REVISITING THE SAFE FIXATION IN HIGH GRADE SCHATZKER WITH SOFT TISSUE INJURY

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ABSTRACT

BACKGROUND

Displaced bicondylar tibial platue fractures (Schatzker V and VI) are otherwise known as high grade Schatzker type tibial platue fractures. They are always associated with soft tissue injury which possess a challenge for orthopaedic surgeons due to higher rate of post-operative infections, skin necrosis and wound dehiscence. Circular external fixator is a good option. However, delayed ORIF reduces the chance of infection & maintains articular congruity resulting in better functional outcome.

MATERIALS AND METHODS

We performed a prospective randomised control trial from August 2015 to July 2016 in which delayed ORIF (Group A) were compared with primary circular external fixator (Group B) in bicondylar tibial platue fracture with compromised soft tissue.30 fractures (21 men and 9 women) were randomised to operative treatment (15 Group A, 15 Group B). Outcome measures included Rasmussen functional knee score, clinical complications, hospital stay.

RESULTS

13(92%) anatomical reductions were achieved in group A compared to 11 (76%) in group B. Superficial infections were commonly seen in group B (30%); whereas deep infections leading to plate exposure encountered in 2 cases (13%) in group A. The mean Rasmussen score was statistically significant ($p<.05$) in ORIF group. Patients in group B spent less time in hospital (9.9 days and 23.4 days, respectively; $p = 0.024$). Associated posteromedial/lateral fragment can be better dealt with group A patients.

CONCLUSION

Primary Ilizarov gives better functional results, decreases chance of infection, provides early rehabilitation and negates the requirement of second surgical procedure compared to delayed IF in closed bicondylar tibial platue fracture with soft tissue compromise.

KEYWORDS

Tibial Platue, Delayed Internal Fixation, Primary Ilizarov, Tscherne, Soft Tissue.

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BACKGROUND

High grade Schatzker type tibial platue fractures are displaced bicondylar fractures (Schatzker types V and VI) which typically follow high-energy trauma, is difficult to treat due to the complexity of the fracture configuration and the associated soft tissue injury.[1,2] They are complex intra-articular injuries with implications for articular congruity, cartilage integrity and extra-articular structures.[3] Associated complications include compartment syndrome, soft tissue damage, secondary osteoarthrosis (OA), and persistent knee instability.[4] The incidence has been as high as 50% for joint stiffness[5-9] and the occurrence of postoperative skin infection and osteomyelitis has been reported as 42% and 33%, respectively.[10] The optimal choice of treatment for these fractures remains controversial.[11] Management aims are anatomic reduction of the articular surface, restoration of axial alignment, and stable fixation to prevent secondary displacement of the fracture fragments.[8] A commonly employed technique is open reduction and internal fixation (ORIF), using a plate and screws through either an extended anterior incision or through multiple smaller incisions to preserve the soft tissue envelope. High-energy Bicondylar fractures are often already accompanied by soft tissue damage, and ORIF in this setting is associated with wound complications, e.g., skin necrosis and infection.[12] Soft tissue considerations may also delay operative fixation and/or contraindicate ORIF altogether. In addition, there is evidence to suggest that, once alignment is restored, residual articular incongruity may not impair long-term functional results following these injuries.[13-17]

As the detrimental effects of excessive dissection of the soft tissue envelope and devascularisation of the osseous fragments have become apparent, a number of alternative methods of treatment, including percutaneous reduction and Ilizarov application, minimally invasive techniques and

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implants (MIPO), and temporary external fixation followed by delayed definitive surgery, have been popularized.[18-19] The advantages of circular frame fixation (with or without percutaneous lag-screw fixation) include minimal soft-tissue dissection, the ability to correct deformity in multiple planes, early knee joint motion, the option of spanning the knee joint in cases of concomitant ligament injury, and the possibility of stabilizing more distal fractures with the same device. However, the quality of articular reduction with circular fixation remains unproven.[20] Delayed internal fixation (IF) not only takes care of the soft tissue but also provides the benefits achieved by internal fixation. But the challenge remains in closed fracture with excessive soft tissue damage resulting formation of superficial blebs and haemorrhagic bullies where there is high chance of infection following internal fixation. In the staged procedure following any forms of external fixation which is usually done 10-14 days after primary trauma, not only the chances of wound infection is still high due to high soft tissue exposure, but also to get the accurate articular reduction will be difficult due to considerable delay. Whereas, primary fixation by means of ilizarov with the help of olive wires in multiple planes not only maintains the articular congruity but also reduces the soft tissue related problems, facilitates early mobility and rehabilitation of the patient. However, we found no published studies comparing the results of primary Ilizarov and delayed IF in complex closed Bicondylar tibial platue fracture with compromised soft tissue to determine which method is superior. The aim of the present study was to compare the clinical, radiological & functional outcomes of closed bicondylar tibial plateau fractures with Tscherne grade 2 soft tissue injury treated by primary Ilizarov versus delayed IF.

