CPQ Orthopaedics (2018) 1:2
Research Article

# Tension-Band Fixation of Transverse Fracture Patellar Assisted with Cannulated Cancellous Screw - A Study Evaluation

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Received: 13 May 2018

Published: 28 May 2018

**Keywords:** *Transverse Fracture Patella; Tension Band Wiring (Tbw); Cannulated Cancellous Screw*

## Abstract

**Background**

Patella fractures account for approximately 1% of all skeletal injuries. The treatment of patellar fractures has undergone many changes in operative methods. Modified Tension Band Wiring Technique is gold standard but now a days Tension Band Fixation with Cannulated Cancellous Screw is well practicing. This study is directed towards the clinical evaluation of Tension Band Wiring Fixation Assisted with Cannulated Cancellous Screw for treatment of transverse fracture patella.

**Methods**

Patella fractures account for approximately 1% of all skeletal injuries. The treatment of patellar fractures has undergone many changes in operative methods. Modified Tension Band Wiring Technique is gold standard but now a days Tension Band Fixation with Cannulated Cancellous Screw is well practicing. This study is directed towards the clinical evaluation of Tension Band Wiring Fixation Assisted with Cannulated Cancellous Screw for treatment of transverse fracture patella.

**Observation & Result**

Subjective complaints and objective deficiency were recorded accordingly with other necessary parameter for evaluation of study during follow up. All patients healed within 4 months of operation. There was no reputation of soft tissue irritation, implant loosening or failure. According to Bostman *et al.* scoring system 20 cases (83.3%) achieved excellent result, 3 (12.5%) patient showed good result. 1 (4.2%) patient with infection that controlled with judicious use of antibiotic showed unsatisfactory resultz.

**Conclusion**

This study suggested that among the multiple option for the treatment of transverse fracture patella Tension Band Wiring Assisted with Cannulated Cancellous Screw technique is one of the standard method for this orthopedic condition.

## Introduction

The patella plays an important role in knee joint motion. Patellar fractures are mostly seen in the age group of 18-50 years, comprising about 1% of all skeletal injuries [1]. To preserve the range of knee motion adequate management followed by aggressive post-operative rehabilitation is mandatory. Patellar fractures may be displaced or undisplaced. Undisplaced fractures are usually managed by immobilizing the limb in a cylindrical cast and allowing mobilization as tolerated by the patient provided the extensor mechanism is intact [2,3]. However, the displaced patellar fractures are usually managed surgically to minimize the risk of developing post-traumatic arthritis [4].

Displaced transverse fracture patella is usually associated with tears of medial or lateral retinacular expansions. If the extensor retinaculum is torn as well the quadriceps muscle displaces, the superior fragment pulls proximally, making adequate reduction of patella fragments impossible by closed means and necessitating operative treatment [5].

Historically the treatment of patella fracture has undergone many changes in operative methods. In 1950's, the principle of using a modified tension band technique for treatment of patella fracture was first proposed and then subsequently recommended primary treatment [6]. But this technique still has few short comings risk like loosening, migration of k-wire, skin irritation and direct inter fragmentary compression cannot be achieved with k-wire [7,8]. To overcome these shortcomings, several surgeons adopted cannulated cancellous screw tension band wiring technique in treating patella fractures. The advantage of cannulated screw tension

band construct is lesser degree of implant irritation, inter fragmentary compression prevent fracture fragment from sliding apart, better fracture union and permit early motion [9].

