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Original Research Article

Clinico-radiological and functional outcome of surgical management of displaced transverse fracture of patella in adults managed by tension band wiring in a tertiary care hospital in North India: a prospective study

Pankaj Spolia*, Ashish Nehru, Abdul Ghani, Sakib Arfee

Department of Orthopaedics, Government Medical College, Jammu, Jammu and Kashmir, India

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***Correspondence:**
Dr. Pankaj Spolia,
E-mail: pankajspolia13@gmail.com

ABSTRACT

Background: Patella is the largest sesamoid bone in the quadriceps tendon in the body. The main function of patella is to improve the efficiency of quadriceps muscle by improving the mechanical leverage of the quadriceps muscle. There are various methods used for fixation of these fractures. Tension band wiring (TBW) works by converting tensile forces into compressive forces when movements occur at the knee joint. The aim of our study was to evaluate the clinico-radiological and functional outcome of surgical management of displaced transverse fracture of patella in adults managed by TBW.
Methods: This was the prospective study of 22 patients aged 20 to 60 years (mean age 41.4 years) with displaced transverse fractures of patella managed by TBW.
Results: The final outcome was observed at 6 months follow up. The results were comparable with the existing literature. Radiological union was achieved within 10 to 16.2 weeks, with an average of 12.4 weeks. Out of 22, (n=16, 72.7%) had excellent outcome, (n=5, 22.7%) had good functional outcome, (n=1, 4.5%) had fair outcome. Complications were observed in 6 (27.3%) patients.
Conclusions: It is concluded that the surgical treatment with TBW is the best treatment in the management of displaced transverse fractures of patella.

Keywords: Patella fracture, Tension band wiring, Visual analogue scale, Reich and Rosenberg criteria

INTRODUCTION

Patella is the largest of the sesamoid bone of the body embedded in the tendon of quadriceps femoris.[1] The fractures of patella constitute 1% of all fractures in the adults. The transverse patellar fractures are the most common pattern usually affecting patients aged from 20-50 years.[2,3] The proximal three-fourths of the patella is covered with thick articular cartilage, while the distal pole is entirely devoid of articular cartilage. For this reason, most distal pole fractures are extra-articular. Fracture of the patella may be associated with intact quadriceps mechanism like in undisplaced fractures but in displaced fractures, it is usually disrupted. So two major reasons for patellar fixation are: first, patella plays a vital role in knee function with proper quadriceps working for knee flexion and extension.[4,5] Secondly, as large part of the patella is intra-articular, fracture of patella if not meticulously reduced, leads to secondary osteoarthritis of the knee.[6] In the 1950s, the technique of tension-band wiring (TBW) was first described, and later biomechanical studies showed it to be superior to intra-osseous wire suture.[2,7]

The principle of the TBW technique is to convert the tension forces acting on the anterior surface of patella into compression forces at the articular surface. This technique

can improve the results because of its reliable fixation and allowance of early joint motion.[8] The treatment of patella fractures with two vertical Kirschner wires (K-wires) and an anterior figure of eight technique, has become an accepted standard of care in the treatment of displaced fractures of the patella.[9-12] The purpose of our study was to assess the clinico-radiological and functional outcome of surgical management of displaced transverse fracture of patella in adults treated by TBW. However, the use of this technique is known to be associated with complications, like hardware symptoms and the need for hardware removal.[13]

METHODS

Study design

This study was an observational prospective study of 22 patients (n=22) satisfying the inclusion criteria treated by open reduction and internal fixation from February 2020 to April 2021 which was done at the post graduate department of orthopaedics, Government Medical College, Jammu. Patients satisfying the selection criteria were included in the study after proper history, clinical examination, written informed consent for the surgery and anaesthesia, and explaining their possible complications prior to the surgery. The data was analysed by appropriate statistical methods. Functional outcome was evaluated at 6 month follow up and was compared with the existing literature. Pain was evaluated by visual analogue scale.

Inclusion criteria

Patients with age 20 to 60 years, displaced transverse (two part) patellar fractures presenting within 2 weeks, closed fractures, extensor mechanism lag at knee, were included in the study.

Exclusion criteria

Fractures presenting after 2 weeks, undisplaced fractures, open fractures, comminuted fractures, longitudinal fractures, polytrauma patients.

Investigations

Appropriate radiological investigations were done. Antero-posterior, lateral and axial views were. In doubtful and complex fractures, computed tomography (CT) scan was also done. All baseline blood investigations, chest X-rays and electrocardiography (ECG) was done. Informed written consent was taken and antibiotic prophylaxis was given.

