

Single Midline Incision Technique for Dual Plating in Proximal Tibial Fractures: An Innovative Approach for Enhanced Fixation

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Abstract

Background: High-velocity trauma causes proximal tibial fractures, which have extensive articular involvement, numerous displaced condylar fracture lines, and soft tissue injuries. Complications are possible with the standard treatment, which is open reduction and internal fixation by a dual midline incision and dual plating. Nevertheless, a single midline incision is sufficient for the procedure. That's why we decided to conduct this intervention.

Objective: To evaluate the effectiveness and outcomes of proximal tibial fracture fixation using a double plating technique through a single midline incision.

Study type, settings & duration: This quasi-experimental study was conducted at Department of Orthopaedic Surgery, PAEC Hospital, Islamabad, from March 2020 to March 2023.

Methodology: Patients, aged 16 or above were enrolled who presented with proximal tibial fracture and underwent dual plating by giving single midline incision. Patients were followed-up and outcomes including infection, union, needed bone grafting, additional split skin graft and flap surgery and others were noted. SPSS version 25 was used to analyse the data.

Results: Total 100 patients were enrolled in the study with the mean age of 44.71 ± 17.88 years. There were 58 (58.0%) male patients and 42 (42.0%) female patients. The mean duration of surgery was 74.11 ± 8.91 minutes. Out of 100 patients, 57 (57.0%) patients had excellent functional outcome, 34 (34.0%) patients had good functional outcome, while 7 (7.0%) patients had fair functional outcome and 2 (2.0%) had poor functional outcome. Out of 100 patients, union achieved in 81 (81.0%) cases. Infection occurred in 2 (2.0%) cases, Knee stiffness in 12 (12.0%) cases, body graft was applied in 1 (1.0%) cases and skin graft and flap surgery was done in 1 (1.0%) cases and deep venous thrombosis in 2 (2.0%) cases.

Conclusion: Dual plating for proximal tibial fracture via single midline is an appropriate method and is more than 90% successful in achieving good to excellent results and can replace other techniques which need more incision and increases the risk of infection.

Key words: Double plating, proximal tibial fractures, single midline incision, union, infection, bone graft, skin graft.

Introduction

It has been noted that the mechanism of damage and the fracture pattern vary with age. This is

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Authors Contribution

DA & SNJ conceptualized the project. DA & MSM did the data collection and performed the statistical analysis. SNJ, MSM & SI did the literature search. Drafting, revision & writing of manuscript were done by KH.

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because the proximal tibia is mechanically fragile at various phases of development in the juvenile skeleton, with the site of the fracture moving more proximally as the child matures.¹ Whether a fracture requires surgery or not depends on the severity of the it and any other problems that may have occurred.^{2,3} Fractures of the proximal tibia are becoming more common in recent years. This is associated with the rise of the automobile use and an ageing population.⁴ The prognosis for fractures of the bicondylar tibial plateau remains dismal, despite recent advances in treatment.⁵

Since extra fixation of posterior column with postero-medial buttress plates, offer the strongest fixation in terms of stabilization of fracture, use of posterior plate with posterior column involvement is becoming a general standard practice.⁶ Bicondylar

tibial fractures are often treated with two-incision dual plating to stabilize the medial and lateral columns. Dual plating enables firm fixation of both tibial condyles, limiting medial collapse, subsequent varus collapse, and double incision improves intra-operative visualization of fracture geometry.^{7,8} Nevertheless, the increased risk of wound complications due to the dissection of large amounts of soft tissue and periosteal damage that occurs when two separate incisions are made.⁹

It is hypothesized that less vitality of bone fragments will occur if two distinct incisions are made for dual plating rather than one large one through the wounded soft tissue membrane.¹⁰ The technical drawback is that this procedure necessitates the formation of a bipedicle flap in a region that is often already damaged. Concern has also been expressed about the single-incision option, which requires both medial and lateral flaps to be raised. Most studies describing the outcomes of dual plating by a single anterior incision are now more than 25 years old, and there has been no large-scale comparison of these two methods.^{11,12} These days, medial and lateral plating are performed by either a single anterior midline incision or through separate anterolateral and anteromedial incisions. These methods, however, do not provide for proper posterior, posterolateral, or posteromedial reduction and fixation. In light of this, many techniques have been established to reduce the posteromedial tibial corner and fix it with a plate and/or screws. There is debate over which method is more effective, but no one seems to agree.^{13,14}

For proximal tibial fracture, dual plating is considered as appropriate method. In routine, dual plating is applied by giving double incision. But it is associated with more complications and infections. We observed that evidence regarding efficacy of single incision surgery lacks in local setting. Therefore, there is a vast need to conduct a study to find the role of single incision surgery for dual plating in proximal tibial fractures in order to improve the practice to lessen down the unnecessary incisions and complications, that may prolong the hospital stay and finance of patient. As a result, we set out to undertake this research to collect data applicable to the area. This would let us collect data on the ground, and in the future, we may use that information to improve our surgical approach, resulting in fewer problems, shorter hospital stays after surgery and higher rates of success and patient satisfaction.