## Materials and Methods

A prospective study was designed to evaluate the above title outcome from January 2014 to December, 2017 in different Medical Center of Kishoreganj, Bangladesh. 24 patients with displaced transverse fracture patella were included in this study. Inclusion criteria are simple transverse patella fractures. Exclusion criteria are patients medically unfit for surgery, undisplaced fractures, patients aged less than 18yrs and over 50 years, comminuted fractures. Radiographs including skyline view were taken for confirmation of diagnosis. Initial treatment started with immobilization of limb by long leg back slab. Operations were done at a later after subsiding acute swelling. If abrasions were present in the skin they were cleaned, dressed and antibiotics given. Patients were prepared for surgery during this period and were taught static quadriceps drill and straight leg raising exercises. All patients underwent open reduction and internal fixation with 4mm cannulated screw with tension band wiring through it. Surgery was performed under spinal anaesthesia in supine position with the help of tourniquet to ensure bloodless field. The fracture was approached through anterior longitudinal incision. After dissecting the subcutaneous tissue, exposure of patella and its sides was done. The fracture fragments were examined, edges were freshened and fracture hematoma was removed and a thorough wash was given with normal saline. With the knee in extension, two large towel clip were used to reduce the fracture fragments and the articular surface congruity were evaluated by palpation. After confirming the articular congruity, two thin k-wires were drilled from the lower pole to the superior pole of the patella or vice versa in parallel fashion, with a 2cm space between two k-wires and a 5mm to 10mm distance from the patellar articular surface. A cannulated drill pit was drilled along the k-wire and after measuring its depth, a 4mm cannulated screw was inserted along the k-wire from smaller fragment to larger fragment, the screw head remained out of patella cortex, and the proximal head of the screw should be close to, or embedded within the patella. The second cannulated screw also similarly inserted and the screw were alternately tightened. The k-wires were removed and a 20-gauge stainless steel wire is passed in a figure of eight fashion through the two cannulated screws, the wires were tensioned with the help of a wire tensioner and the tips of the wire is buried in the soft tissue. It should be noted that cannulated screw length should be 4-8mm shorter than the primary measurement. This allows the sharp tip of the screws to be buried in proximal patella without direct contact and the cutting of the tightened wire. The extensor tendon and the retinaculum were repaired with absorbable sutures with the knee in approximately 45° flexion. The tourniquet was let down, meticulous hemostasis achieved and wound closed in layers. With sterile dressing compression bandaged was applied.

Early physiotherapy comprising of passive range of movement with flexion and extension movement from 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 discharged after two weeks and advices to attend for 1st follow up after one month and then every 3 months' interval upto 10 months for observation and outcome of the operation. Both clinical and radiological assessments were done for fracture healing and functional recovery. Loss of fixation was

defined as a gap at fracture site more than 3mm or articular step more than 2mm. Radiological union was established when the bony trabeculae crossed the fracture line. Patients were evaluated and graded with the criteria of Bostman *et al.* [10].

## Observation

24 cases of transverse fractured patella were treated in patients between the age group of 18-50 years by the tension band fixation assisted with cannulated cancelloous screw. Special attention was given to mobilize the knee early as it helps to regain the quadriceps power. All the cases had pain during the first 2 weeks. 20 cases had not experienced pain after 2 months. 3 cases complaints of mild pain at the end of 2$^{nd}$ months. 1 cases experienced persistence of pain even after the end of 2$^{nd}$ months.

During the first month mild to moderate swelling was present in all cases. At the end of 2$^{nd}$ month none of the cases had noticeable swelling. 3 cases had mild to moderate difficulty in squatting. But getting up from the squatting position was not difficult and one patient was unable to squat.

***Table 1:*** *Subjective complaints following tension band fixation with cannulated cancellous screw in patellar fracture*

| Complaints | Number of Cases | Percentage |
|---|---|---|
| **Pain** | 4 | 16.6 |
| **Mild Difficulty in aquatting** | 4 | 16.6 |
| **Difficulty in climbing stairs** | - | - |
| **Difficulty in stepping down stairs** | - | - |

3 cases had limitation of flexion of only 20° at terminal stage of knee flexion and one case had flexion <120° and so 4 cases had limitation of knee flexion. All the other 20 cases completed almost full range of knee movement. 3 cases had upto one centimeter of muscle wasting and one patient had wasting upto two centimeter. Early and effective physiotherapy is essential to overcome the limitation of knee movement.

Quadriceps strength was graded 0-5 from no muscle activity to full strength. It was assessed by comparing with the normal side. In this series 4 cases hand grade-4 strength. All the other cases had grade-5. Patient co-operation and physiotherapy plays important role for the recovery of muscle power and function on knee joint. None of the patient's hand extension lag.

***Table 2:*** *Objective deficiency after tension band wiring with cannulated cancellous screw*

| Deficiency | Number of cases | Percentage |
|---|---|---|
| **Limitation of flexion** | 4 | 16.6 |
| **Quadriceps wasting of 1cm** | 4 (n=3, upto 1cm & n=1, upto 2cm) | 16.6 |
| **Quadriceps power of grade-4** | 4 | 16.6 |
| **Extension lag** | None | None |

## Results

In this series 24 patient were included in where 14 cases were fracture patella of right side and 10 patients were in left. Out of 24 patients 19 were male and female were 5 in number. Mechanism of injury were predominantly indirect quadriceps tendon injury in case of 18 patients, direct trauma in 4 and road traffic accident in 2 cases. 1 patient with diabetes mellitus developed infection but control with antibiotic therapy showed poor outcome. Final assessment was designed and graded as excellent, good and unsatisfactory with the criteria according to Bostman *et al.* [10].