Operative technique

Patient was placed in supine position on the table. A midline longitudinal incision was made to expose the fracture. Proximal and distal fragments were reduced, held firmly with patella reduction clamps to restore a smooth articular surface. Two 2 mm K-wires were passed from inferior to superior pole or in a retrograde manner keeping about 5 mm deep to the anterior surface of the patella along lines dividing the patella into medial, central, and lateral thirds and as parallel as possible. Tightening was done in a figure of eight using stainless steel wire. The reduction was checked manually and by X-ray in anteroposterior and lateral view. Upper ends of the two K-wires were embedded into the superior margin of the patella after bending it acutely and protruding ends of the K-wires were cut short inferiorly. Retinacular tears were repaired and the wound was closed over a suction drain.

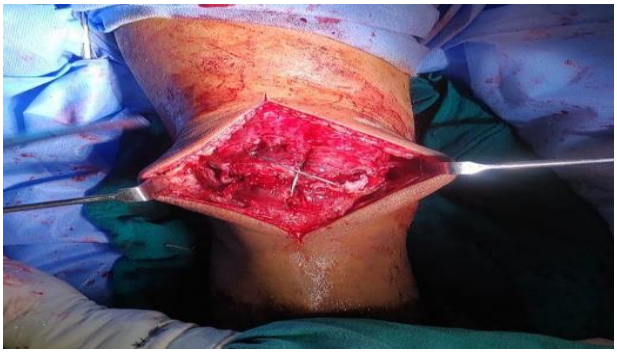

Figure 1: Intraoperative picture showning TBW.

Figure 2: Radiograph of patella fracture.

Post-operative management

In the post-operative treatment, intravenous antibiotics and adequate analgesia was given. The knee was placed in extension in a posterior splint or knee brace. Isometric exercises were started on the first postoperative day. Sterile dressing was done on alternative days. Check X-ray of knee was done in AP and lateral views.

Statistical analysis

Simple statistical methods of mean and percentage were used as the study is not a comparative study.

Follow-up

Active exercises were started after 2 weeks when the wound was healed. Suture removal was done at 2 weeks after the surgery. Weight bearing was started after 6 weeks.

Follow up was done on at 2 weeks, 4 weeks, 8 weeks, 12 weeks, 16 weeks and 24 weeks postoperatively. On each visit, local site was examined for any signs of local inflammation or infection, range of motion of knee was assessed, functional status of the patient was documented and X-rays of the involved knee were taken. Radiological union was established when the bony trabeculae crossed the fracture line. Fracture union, alignment of fracture and all long term complications like non-union or infection were recorded.

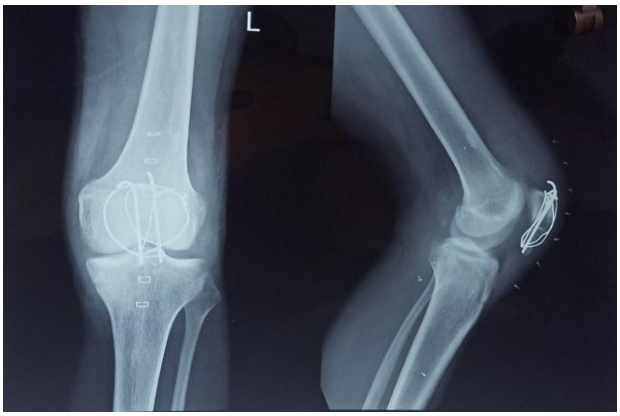

Figure 3: Radiograph of fracture fixation with TBW at 2 weeks follow up.

RESULTS

The total number of cases in our study were 22, out of which, 17 were males and 5 were females, with mean age of 41.4 years ranging from 20 to 60 years. In the present study, the majority of the mode of trauma was road traffic accidents in 63.3% of cases, followed by fall in 26.7% cases and assault in 10% of the cases. Out of 22 patients, 13 had trauma of the right side and 9 had trauma of the left side. In the present study, 13 patients reported on the same day of injury, 6 patients reported after one day, 2 patients after 2 days, 1 patients reported after 1 week. Mean delay in reporting was 2.1 days. 6 patients were sedentary, 12 patients were light workers, and 4 patients were heavy workers. 22.7% (5) of the patients were found to be associated with other injuries head injury (n=1, 4.5%, chest (n=1, 4.5%), fracture proximal humerus (n=1, 4.5%), fracture lateral malleolus (n=1, 4.5%), blunt trauma abdomen (n=1, 4.5%). In the present study, 17 patients were operated within first week, 5 patients were operated after first week.

Clinico-radiological consolidation

Fractures were assessed clinically when painless, unaided movements were possible and there was no tenderness. Out of 22 patients, in 7 patients the fracture was united within 11 weeks. In 11 patients, the fracture was united at 13.5 weeks, and in 4 patients, the fracture was united at 16.2 weeks in the present study. The average union time was 12.4 weeks.