Methodology

This quasi-experimental study was conducted at Department of Orthopaedic Surgery, PAEC hospital Islamabad, from March 2020 to March 2023. The anticipated sample size of 100 patients receiving dual plating through a single midline incision was derived by utilizing the following parameters: 95% confidence level; 5.5% margin of error; and 8.5% infection rate.¹⁵ The patients who fulfilled following selection criteria were enrolled from emergency department by applying non-probability, consecutive sampling technique. Patient's aged 16-75 years, either gender, presented with proximal tibial fracture of schatzker type V and VI were enrolled. Patients with Gustilo - Anderson Type 3 compound proximal tibial fracture, already received similar treatment or previous failed treatment, skeletally immature patients; pathological fractures apart from osteoporosis and patient present after 15 days of fracture, muscular or skeletal dystrophy were not included in the study. Informed written consent was obtained. Demographics like name, age, sex, duration of fracture, lateral side, type of injury (type V or VI) were also recorded. X-ray was performed in all patients before surgery. Then patients underwent surgery by applying single incision and dual plating.

Table 1: Criteria for rasmussen radiologic assessment.

Subjective	Points
<i>A. Articular depression</i>	
Not present	6
<5 mm	4
6-10 mm	2
>10 mm	0
<i>B. Condylar Widening</i>	
Not present	6
<5 mm	4
6-10 mm	2
>10 mm	0
<i>C. Angulation (valgus/ varus)</i>	
Not present	6
<5 mm	4
6-10 mm	2
>10 mm	0
Maximum	18
Excellent	18
Good	12-17
Fair	6-11
Poor	<6

All procedures were done under general anesthesia by a single surgical team with assistance of researcher. After procedure, patients were followed-up and outcomes were noted including good to excellent functional outcome by using Rasmussen criteria (Table-1), bony union, infection,

knee stiffness, needed bone grafting, additional split skin graft, flap surgery and deep vein thrombosis were noted. X-ray was performed in all patients during follow-up after surgery.



Figure: Preoperative x-ray findings.



Figure: Postoperative x-ray findings.

Total hospital stay after surgery was also observed. All the information was gathered by using performa. All the data was entered and analyzed in SPSS v. 25. Descriptive statistic was calculated to present the data.

The ethical approval was obtained from the Institutional Ethical Committee of PAEC General Hospital, Islamabad vide letter no. PGHI-IRB(Dme)-RCD-06-012.

Results

Total 100 patients were enrolled in the study with the mean age of 44.71 ± 17.88 years. There were 58 (58.0%) male patients and 42 (42.0%) were females. Out of 100 patients, 52 (52.0%) patients had fracture of left side while 48 (48.0%) patient had fracture of right side. The mean duration of fracture until presentation of patients was 5.57 ± 3.07 days. Out of 100 patients, 56 (56.0%) cases had type V fracture while 44 (44.0%) cases had type VI fracture (Table-2).

Table 2: Baseline features of patients.

Feature	Mean $\pm$ SD, F (%)
n	100
Age (in years)	44.71 ± 17.88
Gender	
Male	58 (58.0%)
Female	42 (42.0%)
Lateral side	
Left	52 (52.0%)
Right	48 (48.0%)
Duration of fracture (in days)	5.57 ± 3.07
Type of fracture	
Type V	56 (56.0%)
Type VI	44 (44.0%)

Table 3: Outcome of treatment.

Outcome	Mean $\pm$ SD, F (%)
Duration of surgery (min)	74.11 ± 8.91
Functional outcome	
Excellent	57 (57.0%)
Good	34 (34.0%)
Fair	7 (7.0%)
Poor	2 (2.0%)
Union achieved	81 (81.0%)
Infection	2 (2.0%)
Knee stiffness	12 (12.0%)
Need for body graft	1 (1.0%)
Need additional skin graft and flap	1 (1.0%)
Deep venous thrombosis	2 (2.0%)
Total hospital stay (days)	12.60 ± 1.79

The mean duration of surgery was 74.11 ± 8.91 minutes. Out of 100 patients, 57 (57.0%) patients had excellent functional outcome, 34 (34.0%) patients had good fictional outcome, while 7 (7.0%) patients had fair functional outcome and 2 (2.0%) had poor functional outcome. Out of 100 patients, union achieved in 81 (81.0%) cases. Infection occurred in 2 (2.0%) cases. Knee stiffness was noted in 12 (12.0%) cases, body graft was applied in 1 (1.0%) cases and skin graft and flap surgery was done in 1 (1.0%) cases. Deep venous thrombosis was noted in 2 (2.0%) cases. The mean hospital stay was 12.60 ± 1.79 day (Table-3).

