



Original Article

## Functional Outcome of Displaced Patellar Fractures Treated with Tension Band Wiring: A Prospective Study

Dr. Madhu Mohan Siddaiah B<sup>1</sup>, Dr. Revanth Potarlanka<sup>2</sup>, Dr. Patluri Rohit Raj<sup>3\*</sup>, Dr. C. S. Abhiram<sup>4</sup>

<sup>1</sup>Assistant Professor, Department Of Orthopaedics, Viswabharathi Medical College And Hospital, Kurnool, Andhra Pradesh

<sup>2</sup>Associate Professor, Department Of Orthopaedics, Viswabharathi Medical College And Hospital, Kurnool, Andhra Pradesh

<sup>3</sup>Associate Professor, Department Of Orthopaedics, Viswabharathi Medical College And Hospital, Kurnool, Andhra Pradesh

<sup>4</sup>Post Graduate, Department Of Orthopaedics, Viswabharathi Medical College And Hospital, Kurnool, Andhra Pradesh

 OPEN ACCESS

### Corresponding Author:

**Dr. Patluri Rohit Raj**

Associate Professor, Department Of Orthopaedics, Viswabharathi Medical College And Hospital, Kurnool, Andhra Pradesh.

Email: [rohitraj219@gmail.com](mailto:rohitraj219@gmail.com)

Received: 05-05-2026

Accepted: 05-06-2026

Available online: 20-06-2026

Copyright © International Journal of  
Medical and Pharmaceutical Research

### ABSTRACT

**Background:** Displaced fractures of the patella disrupt the extensor mechanism of the knee and often require surgical fixation to restore joint congruity and function. Tension band wiring remains the most commonly employed technique for the management of displaced transverse patellar fractures.

**Objective:** To evaluate the functional outcome and complications of displaced patellar fractures treated with tension band wiring.

**Methods:** This prospective observational study was conducted in the Department of Orthopaedics, Malla Reddy Institute of Medical Sciences and Hospital, Hyderabad, between April 2016 and April 2018. Thirty adult patients with displaced transverse patellar fractures underwent open reduction and internal fixation using the tension band wiring technique. Patients were followed clinically and radiologically for five months. Functional outcome was assessed using West's criteria.

**Results:** The mean age of the patients was 41 years, with the highest incidence observed in the 31–40-year age group. Males constituted 80% of the study population. Indirect trauma was the predominant mode of injury (73.3%). At final follow-up, excellent functional results were observed in 26 patients (86.7%), good results in 3 patients (10%), and poor results in 1 patient (3.3%). Complications occurred in four patients and included superficial wound infection, wound gaping, K-wire migration, and restriction of knee flexion.

**Conclusion:** Tension band wiring provides stable fixation and facilitates early mobilization in displaced transverse patellar fractures. The technique yielded excellent to good functional outcomes in 96.7% of patients with a low complication rate, supporting its continued use as an effective and cost-efficient treatment modality.

**Keywords:** Patellar fracture, tension band wiring, internal fixation, functional outcome, West's criteria.

### INTRODUCTION

Patellar fractures account for approximately 1% of all skeletal injuries and represent an important cause of disruption of the extensor mechanism of the knee. Although relatively uncommon, these fractures can result in significant functional disability due to impairment of knee extension and patellofemoral joint mechanics.<sup>1</sup> The patella is the largest sesamoid bone in the human body and serves an important biomechanical role by increasing the lever arm of the quadriceps muscle, thereby improving the efficiency of knee extension.<sup>2</sup> In addition, it protects the anterior aspect of the knee joint and facilitates transmission of forces across the patellofemoral articulation.<sup>3</sup>

Patellar fractures may occur following either direct or indirect trauma. Direct trauma, such as dashboard injuries and falls onto the flexed knee, commonly results in comminuted fracture patterns and articular cartilage damage.<sup>4</sup> Indirect trauma typically occurs due to sudden forceful contraction of the quadriceps muscle against a flexed knee, producing transverse

fractures with varying degrees of displacement.<sup>5</sup> The fracture pattern is influenced by the mechanism of injury, age of the patient, bone quality, and magnitude of force applied to the knee.<sup>6,7</sup>

The primary objectives in the treatment of patellar fractures are restoration of the extensor mechanism, anatomical reduction of the articular surface, stable fixation of fracture fragments, and early mobilization of the knee joint. Failure to achieve these goals may result in extensor lag, quadriceps weakness, knee stiffness, chronic pain, and post-traumatic patellofemoral osteoarthritis.<sup>8,9</sup> Consequently, displaced fractures with significant fragment separation or articular incongruity generally require operative intervention.