***Table 3 :*** *Details of the clinical grading scale of Bostman et al.*

| Variable | Points |
|---|---|
| **Range of movement (ROM)** | |
| Full extension and the ROM>120° or within 10° of the normal side | 6 |
| Full extension, movement 90° to 120° | 3 |
| **Pain** | |
| None or minimal on exertion | 6 |
| Moderate on exertion | 3 |
| In daily activity | 0 |
| **Work** | |
| Original job | 4 |
| Different job | 2 |
| Cannot work | 0 |
| **Atrophy, difference of circumference of thigh 10cm proximal to the patella** | |
| <12mm | 4 |
| 12 to 25mm | 2 |
| >25mm | 0 |
| **Assistance in walking** | |
| None | 4 |
| Cane part of the time | 2 |
| Cane all the time | 0 |
| **Effusion** | |
| None | 2 |
| Reported to be present | 1 |
| Present | 0 |
| **Giving way** | |
| None | 2 |
| Sometimes | 1 |

| | |
|---|---|
| In daily life | 0 |
| **Stair-climbing** | |
| Normal | 2 |
| Disturbing | 1 |
| Disabling | 0 |
| **Total score** | |
| Excellent | 30 to 28 |
| Good | 27 to 20 |
| Unsatisfactory | <20 |

According to criteria of Bostman *et al.* final outcome of the study shows that 20 cases (83.3%) case achieved excellent result and 3 cases (12.5%) showed good and 1 case (4.2%) gained unsatisfactory result.

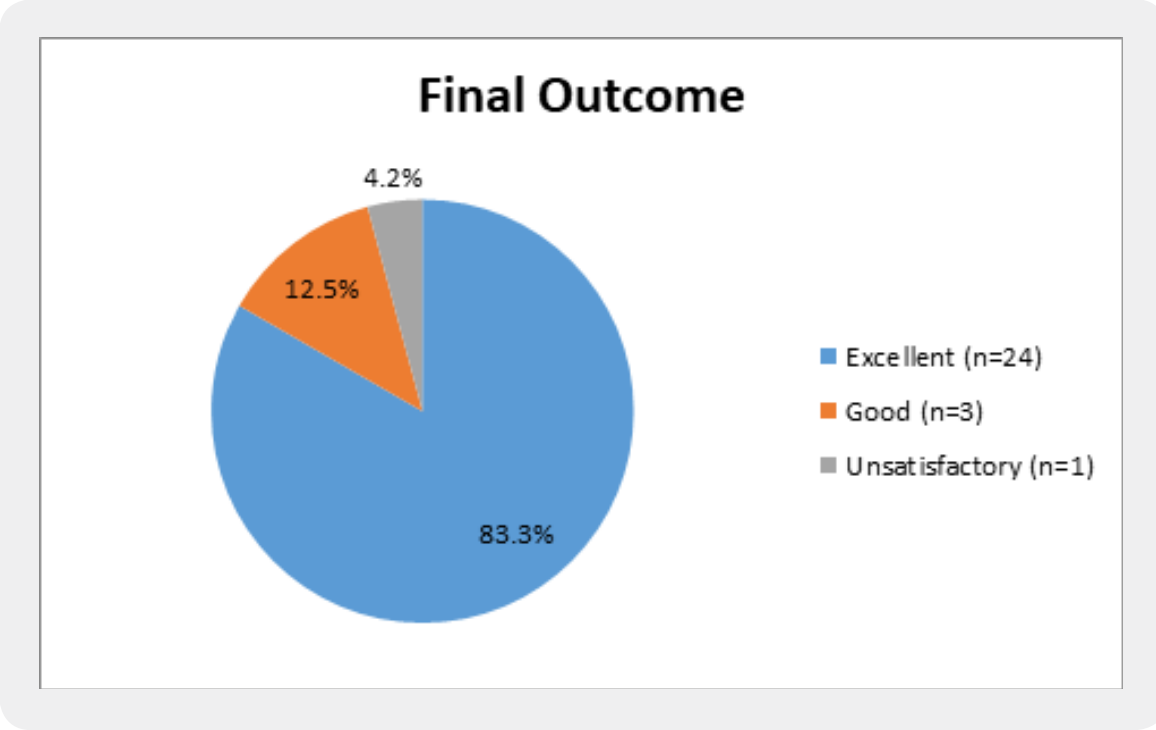


***Figure 1:*** *Final outcome of the study*

## Discussion

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.* [11] who compared five methods of fixation of patella fractures including modified TBW, anterior tension band

with supplemental cerclage wiring, 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 [1].