MATERIALS AND METHODS

We performed a prospective quasi-randomised clinical trial from August 2015 to July 2017 at our department where 30 patients of closed bicondylar tibial platue fracture with Tscherne grade 2 soft tissue injury were divided into two groups. In group A, (n=15) patients underwent delayed IF whereas in group B (n=15) primary Ilizarov fixation was done. The study was approved by institutional research ethical committee. Schatzker type V & VI, soft tissue injury up to Tscherne type 2, external fixation device consisting of only circular frame, internal fixation using MIPO, conventional & dual plating were included in our study. Pathological fractures, associated systemic injuries, >3weeks injury, open fractures, fractures with compartment syndrome requiring immediate fasciotomy, Schatzker type I to IV fractures and external fixators using hybrid frame were excluded. Once the patient arrived in the emergency, the limb was stabilised with posterior POP slab. AP, lateral radiograph of whole leg with knee along with CT scan with 3D reconstruction was done in all cases. All the fractures were classified according to Schatzker classification. Schatzker type VI included 18(60%) cases whereas type V was found in 12(40%) cases. For soft tissue injuries in closed fractures, we used Oestern and Tscherne classification.

Operative Technique for Plating Group

For patients who underwent delayed IF, temporary spanning external fixator applied in 6 cases as soon as the patient became fit for the surgery (preferably on day 1), calcaneal traction in 7 cases and distal tibial traction in 2 cases to heal the soft tissue. While applying temporary spanning external fixator, two 4.5-mm Schantz pins were placed anterolateral in distal femoral shaft, two on the anteromedial aspect of distal tibia. Care was taken to keep tibial pins away from any possible future incision site. The mean time taken for definitive internal fixation was 15 days (10-20 days). The readiness of soft-tissue was determined by appearance of skin wrinkles, reepithelialisation of fracture blisters and reduction of oedema. For internal fixation, MIPO plating (lateral PTCLP) through an anterolateral exposure was done in 11(70%) cases and dual plating (anterolateral PTCLP plus a posteromedial T buttress plate) with 2 separate incisions was done in 4(30%) cases where there was associated posteromedial fragment using standard procedures described by AO/ASIF. Subsequent care of the wound was done as per standard post-operative protocol.

Ilizarov Group

Primary circular external fixator was applied as soon as the patient was fit for surgery from anaesthetic point of view despite the soft tissue conditions. Three ring construct was sufficient for 11 cases where tensioned fine-wires were put at tibial plateau, shaft and distal tibia. In rest of the cases (n=4) where there was knee instability found clinically, after putting three rings one more ring was applied in the distal femur.

Patient was positioned in traction table under spinal anaesthesia. With the help of calcaneal pin, skeletal traction was given to get accurate articular congruity by closed method. As most of the cases were fresh, we were able to get the articular reduction perfectly by means of closed technique. In case of posteromedial fragment, extra stabilization was achieved by olive wire directing posteromedial to antero lateral direction. A small stab incision was given over the fragment with fluoroscopy assistance followed by soft tissue dissection and insertion of olive wire as described above. Thereafter, other wires were inserted. Bone impactors were used through a small stab incision for elevation of the depressed anterolateral fragment. No bone grafts were used in any of our cases. The elevated fragments were stabilised with wires passed from medial and lateral sides as per standard protocol. Rest of the assembly were reconstructed as per standard Ilizarov technique.

Postoperatively limb was elevated strictly with Bohler Braun splint. Immediate quadriceps and knee bending exercise were started. Injectable antibiotics were continued for 5 days followed oral antibiotics in uncomplicated cases. Stich removal was done in day 12. Following internal fixation, patients were mobilized (Non-weight bearing) with crutches for 6 weeks. Partial weight bearing was then commenced, progressing to full weight bearing by 3 months. While in group B, weight bearing was allowed once patient

was free from pain and swelling. Follow up was done for minimum 1 year. Radiographs were repeated at 3, 6, 9 and 12 months. In every follow up patients were evaluated using the Rasmussen functional knee score (RFK), Rasmussen radiological healing score (RRH), superficial and deep infections, time of union, associated posteromedial fragment addressing and hospital stay.