Several surgical techniques have been described for the management of displaced patellar fractures, including circumferential cerclage wiring, tension band wiring, interfragmentary screw fixation, partial patellectomy, and total patellectomy.<sup>10</sup> Among these methods, tension band wiring has emerged as the most widely accepted treatment modality for displaced transverse fractures of the patella. The principle of tension band fixation, originally described by Pauwels and subsequently adopted by the AO-ASIF group, converts tensile forces generated by the quadriceps mechanism into compressive forces at the fracture site during knee flexion, thereby promoting fracture union and permitting early mobilization.<sup>11,12</sup>

Weber et al. demonstrated biomechanically that tension band wiring provides superior fixation stability compared with several alternative fixation methods and remains the standard against which newer fixation techniques are compared.<sup>12</sup> Clinical studies by Dudani and Sancheti, Marya et al., Shrestha et al., and Lefavre et al. have consistently reported high rates of fracture union, satisfactory knee function, and favorable clinical outcomes following tension band fixation.<sup>13-16</sup>

Recent literature has focused on implant modifications and alternative fixation constructs aimed at reducing hardware-related complications and improving functional outcomes. Current reviews by Schuett et al. and Gwinner et al. continue to support tension band wiring as a reliable treatment option for displaced transverse patellar fractures, particularly in resource-limited settings.<sup>17,18</sup>

Despite the widespread use of tension band wiring, complications such as implant prominence, K-wire migration, loss of reduction, and knee stiffness continue to be reported. Therefore, continuous evaluation of the functional outcome and complications associated with this technique remains necessary. The present prospective study was undertaken to evaluate the clinical and functional outcomes of displaced patellar fractures treated with tension band wiring

## **MATERIALS AND METHODS:**

### **Study Design and Setting**

A prospective observational study was conducted in the Department of Orthopaedics, Malla Reddy Institute of Medical Sciences and Hospital, Hyderabad, Telangana, India, over a period of two years from April 2016 to April 2018. The study was approved by the Institutional Ethics Committee, and informed written consent was obtained from all participants before enrollment.

### **Study Population**

Thirty consecutive adult patients presenting with displaced patellar fractures and meeting the predefined inclusion criteria were included in the study. All patients underwent surgical management with open reduction and internal fixation using the tension band wiring technique.

### **Inclusion Criteria**

Patients fulfilling the following criteria were included:

1. Age greater than 18 years.
2. Displaced transverse fractures of the patella with fragment displacement greater than 2–3 mm.
3. Articular step-off greater than 2 mm.
4. Closed fractures and Gustilo-Anderson Type I open fractures.
5. Patients willing to participate in the study and comply with follow-up protocol.

### **Exclusion Criteria**

The following patients were excluded from the study:

1. Gustilo-Anderson Type III open fractures.
2. Grossly comminuted fractures unsuitable for tension band wiring.
3. Vertical and marginal patellar fractures.
4. Old fractures presenting more than 3–6 weeks after injury.
5. Pathological fractures.
6. Patients medically unfit for surgery.

### Preoperative Assessment

A detailed clinical history was obtained in all patients, including age, sex, occupation, mode of injury, side involved, and associated injuries. A thorough general and local examination was performed with particular attention to swelling, tenderness, extensor lag, palpable fracture gap, and ability to actively extend the knee.

Standard anteroposterior and lateral radiographs of the affected knee were obtained for fracture assessment. In cases with significant hemarthrosis, aspiration of the knee joint was performed under aseptic precautions. Initially, all patients were immobilized using an above-knee posterior slab until definitive surgical intervention.

### Surgical Technique

All procedures were performed under regional or spinal anesthesia with the patient in the supine position. A standard longitudinal midline incision was used to expose the patella. The fracture site was cleared of hematoma and interposed soft tissues. Articular reduction was achieved under direct visualization and maintained with reduction clamps.

