

Internal Fixation of Patella Fractures Using Cannulated Cancellous Screws with Anterior Tension Band Wiring

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Abstract

Aims: To evaluate the effectiveness and safety of anterior tension band wiring technique using two cannulated cancellous screws in patients with transverse (AO34-C1) or transverse with mildly comminuted (AO34-C2) patellar fractures.

Materials and Methods: This was a prospective study of 25 patients with transverse fracture or transverse fracture with mildly comminuted patella fractures. All the patients were treated with open reduction and internal fixation using two parallel cannulated screws and 18G stainless steel wire as per the tension band principle.

Results: There were 16 males (64%) and 9 females (36%). The age group ranged from 24 to 58 years, with mean age of 38 years. The most common mode of injury was RTA (72%)

Transverse fracture was present in 72% and transverse fracture with mild comminution in 28% of patients. Mean time to achieve union was 12.4 weeks (range 8-12 weeks). Mean ROM at

three months was 118.3 degree (90-130) and at final follow up this improved to 130.3 degrees (range 100-140). There was one case of knee stiffness and no case of implant failure was observed. Patients were evaluated using Bostman scoring, the mean score at three months being 24.3 which improved to 26.4 at the end of final follow up at one year.

Conclusion: Cannulated cancellous screws with anterior tension band wiring is a safe, reliable and reproducible method in management of transverse patellar fractures, with less chances of implant failure and soft tissue irritation.

Key Words: Patella, transverse fracture, open reduction, cannulated screw, anterior tension band

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I. Introduction

The patella plays an important role in knee joint motion. Patellar fractures are mostly seen in the age group of 20-50 years, comprising about 1% of all skeletal injuries^{1,2}. To preserve the range of knee motion adequate management followed by aggressive post-operative rehabilitation is mandatory. Undisplaced fractures are usually managed by immobilizing the limb in a cylindrical cast and allowing mobilization provided the extensor mechanism is intact. However, the displaced patellar fractures are usually managed surgically to minimize the risk of developing post-traumatic arthritis³, necessitating open reduction. The surgical management of patellar fractures has evolved over the years from simple cerclage wiring to tension band wiring (TBW)⁴. Cancellous screws have also been used in the management of transverse patellar fractures, with high failure rates compared to modified tension band wiring. The addition of anterior tension band wiring with the cannulated cancellous screws has added strength to the construct.

The revolution in the management of patellar fractures was brought on with the introduction of tension band wiring in 1950s, which was further modified by adding Kirschner wires (K-wires) to the construct to increase its strength, allowing early mobilization and rehabilitation. The K-wires may protrude at times leading to soft tissue irritation, thus hindering the range of knee motion. The sharp ends of the K-wires distally may hinder kneeling, thus hampering certain religious activities which require kneeling during praying in the Indian population. To overcome these shortcomings a new technique has evolved replacing the K-wires with cannulated cancellous screws. The screws act as lag screws compressing the fracture site. Mechanically, the addition of the screws to the tension band techniques reduces fracture separation by providing compression throughout the range of motion and by resisting the tensile loading during terminal extension⁵. The construct has been proved to be mechanically stronger than modified tension band in various biomechanical studies pioneered by Burvant *et al*⁵ and followed by Carpenter *et al*⁶ and Cekin *et al*⁷. Various clinical studies have also confirmed these findings.

II. Materials And Methods

This was a prospective clinical study of 25 patients enrolled after obtaining institutional ethical clearance. All the selected patients were informed about this new surgical technique and formal consent was obtained. Of the 25 patients enrolled, Sixteen were males (64%) and nine females (36%). The average age in our study was 38 years (range 24-58 years) The left knee (72%) was involved more frequently than the right (28%). Most common mode of injury was RTA (72%), followed by fall (20%) and violent quadriceps contraction (8%). Transverse fractures without comminution (AO 34-C1) were present in 18 patients (72%) and transverse fractures with mild comminution (AO 34-C2) were present in seven patients (28%). Under tourniquet control a longitudinal midline incision was used to open the fracture site. The retinacular tears were identified. The joint was irrigated and debrided of irreparable bone fragments. The fracture fragments were anatomically reduced and held using reduction clamp or towel clips. Articular congruity was assessed by digital palpation through the retinacular tear and confirmed on fluoroscopy. Two parallel guide wires were passed and their position checked under image intensification. After confirming the screw size, the screws were passed over the guide wires in antegrade or retrograde direction after drilling the fracture fragments. The guide wires were removed and an 18G stainless steel wire was passed through the cannulated screws and crossed over the anterior aspect of the patella. The wire ends were tightened with the knee in full extension. The articular surface was evaluated by palpating the articular surface through the retinacular defect and by fluoroscopy. To compress the fracture site the wires were sequentially tightened both medially and laterally. Final stability of the construct was tested by taking the knee through the range of motion. Finally the soft tissues were repaired including capsule and extensor mechanism and the wound closed and the knee immobilized in a hinged knee brace in extension. Early physiotherapy comprising of passive ROM in a hinged knee brace set at 0-30 degree were started on the second post-operative day. Static quadriceps and hamstring setting were taught and weight bearing using crutches allowed as tolerated. Gradually the ROM was increased up to 90 degrees by the second week and increased as tolerated by the patient.