RESULTS

30 patients of bicondylar tibial platue fracture with Tscherne grade 2 soft tissue injury were divided into two groups. In group A, (n=15) patients underwent delayed IF whereas in group B (n=15) primary Ilizarov fixation was done. Males constitute maximum number (n=70% each group) in both the groups (M: F=21:9). Mean age of the patients were 49.43years. (18-84yr). Most common mode of injury in both the groups was RTA (80%). However, there were no significant differences in between the groups in terms of demographic variables, mechanism of injury, or fracture severity and/or displacement. Patients in the circular fixator group had less intraoperative blood loss than those in the IF group (213 mL and 544 mL, respectively; p = 0.006) and spent less time in the hospital (9.9 days and 23.4 days, respectively; p = 0.024). These results were statistically significant. Associated posteromedial fragment addressing can be done optimally in group A (n=4/6 cases) where separate plate was applied to buttress this fragment using separate incision. In group B, posteromedial fragment reduction was achieved by using stab incision (n=5/7 cases). While two patients (13%) in group A had superficial infections, four (30%) developed superficial pin tract infection in group B. Pin track infections were managed by local dressing and antibiotic application in 3 cases. 1 case required admission and a course of injectable antibiotics. Two patients (13%) developed deep wound infection in group A where plate was exposed requiring secondary plastic procedure (flap coverage). There were no cases associated with deep wound infection in group B. The post-operative infection rate was statistically significant (p=0.02) in group B. Radiological outcomes were evaluated using the Rasmussen's score as shown in table 1. Reductions with less than 3 mm of residual depression were achieved in 13(92%) patients in group A and 11(76%) patients of group B. Poor reduction with residual joint depression was noted in two (8%) patients in group A and three (20%) patients of group B. These differences were not statistically significant (Mann-Whitney U-test, p = 0.26). However, condylar widening was not different between the two groups.

In group A, 13 (88%) of them had normal alignment and 2 (12%) had residual varus angulation $>10^0$. In group B, 11(73%) were normal and 4 (26%) were in varus alignment $>10^0$. Using Rasmussen's score, the radiological outcome of bicondylar tibial plateau fractures was determined by scoring system. Score <5 denotes the poorest outcome and score 9-10 denotes the excellent outcome. At the time of final follow-up, four (28%) patients in group A and five (36%) patients in group B showed radiographic evidence of osteoarthritis. In group A, 66.66% (n=10) achieved an excellent result followed by a good result in 13.33 % (n=2) patients. A fair outcome was achieved in just 2 patients and 1 had poor outcome. In group B, 80 % (n=12) achieved an excellent result followed by a good & fair result in 13.33 % (n=2) & 1 patient (6.67%). None had poor outcome. These results were statistically significant. (Table 2) similarly shows the functional outcome achieved amongst the all the patients. 86.67% patients (n=13) had an excellent functional outcome, followed by 13.3 % (n=2) achieving a good outcome. 60% patients (n=9) had an excellent functional outcome, followed by 26.67 % (n=4) achieving a good outcome. One patient had a fair outcome and none of the patients had a poor functional outcome. These results were statistically significant. The mean time of union in group A was 6.2 months and in group B 8.2 months which was not statistically significant (p=0.087).

Criteria	Points
Articular Depression	
None	3
<5 mm	2
6-10 mm	1
>10 mm	0
Condylar Widening	
None	3
<5 mm	2
6-10 mm	1
>10 mm	0
Varus/Valgus Angulation	
None	3
>10°	2
10° – 20	1
>20°	0
Osteoarthritis	
None/no progression	1
Progression by 1 grade	0
Progression by >1 grade	-1
Maximum Score	
Excellent	9-10
Good	7-8
Fair	5-6
Poor	<5

Table 1. Modified Rasmussen Criteria for Radiological Assessment

Grade	Lack of extension (degrees)	Range of movement (degrees)	Varus or valgus instability (degrees)	Walking distance (meters)	Pain
Excellent (all of the following)	0	≥120	<5	≥3000	None
Good (not more than one of the following)	>0	<90	>5	<1000	Mild on activity
Fair (not more than two of the following)	≥10	<75	>5	<100	Moderate on activity or intermittent at rest
Poor (all results worse than fair)					