The objectives of operative treatment are anatomic reduction of the articular surface and restoration of the extensor mechanism while preserving the patella. Internal fixation is used to maintain reduction until fracture heals [6]. Early motion also shown to be beneficial for articular cartilage nutrition [12]. The principle behind tension band wiring of patellar fractures is to resist bending loads across the fractures as the knee is flxed. If the tension on the anterior surface is carried by the tension band, then there are compressive loads at the articular surface that improve fracture stability and helps in healing. With the introduction of cannulted screws for fracture treatment, an option exiting for combining screw fixation with tension band wiring of patella fractures [5].

Use of lag screws across the fracture site can apply compression across the fracture site in any knee position of adequate screw fixation can be obtained. Addition of an anterior tension band may help to resist some of the tensile forces across the fracture site with the knee in a flexed position, and actually convert them to compressive forces at the articular cartilage as the knee flexes. Another advantage is that as the tension and is threaded through the cannulated screws rather than around k-wires, it can be laid down closer to the poles of the patella with less interposition of the soft tissue, leaving less initial slack in the system that the modified tension band technique. As the wires exit the ends of the screws, they can be subjected to sharp corners that might increase the risk of breakage. This can be minimized by leaving the screws flush with or short of the end of the patella [6].

In this series of 24 cases of fracture patella have been studied where the results were obtained after treating with cannulated screw tension band wiring. Follow up period was 6-10 months with mean follow up 8-9 months. In the series of Titan *et al.* and Rudramuni *et al.* follow time was more from 12-24 months. Patient compliance and consciousness and responsibility is important to attend for follow up.

***Table 4:*** *Follow up duration compared with other studies*

| | **Follow up (Months)** | **Mean follow up (months)** |
|---|---|---|
| **Titan *et al.*** | 12-36 | 12 |
| **Rudramuni *et al.*** | 03-16 | 9.28 |
| **This study** | 06-10 | 8.9 |

Loosening of the implant is considered the main complication of patellar fracture fixation owing to the dense canccellous bone of the patella [8]. Fortunately, in this study there is no reputation of implant loosening in present study. Chiang *et al.* [13] performed this technique arthroscopically, Jin *et al.* [14] performed this technique percutaneously and Qi *et al.* [15] using bioabsorbable Cannulated screw reported in their study that there was no complication like implant loosening. So implant loosening which interfere in healing procedure is very unlikely in cannulated screw technique.

The average rage of knee motion of this study was 126.5° flexion ranging from 110° to 130° without unusual extension which is near to the study of Rudramuni *et al.* that is average 129.54° ranging from 105° to 135°. No patient had loss of fracture reduction, implant migration, implant failure, soft tissue irritation in this study. Same reputation also found in the study of Rudramuni *et al* and Titan *et al.*

Infection is a common threat to all surgery specially in orthopedic practice. 1 patient with diabetes mellitus showed infection in our study which improve with antibiotic therapy. Result of that patient was poor possibly to overcome the infection patient can not follow properly the instruction of post-operative physiotherapy. In the series of Rudramuni *et al.* also faced 4.0% of infection which need secondary suture without removal of implant to control infection.

***Table 5 :*** *Comparison of functional outcome with other study*

| | No of cases | Excellent | Good | Unsatisfactory |
|---|---|---|---|---|
| **Titan *et al.*** | 49 | 45 (91.8%) | 4 (8.2%) | - |
| **Rudramuni *et al.*** | 25 | 22 (88.0%) | 3 (12.0%) | - |
| **This study** | 24 | 20 (83.3%) | 3 (12.5%) | 1 (4.2%) |

In the present study 20 (83.3%) had excellent result, 3 (12.5%) had good and 1 case (4.2%) achieved unsatisfactory results. But in the series of Titan *et al.* result was better 91.8% (Excellent) and 8.2% good outcome. On the other hand, Rudramuni *et al.* found 88.0% excellent result with 12.0% good result. In both series there was no unsatisfactory result. In our study good outcome is almost same with Titan *et al.* and Rudramuni *et al.* but unfortunately 1 case (4.2%) of our study showed unsatisfactory result.

## Conclusion

Fracture patella treated with modified tension band wiring technique is bio-mechanically well established for long time. Now a days cannulated Cancellous screw with tension band wiring technique is well practiced. Soft tissue irritation, implant migration or failure is very rare in this technique. Result of different study is also over all satisfactory. So current study suggested that treatment of transverse fracture patella with tension band fixation assisted with cannulated cancellous screws is a safe and reliable method of this orthopedic condition. Larger sample size, long time follow up may need to delineate further more evaluation and conclusion.

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