Use of Skeletal Traction in Distal 1/3rd Tibia Intraoperatively for Achieving Reduction in Proximal Tibia Fracture

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Abstract

Introduction: Skeletal traction is a technique used to manage fractures by applying continuous axial force directly to the bone through a pin inserted through it. This method is particularly useful in maintaining proper alignment of fracture fragments, reducing pain, and preventing muscle spasms. It is commonly employed in the management of long bone fractures, such as those of the femur, especially when immediate surgical intervention is not possible. Skeletal traction stabilizes the fracture, facilitating proper healing and often serving as a temporizing measure before definitive surgical fixation. This study focuses on skeletal traction applied for the reduction of proximal tibia fractures. Studies on this subject are lacking as most established data focuses on its use for shaft femur fractures.

Materials and Methods: This study was conducted in a tertiary care teaching hospital by a single skilled surgeon team on 30 skeletally mature patients. Skeletal traction was applied for each patient using a Steinmann pin and 15% of the patient body weight over distal 1/3rd tibia shaft immediately post-trauma for 1 week and continued intraoperatively during primary fixation as plating. Pre-operative and post-operative radiographs were taken. Knee range of motion was measured using a goniometer at 2 weeks, 1 month, 3 months, and 6 months post-operative. Serial radiographs were taken immediately, 1 month, 3 months, and 6 months post-operative.

Conclusion: Skeletal traction applied over the distal 1/3rd shaft tibia shows promising results for comminuted proximal tibia fractures. It reduces fracture fragment displacement commonly occurring during manual traction.

Keywords: Skeletal traction, proximal tibia, tibial fractures, lower extremity trauma.

Introduction

The increasing trend of high-velocity trauma such as road traffic accidents or sports-related injuries demands more accurate articular alignment in proximal tibial fractures due to comminuted fracture pattern to prevent the early onset of osteoarthritis of the knee [1]. It is highly challenging to treat tibial plateau fractures with intra-articular extension. The barriers to healing are further exacerbated by osteoporosis, compartment syndrome, advanced age, and comorbidities. Hurdles faced by surgeons in this regard are complicated ligamentous stability, difficult weight-bearing biomechanics, and complex articular congruency. No single best method for such high-velocity tibial plateau fractures had well-established data. Early knee mobilization has been made possible by open reduction and stable internal fixation, which serve to maintain the articular surface and restore mechanical alignment [2]. However, open reduction and internal fixation procedures damage soft tissues, and wound infection rates are generally high [3]. To counteract the effects of the forces causing the malformation, traction is frequently administered to a specific area of the body. The traction should just work on the deformity and not the entire body to be effective. We need a force that acts in the opposite direction to counteract the effect on the entire body known as countertraction [4]. Traction is a definite treatment for fractures and dislocations of the joints when used properly. Traction is a crucial orthopedic first aid technique that should be used in conjunction with splinting and closed reduction until final fixation can be completed [5].

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Figure 1: Case 1 Proximal tibia fracture radiographs anteroposterior and lateral views (a, b), with traction (c, d), post operative (e,f)

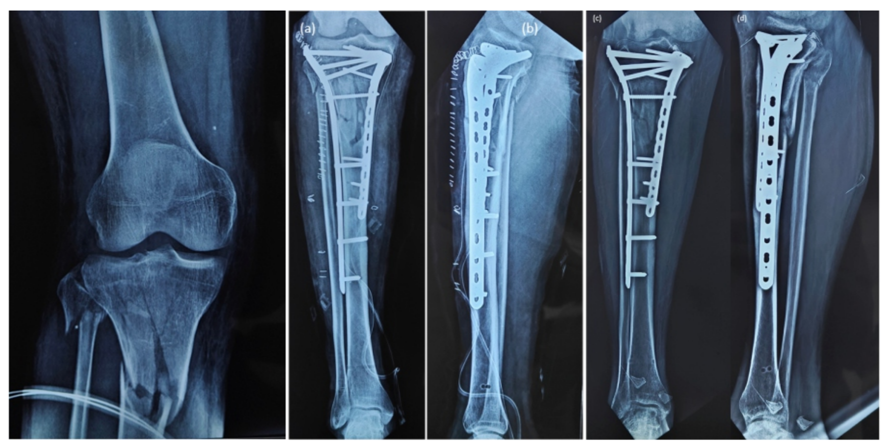

Figure 2: Case 2 Proximal tibia fracture anteroposterior radiograph, post operative day 1 (a,b), post operative 3 months (c,d)

Manual traction has drawbacks, though. Since the force is exerted manually, there may be differences in its strength. In addition, the amount of traction that is given varies from person to person [6].

