

Effects of smoking on healing of distal femur intra articular fractures, treated with distal femur locking compression plate

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Abstract

Background: The aim of this study was to identify the effect of smoking on bone healing and other complications encountered in treatment and follow up of distal femur fracture.

Methods: A total of 54 patients with AO type B and C Distal femur fracture were included during the study period. All the patients were treated with distal locking compression plating. Functional outcome was recorded on the basis of American knee society scoring system.

Results: The mean radiological union time and incidence of post-operative infection was significantly higher in smoker as compared to non-smokers. Total American knee society score was similar in both the groups.

Conclusion: Smoking affects the fracture union in distal femur fracture patients. Smokers have more infection rate and more stiffness compared to non- smokers. It is recommended to stop smoking during fracture treatment.

Keywords: Distal Femur Locking Compression plate, Fracture, Union time, Smoking

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Introduction

Distal femur fracture constitutes a heterogeneous group of injuries affecting knee and accounts for approximately 7% of all femoral fracture [1]. Distal femoral fracture can be caused by any high or low energy trauma. High energy trauma are mainly associated with road traffic accidents and occur in younger patients while low energy traumas are due to sudden fall in house and occur in osteoporotic bones of elder patients.

Effective ways of managing most distal femoral fractures are anatomical reduction of the articular surface, restoration of limb alignment, and early mobilization. However the treatment of distal femur articular fracture

is still a challenge for the surgeons as long term disability can occur in patients with extensive articular cartilage damage, marked bone comminution and severe soft tissue injury [2]. Moreover intra-articular step ≥ 3 mm may lead to osteoarthritis [3].

With the conversion of shearing forces into compressive forces at the screw bone interface; anatomically contoured locking plate system reduces the load experienced at the implant [4,5]. Locking plates provides an additional advantage of angular stability of locked screws by which applied load is evenly distributed amongst the component screws and avoids significant load concentration at a single screw bone interface [4,6,7]. This leads to the overall

fixation strength of the locked plate system, equaling the sum of fixation strengths of all screw bone interfaces instead of that of a single component screw as in conventional plating [8].

Voluminous literature [8-10] is available showing good to excellent results of locking plates for the treatment of distal femur fracture however none of study has compared the outcome of patients in smoker and nonsmoker. Since smoking affects the bone union time therefore this study was carried out to assess the long term functional outcome of distal femur fracture treated with locking plates and compared the outcome results among smokers and nonsmokers.

Materials and Methods

A total of 54 patients of distal femur AO type B and C were recruited for the study during 2013 to 2016. Patients with skeletally immature individuals, unfit for surgery any other associated fractures/ head injury open fractures were excluded from the study.

All the fractures were treated with definitive open reduction and internal fixation (ORIF) within 3 days. Patients were positioned supine on radiolucent table. Depending on the fracture classification, a standardized direct lateral and/or medial approach was used for the reduction of intra-articular fragments. After temporary fixation of articular fragments using screws, K-wires, or clamps the locking plate was placed and fixed temporarily using K-wires. The placement of the plate and reduction of the fracture was confirmed under intra operative image intensifier control. Patient was immobilized for 48 hours after removal of drain and progressive range of motion was allowed as per tolerance. Full range of motion was allowed after suture removal. Static and dynamic quadriceps was encouraged throughout the day as far as possible. Partial weight bearing (PWB) was allowed after 6 weeks and full weight

bearing was allowed on the basis of radiological evidence during follow up. Patients with radiographic evidence of delayed union, were given functional brace for support and allowed PWB.

Patients were followed up at the end 6 weeks, 3, 6 months, 1 year and every 6 months up to 4 year. Functional outcome of patients were recorded as per American knee society score on each visit. Radiological union was defined as bridging of three of the four cortices and disappearance of the fracture line on the plain radiographs for a patient who was able to bear full weight.

A person was called smoker who has smoked 100 cigarettes in his or her lifetime and who currently smokes cigarettes as per NHIS Guidelines [12].

Statistical analysis was done using MedCalc Software (Trial Version). Patients were divided into two groups depending upon the smoking status. Mann Whitney U test was applied to see the significant difference in median of scores in two groups. Chi Square test was applied to see the difference in frequency of discrete variables in two groups.

Results

The mean age of patients was 43.72 ± 16.0 years. High and low energy fracture was observed in 29 and 25 patients respectively. 45(83.3%) patients show the good (AKSS 70-79) to excellent (AKSS ≥ 80) outcome in terms of American Knee Society score. One patient showed the poor results (AKSS < 60) whereas 8 patients had fairly acceptable results.

Out of 54 studied subjects 22 were classified as smoker and 32 were as non-smoker. We found no significant difference in median of Pain, range of flexion, stability, flexion contraction and extension lag and total American knee society score among the two groups. However, smokers have

significantly delayed radiological union time (median 16 weeks, Range 12-24 weeks) as compared to non-smokers (median 12 weeks, range 12-20 weeks). Incidence of infection was also observed higher in smokers (27.3%) as compared to non-smokers (6.2%) (P= 0.033).

Discussion

The present study shows the efficacy of Distal Locking Compression plate in the treatment of Distal Femur fracture. The mean radiological union time was 14.56 ± 3.37 weeks in non-smokers and 16.73 ± 3.6 weeks in smokers. Malik et al [3], Schandelmeir et al [13] and Mackmiller et al [14] reported full radiological union at 13.88, 14.3 and 13.8 weeks respectfully. Smokers have delayed radiological union time of distal femur fracture treated with locking plate. Hernigou et al [15] studies the 114 subjects with femur, humerus or tibia fracture and shows that smokers have a higher risk of developing a nonunion after a diaphyseal fracture, whether open or closed. The deleterious effects of smoking on bone healing were also reported in fractures other than femur [16-18]. However Giannoudis et al shows that smoking was not a statistically significant factor for nonunion of the femoral diaphysis [19]. Schenker et al in 2013 [20] conducted a meta-analysis on 18 papers and shows that odds of nonunion was 2.3 times in the smoking group compared to the non-smoking group.

Norepinephrine is released from adrenergic axon terminals within the tissues of smokers. [21] Oxygen perfusion in the

subcutaneous affected tissue declines rapidly and remains low for 30 to 50 minutes [22]. Following smoking inhibition of vascular endothelial growth Factor (VEGF) - induced tube formation occurs, leading to negative effect of smoking on endothelial function and vessel growth and ultimately results in delayed or non-union of the fracture [23].

We observed higher knee stiffness and infection in smoker groups. Similar to our study Castillo et al [24] showed that infection rate was twice in smokers, as compared to non-smokers ($p < 0.05$). Adams [25] shows that more patients in smoking group required bone grafting to stimulate union as compared to nonsmokers. Schenker et al [20] shows no difference in post-operative superficial and deep infections between smokers and non-smokers undergoing long bone fracture surgery.

There are certain limitations of the study. We did not analyze the effect of duration and smoking pack size on the radiological union time and other complications. Secondly the sample size is too small to make any conclusive result.

Further studies on other type of fracture should also be conducted in future to see the effect of smoking on bone union.

Conclusion

Smoking affects the fracture union in distal femur fracture patients. Smokers have more infection rate and more stiffness compared to non-smokers. It is recommended to stop smoking during fracture treatment.

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