Discussion

Bicondylar (Schatzker type V and VI) tibial plateau fractures are complex high-velocity injuries with compromised soft tissue. Most publications suggest dual plating with dual incision or hybrid external fixator.^{16,17} The objective of the treatment remains to achieve anatomical intra-articular reduction, stable fixation with functional range of movement of the knee joint. The degree of soft tissue injury will guide the treatment plan.¹⁸ Methods of treatment include conservative treatment (cast immobilization and functional braces), percutaneous

wires with external fixators or circular fixators (Ilizarov), open reduction, and internal fixation with plating on lateral and medial side also using single or dual incision.¹⁹ The routine protocol remains temporary stabilization, limb elevation, ice compression, till the soft tissue swelling has come down, and plan for dual plating using dual incision.²⁰

Few papers supporting midline anterior approach with dual plating have encouraged us to take up this method of treatment; with limited complications, which is a part and parcel of such injuries.^{17,21} The midline approach has the advantage to provide complete exposure of the fracture pattern by lifting long full-thickness soft-tissue flap which also enables to do fasciotomy of anterior, medial, and also sometimes posterior compartment and achieve dual plate fixation and obtain satisfactory closure also midline incision enables future arthroplasty procedure. The proponents of dual approach have reported lower rates of complications such as infection and wound gapping.^{22,23}

In our study, out of 100 patients, union achieved in 81 (81.0%) cases and 57 (57.0%) patients had excellent functional outcome, 34 (34.0%) patients had good functional outcome, while 7 (7.0%) patients had fair functional outcome and 2 (2.0%) had poor functional outcome. Singhi et al., also found that bony union was achieved at average of 14 weeks (12–20 weeks), 80% patient had excellent and good results. 22% of patient needed bone grafting which was done primarily and 11.1% patient required an additional split skin graft and flap surgery. Deep and superficial infection were seen in 8.5%, knee stiffness (range of motion <90°) in 8.5% and deep vein thrombosis in 0%. Mean hospital stay was 5.6 days.¹⁵ Kumar et al., also conducted a study on dual plating and found that Honkonen Jarvinen clinical outcome to be 86% excellent, 11.7% good and 1.7% fair. There was an 81% outstanding, 13% good, 5% fair, and 1% bad rating for the functional result. Results from radiology were 80.2 percent outstanding, 12.1 percent decent, and 0.7 percent fair. With proper surgical scheduling and an awareness of the anatomy, complications may be reduced, resulting in excellent to good outcomes for all Schatzker type V and VI Tibial fractures treated with dual plating. Nonetheless, 2 cuts were made to insert the plates.²⁴

In our study, we observed infection in 2 (2%) cases, which was later resolved by prescribing oral antibiotics. The disadvantage of dual plating includes extensive soft tissue dissection that may raise the chances of infection, dehiscence at wound site, delay in healing and necrosis.^{25,26} Neogi et al., conducted a trial an applied dual plating. They

observed that superficial infection occurred in 12.5% cases while deep infection in 4% cases.²⁵ Söylemez et al., found that superficial infection with dual plating may occur in 4% cases that was healed with oral antibiotics,⁶ which was double as we observed in our study.

In our study, we observed that patients stayed in the hospital for average of 12.60±1.79 days. Arya et al., also found that the mean hospital stay after dual plating would be around 13.7±2.2 days.²⁷

In our study, knee stiffness was noted in 12 (12.0%) cases, and deep venous thrombosis was noted in 2 (2.0%) cases. An article from Barei et al., which included 83 patients of Type V and VI Schatzker treated with dual incision dual plating followed up over a period of 77 months has reported deep wound infection of 8.4%, septic arthritis of 3.2%, fasciotomy was done in 14.5% of patients, 19.3% patient developed nonfatal deep venous thrombosis, 9% had coronal malalignment, 28% had sagittal malalignment.²⁸ The danger of wound complications is raised by the large soft tissue dissections required for dual plating fixation. Depending on the source, the reported rate of deep wound infection after dual plate fixation ranges from 4.8% to 8.4%. One patient (2.7% of the total) with dual plating had a superficial wound infection, according to Patil et al.²⁹ The 3.12% deep infection rate reported by Neogi et al. was similar to the 3.33% reported by other researchers.³⁰ Just two patients (2.0%) in our research developed an infection. The average final follow-up score on Rasmussen's functional grading scale was 26.75 in yet another research. According to Rasmussen's radiological rating, all patients had either excellent or good outcomes, with a mean score of 8.5. (range 6-10).⁵

In 346 patients, one research assessed the effectiveness of dual vs single incisions. Just 92 patients had been dual-plated, with 41 receiving both plates via single anterior incision and 51 receiving them through separate lateral & medial or posteromedial incisions. The other 254 patients were treated with the single-plate/ single-approach method. There was no statistically significant difference between the single and dual incision groups for deep skin infection (22.0% vs. 23.5%, $s=0.858$) or redo surgery (31.7% vs. 31.4%, $p=0.973$) in these 92 fractures. Comparatively fewer injuries requiring redo surgery (12.2% vs. 31.5%, $p<0.001$) and fewer cases of deep infection (10.2% vs. 22.8%, $p=0.003$) occurred after first treatment with single plating via a single incision.³¹

Dual plating for proximal tibial fracture via single midline is an appropriate method and is more

than 90% successful in achieving good to excellent results and can replace other techniques which need one incision and increases the risk of infection. This would ultimately reduce need for other tools for surgery and risk of adverse event, thus early discharge from hospital that will ultimately reduce the burden from surgeons and hospital.

Conflict of interest: None declared.

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