Two parallel Kirschner wires (K-wires) were inserted longitudinally across the fracture fragments. An 18-gauge stainless steel wire was then passed in a figure-of-eight configuration anterior to the patella, following the principles of tension band fixation. The wire was tightened adequately to achieve compression at the fracture site. Associated retinacular tears, when present, were repaired using interrupted non-absorbable sutures.

Reduction and implant position were confirmed intraoperatively. The wound was irrigated thoroughly and closed in layers over a suction drain.

### Postoperative Protocol

Postoperatively, all patients received intravenous antibiotics and analgesics according to institutional protocol. The suction drain was removed on the second postoperative day, and a check radiograph was obtained to assess fracture reduction and implant position.

Quadriceps strengthening exercises, straight-leg raising exercises, and weight-bearing ambulation as tolerated were initiated from the third postoperative day. Intravenous antibiotics were continued for three days followed by oral medications when indicated.

Sutures were removed between the 10th and 12th postoperative days. Progressive knee mobilization was started thereafter using active-assisted range-of-motion exercises and continuous passive motion (CPM) therapy. Patients were instructed to continue quadriceps strengthening and knee mobilization exercises at home.

### Follow-up Evaluation

Patients were reviewed monthly in the outpatient department. At each follow-up visit, clinical and radiological assessments were performed. Clinical evaluation included assessment of pain, ability to walk, squat, climb stairs, return to routine activities, extensor lag, quadriceps muscle power, range of knee motion, and thigh muscle wasting.

Radiological assessment was performed using serial anteroposterior and lateral radiographs to evaluate fracture union and maintenance of reduction.

### Outcome Measures

Functional outcome was assessed at the final follow-up using West's Criteria, which evaluates pain, knee range of motion, quadriceps strength, extensor lag, and overall functional ability. Results were categorized as Excellent, Good, or Poor.

### Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 24.0. Continuous variables were expressed as mean  $\pm$  standard deviation, while categorical variables were presented as frequencies and percentages. Results were summarized using appropriate tables and graphical representations.

### RESULTS:

Thirty patients with displaced patellar fractures underwent tension band wiring fixation. The mean age of the study population was 41 years (range: 20–69 years), with the highest incidence observed in the 31–40 years age group. Males constituted 80% of the study population. Indirect trauma was the most common mechanism of injury (73.3%), while direct trauma accounted for 26.7% of cases. Right-sided fractures were slightly more common than left-sided fractures (56.7% vs. 43.3%) (Table 1).

**Table 1. Baseline Demographic and Clinical Characteristics of the Study Population**

Variable	Category	Number (n)	Percentage (%)
	11–20	1	3.3

<b>Age Group (years)</b>	21–30	5	16.7
	31–40	10	33.3
	41–50	6	20.0
	51–60	6	20.0
	61–70	2	6.7
<b>Sex</b>	Male	24	80.0
	Female	6	20.0
<b>Mechanism of Injury</b>	Indirect trauma	22	73.3
	Direct trauma	8	26.7
<b>Side Involved</b>	Right	17	56.7
	Left	13	43.3

Functional assessment was performed at the final follow-up using West's Criteria. Excellent functional results were observed in 26 (86.7%) patients, good results in 3 (10.0%) patients, and poor results in 1 (3.3%) patient. (Table 2)

**Table 2: Functional Outcome According to West's Criteria**

Outcome	Number (n)	Percentage (%)
Excellent	26	86.7
Good	3	10.0
Poor	1	3.3
Total	30	100

Complications were noted in four patients (13.3%). One patient developed superficial wound infection, which resolved with antibiotics and local wound care. One patient experienced wound gaping requiring secondary suturing. One patient developed terminal restriction of knee flexion of approximately 25 degrees. K-wire migration was observed in one patient, necessitating implant removal after fracture union. (Table 3)

**Table 3: Complications Following Tension Band Wiring**

Complication	Number (n)	Percentage (%)
Superficial wound infection	1	3.3
Wound gaping	1	3.3
K-wire migration	1	3.3
Flexion restriction	1	3.3
No complications	26	86.7
Total	30	100

## DISCUSSION:

Patellar fractures constitute a unique group of injuries because disruption of the extensor mechanism directly affects knee function and mobility. The treatment strategy should therefore focus not only on achieving fracture union but also on restoring the biomechanics of the patellofemoral joint and allowing early rehabilitation. The tension band principle remains the most widely accepted method for the management of displaced transverse fractures of the patella because it converts tensile forces generated during knee flexion into compressive forces at the fracture site.<sup>11,12</sup>

In the present study, the mean age of patients was 41 years, with the highest incidence observed in the third and fourth decades of life. Similar age distributions have been reported by Nummi<sup>4</sup> and Böstman et al.<sup>5</sup> who observed that patellar fractures occur predominantly among economically active individuals exposed to occupational and road traffic-related trauma. The predominance of younger and middle-aged adults in the present study may be attributed to greater physical activity and increased exposure to high-energy injuries.