Functional evaluation

In the present study, at 6 month follow up, 18 patients had no pain, 2 patients had pain at extreme of movements and 2 patients had pain which restricted their excessive walking. Out of 22 patients, in 18 patients the range of motion was more than 90 degrees, 4 patients had range of motion less than 90 degrees.

Table 1: Following parameters studied.

Parameter	No. of patients	Percentage (%)
Mode of injury		
RTA	14	63.6
Fall	6	27.3
Assault	2	9.1
Side involved		
Right	13	59.1
Left	9	40.9
Sex		
Male	17	77.3
Female	5	22.7
Delay in surgery (weeks)		
Less than 1	17	77.3
More than 1	5	22.7

Table 2: Clinical outcome.

Parameter	Outcome	Number (%)
Pain	No pain	18 (81.8)
	Require double support	0
	Require single support	0
	Limit excessive walking	4 (18.2)
	Limit routine walking	0
Range of motion	11°-30°	0
	50°-70°	0
	71°-90°	4 (18.2)
	>90°	18 (81.8)
Quadriceps strength	<50%	0
	50-74%	4 (18.2)
	>75%	18 (81.8)

Complications

In the present study, complications were observed in 6 patients. Superficial infection was noted in 3 patients, which was managed by thorough wound wash, intravenous antibiotics and regular sterile dressings. Hardware symptoms were noted in 3 patients in which the implant was removed after the fracture was healed.

DISCUSSION

There are many surgical techniques for open reduction and internal fixation of transverse fracture of patella but at the degree of 90^0 of flexion of knee joint articular surface was

distracted by posterior angulation of fracture fragment.[14,15] But after application of tension band wiring technique chances in the articular surface distraction are not seen and early mobilization can be started as noted by Levak et al.[16]

In the present study, maximum incidence was observed in 4th decade with mean age of trauma was 41.4 years, which has similar results as compared to Mohapatra et al (37 years), Mahindra et al (40.46 years), and Yang et al (63.73).[17-19] Fractures were more common on the right side (59.1%), than on left side (40.9%) which were in agreement with previous studies Asimuddin et al and Mahindra et al.[18,20]

In the present study, 17 (%) were males and 5 (%) were females, with male to female (M: F) ratio of 3.4:1. Similar observations were made by Asimuddin et al, Ramu et al and Lone et al.[20-22]

In our study, the most common cause of fracture was road traffic accident (%), followed by fall (%), and assault which was similar to previous studies Asimuddin et al, Mohapatra et al and Mahindra et al.[17,18,20]

Table 3: Time of radiological union.

Study	Average time of union (weeks)
Asimuddin et al[20]	10 (8-12)
Mohapatra et al[17]	13.6
Mahindra et al[18]	12.7
Present study	12.4

Radiological union was achieved within 10 to 16.2 weeks, with an average of 12.4 weeks. Similar observations were made by Asimuddin et al, Mohapatra and Mahindra et al.[17,18,20] The functional outcome was assessed on the basis of Reich and Rosenberg scale.

Table 4: Reich and Rosenberg (1954) scale for patella fracture.

Results	Pain	Movement
Excellent	No pain or occasional	No limitation
Good	Pain on prolonged activity	Limitation of 10°-20° of flexion
Fair	Pain while climbing or during work	Flexion >75°
Poor	Constant pain	Flexion <75°

Out of 22, (n=16, 72.7%) had excellent outcome, (n = 5, 22.7%) had good functional outcome, (n=1, 4.5%) had fair outcome. Our results were similar to Asimuddin et al, Mohapatra and Lone et al.[17,20,22]

Out of 22 patients, complications were observed in 6 (27.3%) patients. Superficial Infection was noted in 3 patients, which was managed by thorough wound wash, intravenous antibiotics and regular sterile dressings. Hardware symptoms were noted in 3 patients in which the implant was removed after the fracture was healed.

Our results were comparable with the existing literature Asimuddin et al, Mahindra et al and Lone et al.[18,20,22] No neurovascular complications were observed in the present study.

Limitations

The present study had limitations. It was non randomised study. The sample size was less. Pain is a subjective parameter. All these factors can lead to bias in the study.

CONCLUSION

Patella is essential for effective function of quadriceps and for proper biomechanics of knee joint so it should be preserved wherever possible. Careful selection after proper history and examination of cases and good surgical technique is essential for a good functional outcome in fractures of patella. Conservative treatment has limited role in patella fractures except for undisplaced fractures. Operative treatment is preferred and it gives good results. Postoperative immobilization and physiotherapy plays an important role in the surgical outcome. It is concluded that the surgical treatment with TBW is the best treatment in the management of displaced transverse fractures of patella.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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