Materials and Methods

This study was conducted in a tertiary care teaching hospital from December 2022 to February 2024 where 30 skeletally mature patients with proximal tibia plateau fractures were treated with distal tibia skeletal traction followed by open reduction internal fixation with plating while continuing intraoperative skeletal traction. Patients who were diagnosed with proximal tibia plateau fractures on radiographs, who were skeletally mature, and who consented to the study were included in the study. Patients who did not consent to the study, had compound fractures, distal 1/3rd tibia fractures, and had neuromuscular disorders and/or palsy were excluded from the study.

Pre-operative radiographs (Fig. 1, Fig. 2, Fig 3) were taken to diagnose the fracture pattern. Percutaneous insertion of a Denham's pin or a Steinmann's pin into the distal tibia is done to provide skeletal traction under all aseptic precautions. Medial to the lateral pin was inserted 5 cm proximal to the medial malleolus. Bi-cortical purchase taken. Weight approximately 15% of the patient's body weight applied using a water bag and suspended with a Bohler Braun splint, fixed with a Bohler stirrup. This was undertaken on post-trauma day 1. Radiographs post-traction were taken (Fig. 1). Skeletal traction was maintained for 1 week after which primary fixation with plating was done. Waiting period also allowed for swelling to relatively subside allowing for better results of open reduction. Application of skeletal traction intraoperatively allowed for the prevention of loss of reduction of fracture fragments often seen with manual traction.

Bipillar plating with open reduction was done as primary fixation after 1 week, under all aseptic precautions, and under adequate anesthesia using anteromedial and anterolateral approaches. Articular congruity was checked under C arm guidance and found to be satisfactory. The stability of fixation

Figure 3: Case 3 Proximal tibia fracture anteroposterior radiograph (a,b), post operative day 1 (c,d)

Figure 4: Case 1 (a, b) Range of motion of knee joint at 3 months post-operative.

Figure 5: Case 2 (a, b) Range of motion of knee joint at 3 months post-operative.

was checked under live C arm shoot and found satisfactory. A thorough wash was given, the skeletal traction pin was removed and closure was done in layers.

Post-operative patients were started on knee range of motion exercises with static quadriceps and dynamic quadriceps strengthening. Static quadriceps strengthening was started immediate post operatively. Patients were recommended to start active straight leg raising followed by passive knee flexion under influence of gravity in raised leg position. Bedside sitting started from post operatively day 2, with patients advised on assisted dynamic quadriceps strengthening and shifted to dynamic strengthening within 3-4 days. Nil weight bearing followed by partial then full weight bearing done dependent on union visible of follow-up radiographs usually at immediate post operative, 1.5-2 months and 3-3.5 months respectively.

Post-operative radiographs were taken immediately, 1 month, 3 months, and 6-month postoperatively. Range of motion documented using goniometer at 2 weeks, 1 month, 3 months, and 6 months post-operative.

Results

The average intraoperative time of the procedure was 1 h 48 min from incision to closure. All cases showed union at 3-month post-operative, documented by radiographs (Fig. 4, Fig. 5, Fig 6). All cases regained functional knee range of motion up to 120° at the end of 3 months. One case had a surgical site infection treated with 2 weeks of intravenous (IV) analgesics according to the culture sensitivity report. Patients were started on partial weight bearing at 6–8 weeks followed by full weight bearing at 3–3.5 months. One case presented with secondary valgus displacement at 2-month post-operative (Fig. 4).