A male predominance was observed in the present series, with males constituting 80% of the study population. Comparable findings were reported by Dudani and Sancheti<sup>13</sup> and Marya et al.<sup>14</sup> who attributed the higher incidence among males to greater participation in outdoor activities and increased risk of trauma. The demographic profile observed in the present study is therefore consistent with previously published literature.

Indirect trauma accounted for the majority of fractures (73.3%) in the present series. Similar observations have been reported by Nummi<sup>4</sup> and Carpenter et al.<sup>3</sup> who identified forceful contraction of the quadriceps muscle against a flexed knee as a common mechanism responsible for displaced transverse fractures. The predominance of indirect trauma in the present study may explain the higher proportion of fracture patterns suitable for tension band fixation.

The most important finding of the present study was the excellent functional outcome achieved following tension band wiring. According to West's criteria, excellent results were obtained in 86.7% of patients, good results in 10%, and poor results in only 3.3%. These findings compare favorably with those reported by Shrestha et al.<sup>15</sup> and Lefaivre et al.<sup>16</sup> who

demonstrated excellent to good outcomes in the majority of patients treated with tension band fixation. Similarly, Böstman<sup>19</sup> reported satisfactory functional recovery and high union rates following operative management of patellar fractures.

The favorable outcomes observed in the present study may be attributed to anatomical reduction of the fracture, stable fixation, preservation of the extensor mechanism, and initiation of early postoperative rehabilitation. Biomechanical studies by Benjamin et al.<sup>20</sup> and Berg<sup>21</sup> demonstrated that stable fixation constructs effectively resist displacement forces generated by the quadriceps mechanism and facilitate early knee mobilization. Early rehabilitation minimizes joint stiffness, restores quadriceps strength, and contributes significantly to functional recovery.

Complications were observed in four patients (13.3%). These included superficial wound infection, wound gaping, K-wire migration, and restriction of knee flexion. Hardware-related complications remain a recognized limitation of conventional tension band wiring. Smith et al.<sup>25</sup> reported implant-related complications in a proportion of patients undergoing patellar fracture fixation, while Schuett et al.<sup>17</sup> highlighted implant prominence and hardware irritation as common reasons for secondary implant removal. Nevertheless, the complication rate observed in the present study was low and did not significantly influence the final functional outcome.

Recent studies have explored alternative fixation techniques to reduce implant-related complications. Tian et al.<sup>22</sup> reported favorable outcomes with cannulated screw and cable constructs compared with conventional tension band wiring. Similarly, Melvin and Mehta<sup>23</sup> and Lazaro et al.<sup>24</sup> described evolving fixation strategies aimed at improving stability and reducing hardware-related morbidity.

## CONCLUSION:

The present study demonstrates that tension band wiring is an effective and reliable method for the management of displaced transverse fractures of the patella. The technique provides stable fixation, facilitates early mobilization, and restores the integrity of the extensor mechanism, resulting in satisfactory functional recovery. In the present series, excellent to good functional outcomes were achieved in 96.7% of patients, with a low incidence of complications. The procedure is simple, cost-effective, and reproducible, making it a valuable treatment option in routine orthopaedic practice. Therefore, tension band wiring continues to be a dependable method for achieving fracture union and favorable functional outcomes in displaced patellar fractures.