Table 2: Functional Grading Used in the Evaluation

Results	Group A	Group B	P value
Anatomical reduction	13 (92%)	11 (76%)	0.026
Functional outcome (Excellent)	10 (66.66%)	13 (86.67%)	0.035
Superficial infection	2 (13%)	4 (30%)	0.025
Deep infection	2 (13%)	Nil	
Hospital stay	23.4 days	9.9 days	0.024
Intraoperative blood loss	544 mL	213 mL	0.006
Time of union	6.2 months	8.2 months	0.087

Table 3. Showing the Summary of the Results

Cases Treated with Delayed internal fixation

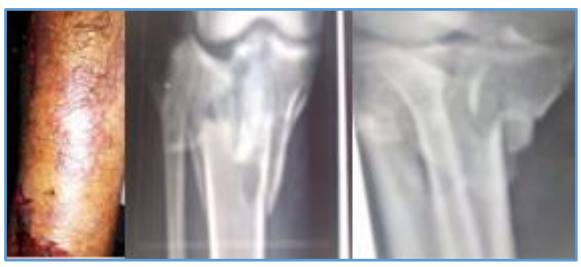

Figure 1

Figure 1. Pre-operative clinical and radiograph of Schatzker Type 6 tibial platue fracture with posteromedial fragment with Tscherne grade 2 soft tissue injury.

Figure 2

Figure 2. Temporary spanning External fixator & calcaneum traction for delaying internal fixation & healing of the soft tissue.

Figure 3

Figure 3. Preoperative radiograph showing healing of blisters. Post –operative radiological and clinical photograph showing optimal fixation and good knee function.

Figure 4

Figure 4. Type 6 Schatzker fracture treated with MIPO PTLCP having optimum functional outcome.

Figure 5

Figure 5. Clinical, radiograph, CT scan and intra operative fluoroscopy showing optimal reduction of Schatzker type 6 tibial platue fracture with good post-operative function of knee joint.

Figure 6

Figure 6. Showing deep wound infection with plate exposure and secondary procedure with adequate function at final follow up.

Cases treated with primary Ilizarov fixator

Figure 7

Figure 7. Clinical and radiographic picture of Schatzker type 6 tibial platue fracture with Tscherne grade 2 soft tissue injury treated with primary Ilizarov having good functional result and union at 6 months.

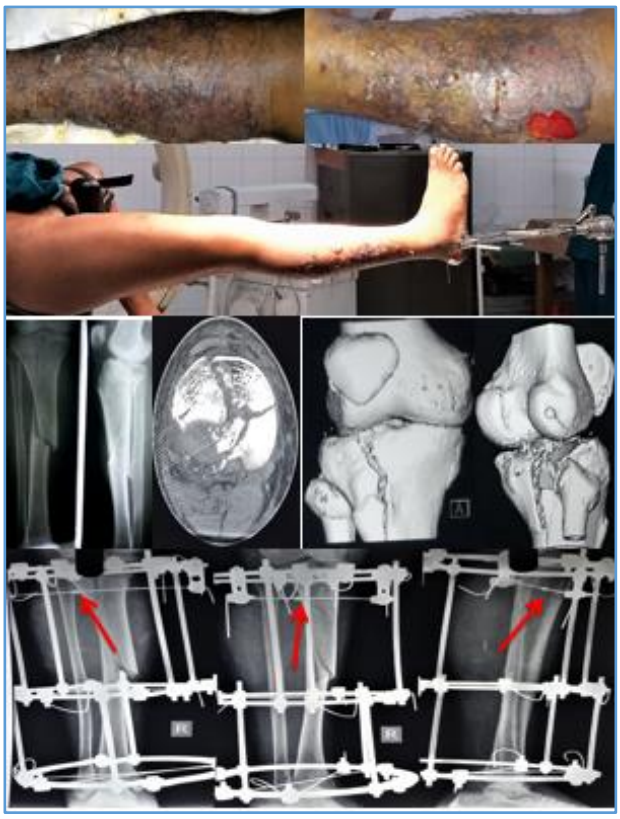

Figure 8

Figure 8. Clinical, preoperative, intraoperative and post-operative photograph showing Schatzker type 6 tibial platue # with compromised soft tissue treated with primary Ilizarov and healing of soft tissue with good function. Olive wires are marked with red arrow which helped to deal with the posteromedial fragment.