The patients were followed up at two and six weeks, three months and one year. Both clinical and radiological assessments were done for fracture healing and functional recovery (Figure 1, 2,3,4). Radiological union was established when the bony trabeculae crossed the fracture line. Patients were evaluated using the Bostman scoring.

III. Results

Mean time to achieve radiological union was 12.4 weeks after the surgery (range 8-14 weeks). Mean ROM at three month follow up was 118.3 (range 90-130- degrees) and at the final follow up at one year was 130.3 degrees (range 100-140 degrees). The mean Bostman score at three months was 24.3 which improved to 26.5 at the end of final follow up at one year.

COMPLICATIONS

Four complications were observed. Three patients had superficial wound infection which subsided with meticulous wound care and antibiotic administration. One had knee Stiffness which improved over a period of six months with physiotherapy. No case of loss of reduction, implant migration or soft tissue irritation was observed.

Figures 1 and 2



Postoperative (A) anteroposterior and (B) lateral radiographs.

Figure 3 and 4



Post operative Anteroposterior(A) and Lateral (B)

IV. Discussion

The application of cannulated cancellous screws with anterior tension band wiring is a relatively new technique in the management of transverse patella fractures. The first biomechanical study was done by Burvant *et al*⁵ who compared five methods of fixation of patella fractures including modified TBW, anterior tension band with supplemental cerclage wiring (Pyrford technique), anterior tension band with cannulated cancellous screws, Pyrford technique with cancellous screws and cancellous screws alone. The technique of tension band with screws performed significantly better than the modified tension band. The second biomechanical study done by Carpenter *et al*⁶ compared the mechanical effectiveness of three different techniques for stabilization of transverse fractures of the patella (a) modified tension band (AO technique); (b) two parallel 4.5-millimeter interfragmentary lag screws; or (c) a new technique using four-millimeter cannulated lag screws with a tension band wired through the screws. Fractures stabilized with a modified tension band were found to displace

significantly more than those fixed with screws alone or screws plus a tension band in simulated knee extensions ($p < 0.05$). The fractures fixed with the cannulated screws plus the tension band failed at higher loads (mean = 732 newtons) than those stabilized with screws alone (mean = 554 newtons, $p = 0.06$) or those with a modified tension band (mean = 395 newtons, $p < 0.05$). The clinical study by Malik and Halwai⁸ with a larger sample size, also confirmed the findings of the above mentioned studies. Chiang⁹ performed this technique arthroscopically and concluded that this was a safe and reproducible method for transverse patellar fractures.

In our study the males outnumbered the females. The most common mode of injury was RTA and the more common side involved was the left. Majority of fractures (72%) were simple fractures (AO 34-C1). The average time to achieve radiological union was 12.4 weeks. The average ROM at three months was 118.3 and the average Bostman score being 24.3. At the final follow up at one year average ROM improved to 130.3 and the average Bostman score being 26.5. No cases of implant failure, implant migration or soft tissue irritation were observed. One patient developed knee stiffness which improved over six months with useful range of motion regained. This relatively new technique is a good alternative to modified tension band wiring. The construct being biomechanically stronger allows early useful range of motion, with less chances of implant failure and soft tissue irritation, thus minimizing the need for a second surgery.

V. Conclusion

Cannulated cancellous screws with anterior tension band wiring is a safe, reliable and reproducible method in the management of transverse patellar fractures, with less chances of implant failure and soft tissue irritation with early rehabilitation. This procedure is thus a good alternative to modified tension band wiring

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