Discussion

It is challenging to treat comminuted or complicated tibial plateau fractures [7]. The intraoperative time required in plateau fracture plating can be reduced with the use of skeletal traction, cutting back the time used for attaining reduction and joint surface congruity [8].

Current studies focus on the type of plating and approach to plateau fractures [9, 10]. With distal tibial skeletal traction, there is scope to in aid for reduction of fracture fragments no matter the approach or type of plating employed. This would aid greatly in the disimpaction of fracture fragments and would reduce the operative time for conventional as well as novel techniques for plateau fracture fixation.

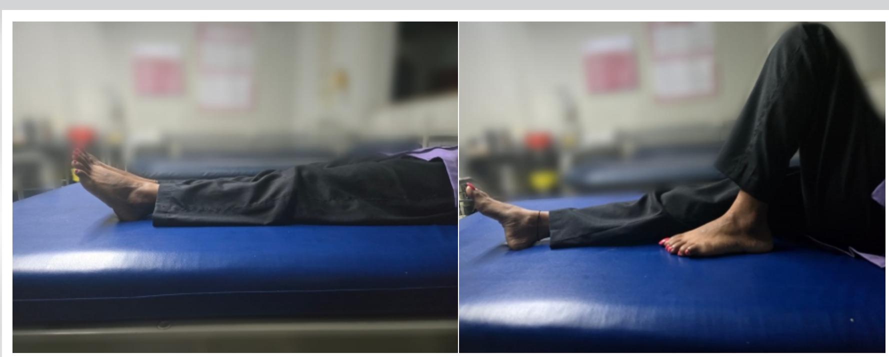

Figure 6: Case 3 (a, b) Range of motion of knee joint at 3 months post-operative.

Acute compartment syndrome is a major risk factor for high-energy tibial plateau fractures [11]. A number of clinical, radiological, and demographic variables that are linked to the development of compartment syndrome following a tibial plateau fracture should be known to clinicians. Emergent decompressive fasciotomies are required if compartment syndrome is diagnosed [12]. The course of treatment and certain aspects of post-operative care are complicated by fracture fixation. There is still debate over the best time for fixation and soft-tissue closure in these complicated fractures, and deep surgical site infections are a frequent consequence [13]. Using skeletal traction for the disimpaction of proximal tibia fractures would allow the management of compartment syndrome or impending compartment syndrome while also providing relative stability of fracture fragments and preventing the worsening of condition. With skeletal traction, the choice of definitive fixation remains open and the surgeon can opt for external fixation if surgical site infection remains a viable concern.

Femoral distractors have been engaged for the distraction of articular fragments in tibia plateau fractures [14]. They are, however, a more extensive procedure with a steeper learning curve and more surgeon's skill required when compared with distal tibial skeletal traction using a single Steinmann on Denham pin. Availability may also be an issue in remote places or under acute circumstances when skeletal traction can be done in an emergency.

One of the most common complications of tibial plateau fracture remains blood loss during operative procedure [15], routinely managed by tranexamic acid, IV, or topical. For tibia plateau fracture the longer intraoperative time contributes further to increased blood loss due to extensive exposure required for plating. The majority of this intraoperative time could be shortened with aid in reduction in the form of skeletal traction utilized both preoperatively and intraoperatively.

Conclusion

Skeletal traction over the distal 1/3rd shaft tibia for aid in the reduction of proximal tibia fractures is a beneficial procedure which would reduce intraoperative time, thereby reducing complications associated with the same such as increased blood loss. It allows the surgeon to opt for external fixation if compartment syndrome or impending compartment syndrome is suspected in the patient. It would also allow simultaneous management of compartment syndrome providing relative stability to the fracture site. This is however a small-scale study, done in a single institution. Further larger-scale studies need to be conducted for further evidence along with comparisons with primary fixation with external fixation or the use of a femoral distractor for the distraction of articular fragments. Distal 1/3rd tibia shaft skeletal traction remains.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given his consent for his images and other clinical information to be reported in the Journal. The patient understands that his name and initials will not be published, and due efforts will be made to conceal his identity, but anonymity cannot be guaranteed.

Conflict of Interest: NIL; **Source of Support:** NIL

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