DISCUSSION

This study evaluated the outcome of two matched groups of patients with closed bicondylar tibial plateau fractures with Tscherne grade 2 soft tissue injury treated by delayed internal fixation or primary Ilizarov fixation at a single centre. Our results suggest that there is significant difference in the radiological and functional outcome between the patients treated by these two methods. Recently no difference between circular external fixator and internal fixation was reported at two year postoperative period, however because circular fixator results in a shorter hospital stay, a marginally faster return of function and similar clinical outcome and because the number and severity of complications is much higher with open reduction and internal fixation, authors concluded that circular external fixation is an attractive option for high energy fractures.[21] At another study, Jiang et al[22] reported similar outcomes for internal fixation and primary Ilizarov fixation at the treatment of high energy closed bicondylar tibial plateau fractures. However postoperative malalignment incidence was higher at internal fixation group. Present study reported the clinical, radiological scores were statistically significant in delayed ORIF group among two groups however unlike the study by Jiang et al, possibly due to higher incidence of low energy fractures in their study.

Suboptimal fixation with Ilizarov fixation, compared to open reduction groups possibly resulting worse radiological scores. Reflecting the severity of the injury, there was a high percentage of osteoarthritic change in both groups but the requirement for TKR couldn't be assessed due to shorter duration of study. In the present study, we found positive correlation between functional scores and radiological scores. This might clarify questions regarding the importance of quality of articular reduction on the effect of functional outcomes that at short to medium follow-up, osteoarthritis does not develop or progress to have functional importance while malalignment 'varus/valgus', knee stability are probably more important functionally.[23-26] Varus/valgus alignment scoring rather than the degree of articular congruency at Rasmussen radiological scoring system probably resulted a positive correlation with the functional scores at the present study. Articular in congruency and later osteoarthritis development might affect the functional results at longer term follow-up supporting this is, Katsenis et al[27] reported deterioration of the radiological scores 5 years postoperatively compared to 3 years postoperatively while no effect at functional results could be demonstrated.

Although internal fixation has been popular in the past, it is often thought to be associated with a high risk of early wound problems. [12] It is often successful in restoring articular congruity, but further compromises the soft tissue envelope resulting increase chance of deep wound infections. These results were similar to our study. Many case series have highlighted the dangers of wound breakdown and deep infection following ORIF of bicondylar tibial plateau fractures.[12,28,] These problems have persisted, even in modern studies utilizing techniques such as delayed surgery and minimal soft tissue dissection. For example, Baeri et al. reported deep infections in seven (8.4 %) of 83 patients treated with ORIF, each of whom required a mean 3.3 additional operations as a consequence.[29] A number of recent studies have indicated that satisfactory results can be achieved with Ilizarov fixation.[30-32] Ilizarov fixation devices preserve soft tissues and an emerging body of evidence suggests they can achieve lower rates of deep infection.[33,34] It is also associated with less stiffness of the joint and no second operative procedures (for implant removal) are required after wards.[34] Although Ilizarov fixation might risk sacrificing the quality of fracture reduction, reducing the articular congruity, it is uncertain whether this ultimately affects functional outcome.[35] In our study, the functional outcome following Ilizarov fixation was significantly lower as compared to other group. Pooled data from different studies suggests that patients managed with Ilizarov fixation are at greater risk of superficial infection, although other complications (including deep infection) were comparable between the groups.[4] However, in our study, there were pin tract infections which is a well-recognised complication associated with Ilizarov external fixation around the knee. We found no other large study comparing these two treatment methods for closed bicondylar plateau fractures.

Mallik et al (1992) reported on 10 patients with bicondylar plateau fractures, three of whom had been treated with fine wire external fixation.[28] The remainder had been treated with internal fixation. They reported no difference in outcome but had a higher rate of infections in the internal fixation group.

The main drawbacks of the present study are the non-randomised design and the relatively small number of cases and smaller follow up. The authors acknowledge that a longer follow-up period would be preferred to further detect the development of osteoarthritis and the need for TKR.

CONCLUSION

The existing evidence suggests that primary Ilizarov fixation has got superior functional and radiological outcome as compared to delayed IF in closed displaced bicondylar tibial plateau fractures with Tscherne grade 2 soft tissue injury. The overall infection rate is significantly less in Ilizarov group. There was no need of second surgery like implant removal to be required in these patients and the duration of hospital stay was also significantly less resulting early rehabilitation. However, the mean union time was also less in delayed IF. Importantly, primary Ilizarov fixation offers clear advantage over IF in terms of avoiding soft tissue complications as it can be applied even if there are haemorrhagic blisters or bullae. There is also substantial decrease in the chance of deep infection which can augment its beneficial effect on the functional outcome. As primary Ilizarov can provide better functional outcome, lesser deep infection, decreases soft tissue related complications, promotes early weight bearing and rehabilitation it can be considered as an alternative to delayed IF in closed bicondylar tibial platue fracture with soft tissue compromise.

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