-20 weeks (12.83) in the open method (55 cases) (diagram 1) ($P < 0.001$).

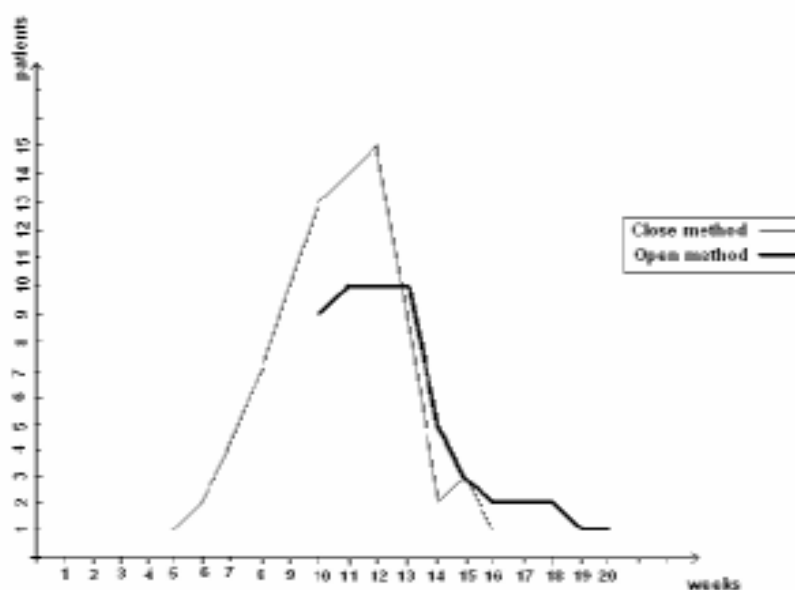


Diagram 1. Time of full weight bearing.

Complications

Nonunion: 2 cases in closed and 4 in open method, $P = 0.039$. External rotation deformity: 6 cases in closed and none in open method, $P = 0.181$. Malunion: shortening of more than 1.5 centimeters in 4 cases and angulations of more than 5 degrees in 3 cases in closed nailing. Nonunion: 6 cases; 5 patients were operated on with reaming and nail changing with greater diameter nail (2 mm) and eventually healed. One patient refused reoperation who had subtrochanteric nonunion and 25 mm shortening. Deep infection: 2 cases; one after open reduction and nailing, the other was a polytraumatized patient with type IIIA open fracture. Both of them cured after reaming of the canal and antibiotic administration. There were 3 implant failures, 2 at subtrochanteric and one at the supracondylar area.

Discussion

Medullary nailing is the treatment of choice for all femoral fractures from lesser trochanter to 10 centimeters above the knee joint ^{4,6-13}. First-generation interlocking nails using oblique or transverse screws are superior to unlocked nails ^{4,14-18}. In resisting torsional forces, one screw proximally and distally appears to be as effective as two screws ¹⁶. For distal third femoral fractures, where there is not effective contact between the cortex and the nail, two cross-locking screws are necessary for adequate stability ¹⁴. In mid-diaphyseal Winquist-Hansen type I and II, one screw proximally and one distally is adequate. In type III and IV, using the maximum number of cross screws available in the nail design is advisable ¹⁹. Despite Winquist's recommendations, we currently use static locking for all stable fractures, because there may be a subtle crack not seen in the pre- and post-operative radiographs. To maximize bone apposition we recommend impaction of fracture site in type I and II or AO type A and B ²⁰. We found that distal cross

locking is best accomplished by free hand technique under fluoroscopic control ⁸. Proximal-third, distal-third and unstable fractures are at higher risk for malalignments ^{21,22}.

IM nailing allows early mobilization with minimal scaring of thigh musculature, and early functional recovery can be expected ²³. Early weight-bearing after reamed static interlocked nailing of Winquist type II, III and IV femoral fractures is a safe and effective method, and the risk of implant failure does not preclude the procedure ^{2,10,24,25}. Mobilization out of bed within 24 hours after surgery is allowed. This rapid mobilization and speedy healing leads to obvious economic benefits for the patient. Exchange reamed nailing is the treatment of choice for most cases of femoral diaphyseal nonunion ⁹.

Numerous complications have been cited in the literature for IMN ²⁶. Benirschke reported minimal complications such as screw failure ²⁷. In a systematic overview and meta-analysis by Bhandari, 7% nonunion rate was reported ²⁸, but in our report the rate of nonunion was about 4.41%. The prevalence of infections in Tuzuner's report was 2.38% ²⁹. In our research there was 1.47% infection in 136 cases. In the Jeny report in 744 femoral shaft fractures with 13.4% open fracture the infection prevalence was 3.2% ³⁰ while in our research with 20.66% open fracture, the prevalence of infections was lower than in that report. This infection rate is also lower than Vecsei's report ³¹ in 559 femoral fractures.

Conclusions

With closed nailing of femoral fractures, the duration of union was shorter and prevalence of nonunion was lower than in open method, while the prevalence of external rotation deformity, shortening and angulation was higher in the closed method. Thus, in closed method attention should be paid to malalignment while locking the nail.

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