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Research Article

SURGICAL MANAGEMENT OF TRANSVERSE FRACTURE PATELLA WITH CANNULATED SCREW TENSION BAND WIRING

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ABSTRACT

Background: Patella fractures account for approximately 1% of all skeletal injuries. The treatment of patellar fractures has undergone many changes in operative methods. With introduction of the cannulated screw for fracture treatment, an option exists for combining screw fixation with TBW of patellar fractures. **Purpose:** To assess the fuctional outcome of patellar fractures treated with cannulated screw tension band wiring**. Materials & Methods:** 25 patients with displaced transverse patella fracture studied prospectively are included in this study which was conducted in Department of Orthopedics at Chigateri General Hospital and Bapuji Hospital, attached to JJM Medical College, Davangere, during the period from June 2014 to May 2016. All patients underwent open reduction and internal fixation with 4mm cannulated screw with tension band wiring through it. The IOWA knee score was used to assess the functional outcome of fixation. **Results**: According to IOWA knee score, 22 patients had excellent results and 3 patients had good results. No patient had loss of fracture reduction, implant migration, knee stiffness, implant failure or soft tissue irritation. **Conclusion:** Cannulated screw tension band wiring can be considered as alternative method to treat transverse patella fractures with excellent to good results and few complications

INTRODUCTION

Fractures of patella are relatively common injuries and account for approximately 1% of all skeletal injuries. [1,2] The subcutaneous location of patella makes it vulnerable to direct trauma as in dashboard injuries or a fall on the flexed knee. Wheres violent contraction of the quadriceps results in indirect fractures of patella. These fractures are usually transverse and are associated with tears of medial or lateral retinacular expansions.

With the extensor retinaculum is torn as well the quadriceps muscle displaces the superior fragment proximally making adequate reduction of patella fragments impossible by closed means and necessiating operative treatment. [1]

The goals of surgical treatment are to obtain adequate reduction of fracture of patella, to provide stable fixation, to facilitate early range of motion of knee.

Historically the treatment of patella fracture has undergone many changes in operative methods[3] 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.[3] But this technique still has few short comings like risk of lossening and migration of k wire, direct inter fragmentary compression cannot be achieved with k wire and skin irritation.[3] To overcome these shortcomings, several surgeons adopted cannulated screw tension band wiring technique in treating patella fractures.

The advantage of cannulated screw tension band construct are lesser degree of implant irritation, interfragmnetary compression from screw fixation prevent fracture fragment from sliding apart, better fracture union and permit early motion. [1,4]

MATERIALS AND METHODS

25 patients with displaced transverse patella fracture studies prospectively are included in this study which was conducted in department of orthopaedics at Chigateri General Hospital and Bapuji Hospital, attached to JJM medical college, Davangere, during the period from June 2014 to May 2016. All patients underwent open reduction and internal fixation with 4mm cannulated screw with tension band wiring through it. Patients reviewed regularly at 1, 3, 6, 12 month post-operatively. The IOWA knee score was used to assess the functional outcome of fixation.

Inclusion criteria are simple transverse patella fractures, type 1 and 2 compound fractures. **Exclusion** criteria are patients medically unfit for surgery, undisplaced fractures, patients aged

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less than 18yrs, comminuted fractures, type 3 compound fractures.

Radiographs in anteroposterior and lateral views were taken for confirmation of diagnosis. Radiographs in skyline view were taken in cases suspected to have longitudinal and marginal fractures.

After the radiographs, the limb was immobilized by above knee POP posterior cylinder slab. Operations were done at a later date. If abrasions were present in the skin they were cleaned, dressed and antibiotics given.

Patients were prepared for surgery during this period. Patients were taught static quadriceps drill and straight leg raising exercises.

Surgical Technique

Surgery was performed with the patient in spinal anaesthesia in supine position with tourniquet. 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, a large towel clip or patella holding clamp were used to reduce the fracture fragments and the articular surface congruity were evaluated by palpation. To maintain flexion of knee joint of approximately 45^0, a small roll was placed on the posterior aspect. 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 parallal fashion, with a 2 cm 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 similiarly 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 srews, the wires are 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 the final cannulated screw length should be 5-10mm 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 45^0 flexion. The tourniquet was let down, hemostasis achieved and wound closed in layers. The knee was bandaged in sterile dressing and an elastic wrap applied.

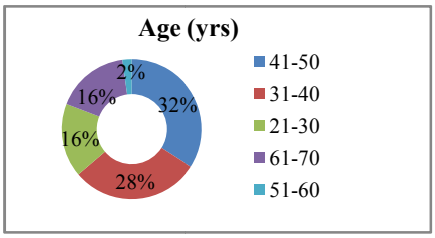
RESULTS

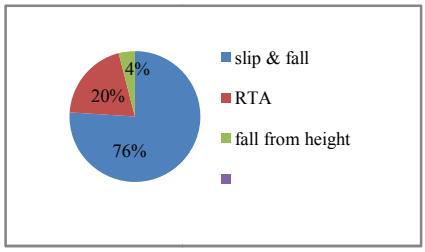
According to IOWA knee score, 22 patients had excellent results and 3 patients had good results. No patient had fair or poor results. No patienst was missed from the study. 2 patients underwent implant removal totally. No patient had loss of fracture reduction, implant migration, knee stiffness, implant failure or soft tissue irritation.

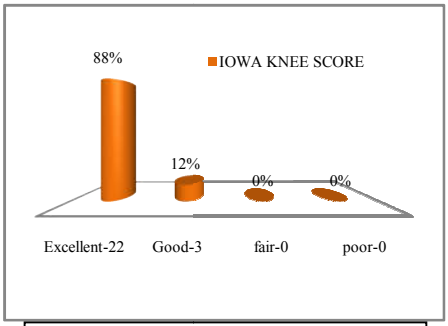
Pre op X ray

Immediate post op X ray

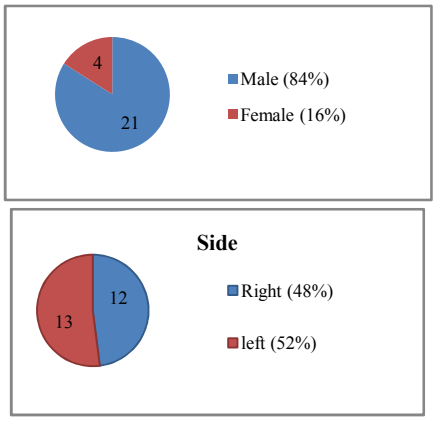
12th month post op X ray







Functional outcome of our study



Associated injuries

2 of the 25 patients had associated trauma to other parts of the body. One patient had associated greater tuberosity fracture and another patient had associated shaft of femur fracture and proximal 3rd tibia and fibula fracture on the ipsilateral side. Intramedullary nailing for shaft femur done in one sitting and tibia and patella fixation were done in second sitting.

Post-operatively

All patients were encouraged to perform isometric knee extension and straight leg elevation. Partial weight bearing was permitted until suture removal. After the incision is stabilised, usually at 3 or 4 days, knee flexion was allowed to less than 45^0 in the first week and gradually increased to 90^0 in the 2nd week. All patients were provided with exercise chart and advised to perform regularly at home twice daily.

None of the knee was immobilized at all and active flexion and quadriceps exercises encouraged from the beginning only. One patient had complication on the 5th postoperative day with superficial wound infection which healed after saline irrigation and wound debridement and secondary suturing without removal of the implant. None had loss of fracture reduction, implant migration, knee stiffness, implant failure or soft tissue irritation.

All patients reviewed at 1,3,6 & 12 months after the operation. At each visit post-operatively, radiograph of affected knee in AP and lateral views taken to observe the fracture healing and range of motion of the knee joint assessed. Fracture healing was defined as when a patient had no local pain or tenderness, the ability to walk well without help, and evidence of trabecular bone growing across the fracture site.

All the patients were followed up for an average of 9.28 months (range 3-16 months). The average range of motion is 129.54^0 flexion (ranging from 105^0 to 135^0) and 0^0 extension.

At the final follow up, the knee function was evaluated according to the IOWA knee score criteria, which evaluate knee function in daily life, inquires about joint pain when weight bearing, walking gait, the existence of deformity or instability and joint range of motion. The total score is 100 points: 90-100 points is excellent, 80-89 points is good, 70-79 points is fair, and less than 70 points is poor[10]

DISCUSSION

The patella facilitates knee extension by increasing the distance of the extensor mechanism from the axis of knee joint motion.[4] 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.[1] Early motion also shown to be beneficial for articular cartilage nutrition. [9]

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 existing for combining screw fixation with tension band wiring of patella fractures.[1]

Use of lag screws across the fracure site can apply compression across the fracture site in any knee position if 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 band 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 than 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.[1]

In this study we combined the cannulated screw fixation and tension band wiring in management of patella fractures.

In cadaveric knees, ***Benjamin et al.*** compared screw fixation with modified tension band, *lotke longitudinal anterior band*, and *magnusson wiring*. They reported that the most consistent results were achieved with modified tension band followed by screw fixation. They recommended screw fixation for patients with good bone stock and modified tension band for patients with osteopenia or comminution.[6]

In contrast to Benjamin *et al*., ***Carpenter et al.,*** who compared the modified tension band technique with the tension band technique incorporated into cannulated screws and screws alone in a simulated leg extension models and found that the combining lag screw and tension band principles provided more secure fixation of tranverse patella fractures than either method alone, with less displacement at the fracture site as the knee is extended and a higher load to failure of fixation from 554 N for screw alone to 732 N for screws plus tension band wiring. [1,5,7,8]

Berf et al., evaluated clinical result of transverse patella fracture fixation with tensioned anterior figure of eight wire placed through the parallel cannulated screws in 10 patients and found this technique has several advantages like low profile construct that caused lesser degree of implant irritation to local soft tissue structure, compatible with use of early

restricted motion and maintain anatomic reduction even in osteoporotic bone.[4,5,7,8]

Chang ***et al.*** evaluated 10 cases of displaced inferior pole patella fractures treated with tensioned anterior wire passed within paired cannulated compression screws and found that the anterior tension band wiring through cannulated screws for displaced inferior pole patella fractures is safe simple reliable alternate treatment, stable construct with minimal soft tissue irritation and early range of motion and excellent results in knee function.[2]

Titan ***et al.*** compared titanium cable cannulated screw tension band technique with tension band in treatment of transverse patella fractures and found titanium cable cannulated screw tension band group showed improved fracture reduction, reduced healing time, better IOWA knee score compared with modified tension band group.[3]

In this study a series of 25 cases of fracture patella have been studied where the results were obtained after treating with cannulated screw tension band wiring.

Tab Follow up duration compared with other studies

	Follow up (months)	Mean follow up (months)
Berg [4]	12-40	24
Titan *et al* [3]	12-36	12
Cho [9]	12-25	15
This study	03-16	9.28

The average range of motion is 129.54^0 flexion (ranging from 105^0 to 135^0) and 0^0 extension.

Lee et al. compared horizontal versus vertical orientation of the loop for tension band wiring of transverse patella fractures found that compared with vertical orientation, placing the wire in a figure of eight in horizontal orientation increases the inter-fragmentary compression force.[11] In this study we used horizontal figure of 8 pattern with single tension band in all cases.

The modified tension band technique with two k-wires still has few shortcomings like risk of loosening and migration of k wire, direct inter fragmentary compression cannot be achieved with k wire and skin irritation.[3]

As the support of a tension band, the k wire itself cannot generate reduction and compression effects on fractured bones. Rather, the reduction and compression effects on the fracture line are generated by tightening the wires from the superior pole to the lower pole. However the flexibility of k wire will counteract a part of the force that acted on the fractured bone. When using a cannulated screw tension band the primary pressure is achieved by 2 cannulated lag screws and stainless steel wire, which is flexed through the cannulated screw and tightened and plays its role as a tension band. Because the acting force generated by the cannulated screws is perpendicular to the fracture, the acting forces on the patellar articular and anterior surfaces are consistent, which is different from a modified k wire tension band.[3]

Loosening of the implant is considered the main complication of patellar fracture fixation.[3] The surface of k wire is smooth, so loosening of k wire is inevitable with time. The probability of cannulated screws tension band wiring loosening is very low owing to the dense cancellous bone of the patella and the fact that the distal end of the cannulated screw is threaded. In addition, the strong stainless steel wire tightly attaches to the patellar surface to limit the seperation of fracture fragments as tension band.[3]

Skin irritation is the main complication of the modified k wire tension band. K wire prominence and migration are the primary causes of skin irritation associated with this technique. With the cannulated screw tension band technique, the tail of the cannulated screw tightly attaches at the superior pole or inferior pole of the patella, and the screw threads are not exposed to the patellar surface. The stainless steel wire closely attaches to the patellar surface after being tightened reducing the risk of skin irritation and post operative activity discomfort.[3]

In this present study, no patient had loss of fracture reduction, implant migration, knee stiffness, implant failure or soft tissue irration. Only one patient had a superficial wound infection on the sixth postoperative day that healed following irrigation and wound debridement and secondary suturing without removal of the implant.

The advantages of cannulated screw tension band construct are lesser degree of implant irritation, interfragmentary compression from screw fixation prevent fracture fragment from sliding apart, better fracture union and permit early motion.[1,4]

In this present study out of 25 patients, the average IOWA knee score was 96.18% with 22 patients had excellent (88%) and 3 patients had good (12%) results. No patient had fair or poor results. Similar results were observed by titan *et al*, out of 49 cases, 45 had excellent (91.84%) and 4 had good (8.16%) results.[3]

Table Comparision of functional outcome with other study

	No.of cases	Excellent	Good	Fair	Poor
Titan *et al*[3]	49	45	4	-	-
This study	25	22	3	-	-

CONCLUSION

Patella is essential for effective function of quadriceps and for proper biomechanics of knee joint so it should be preserved wherever possible. Anatomical reduction and stable fixation in patellar fracture is necessary for the normal integrity and stability of the joint. Cannulated screw tension band wiring technique combines the principle of lag screw and tension band thus provided more secure fixation of transverse patellar fractures. It is an improved technique to remedy the short comings of the modified k wire tension band wiring in transverse patellar fractures.

Since most cases of patellar fractures are associated with extensor retincular tear, repair of the tear is necessary for early mobilization. Early post operative physiotherapy plays an important role in final outcome. Cannulated screw tension band wiring can be considered as an alternative method to treat transverse patella fracture with excellent to good results with few complications.

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