## REFERENCES

1. Wiberg G. Roentgenographic and anatomic studies on the femoropatellar joint. *Acta Orthop Scand.* 1941;12:319-410.
2. Kaufer H. Mechanical function of the patella. *J Bone Joint Surg Am.* 1971;53(8):1551-1560.
3. Carpenter JE, Kasman R, Matthews LS. Fractures of the patella. *Instr Course Lect.* 1994;43:97-108.
4. Nummi J. Fracture of the patella: A clinical study of 707 patellar fractures. *Ann Chir Gynaecol Fenn.* 1971;60(Suppl 179):1-85.
5. Böstman O, Kiviluoto O, Santavirta S, Nirhamo J, Wilppula E. Fractures of the patella treated by operation. *Arch Orthop Trauma Surg.* 1983;102(2):78-81.
6. Rockwood CA Jr, Green DP, Bucholz RW, Heckman JD. *Rockwood and Green's Fractures in Adults.* 8th ed. Philadelphia: Wolters Kluwer Health; 2015.
7. Whittle AP. Fractures of lower extremity. In: Canale ST, Beaty JH, editors. *Campbell's Operative Orthopaedics.* 12th ed. Philadelphia: Elsevier; 2013. p. 2783-2795.
8. Braun W, Wiedemann M, Rüter A, Kundel K, Kolbinger S. Indications and results of nonoperative treatment of patellar fractures. *Clin Orthop Relat Res.* 1993;(289):197-201.
9. Levack B, Flannagan JP, Hobbs S. Results of surgical treatment of patellar fractures. *J Bone Joint Surg Br.* 1985;67(3):416-419.
10. Müller ME, Allgöwer M, Schneider R, Willenegger H. *Manual of Internal Fixation. Techniques Recommended by the AO-ASIF Group.* 3rd ed. Berlin: Springer-Verlag; 1991.
11. Pauwels F. *Biomechanics of the Locomotor Apparatus.* Berlin: Springer-Verlag; 1980.
12. Weber MJ, Janecki CJ, McLeod P, Nelson CL, Thompson JA. Efficacy of various forms of fixation of transverse fractures of the patella. *J Bone Joint Surg Am.* 1980;62(2):215-220.
13. Dudani B, Sancheti KH. Management of fracture patella by tension band wiring. *Indian J Orthop.* 1981;15:43-48.
14. Marya SKS, Bhan S, Dave PK. Comparative study of knee function after patellectomy and osteosynthesis with tension band wiring following fracture of the patella. *Int Surg.* 1987;72(1):4-8.
15. Shrestha B, Bajracharya A, Rajbhandari A, Singh N. Functional outcome of modified tension band wiring in transverse fracture patella. *J Gandaki Med Coll Nepal.* 2009;2(3):132-136.
16. Lafavre KA, O'Brien PJ, Broekhuysen HM, Guy P, Blachut PA. Modified tension band technique for patella fractures. *Orthop Traumatol Surg Res.* 2010;96(5):579-582.
17. Schuett DJ, Hake ME, Mauffrey C, Hammerberg EM, Stahel PF, Hak DJ. Current concepts review: Patella fractures. *Injury.* 2015;46(11):1953-1958.

18. Gwinner C, Märdian S, Schwabe P, Schaser KD, Krapohl BD, Jung TM. Current concepts review: Fractures of the patella. *GMS Interdiscip Plast Reconstr Surg DGPW*. 2016;5.
19. Böstman O. Results of nonoperative and operative treatment of patellar fractures. *Clin Orthop Relat Res*. 1991;(269):152-158.
20. Benjamin J, Bried JT, Dohm M, McMurtry M. Biomechanical evaluation of various forms of fixation of transverse patellar fractures. *J Orthop Trauma*. 1987;1(3):219-222.
21. Berg EE. Open reduction internal fixation of displaced transverse patella fractures with figure-of-eight wiring through parallel cannulated compression screws. *J Orthop Trauma*. 1997;11(8):573-576.
22. Tian Y, Zhou F, Ji H, Zhang Z, Guo Y. Cannulated screw and cable are superior to modified tension band in the treatment of transverse patella fractures. *Clin Orthop Relat Res*. 2011;469(12):3429-3435.
23. Melvin JS, Mehta S. Patellar fractures in adults. *J Am Acad Orthop Surg*. 2011;19(4):198-207.
24. Lazaro LE, Wellman DS, Sauro G, Pardee NC, Berkes MB, Little MTM, et al. Outcomes after operative fixation of complete articular patellar fractures. *J Bone Joint Surg Am*. 2013;95(14).
25. Smith ST, Cramer KE, Karges DE, Watson JT, Moed BR. Early complications in the operative treatment of patella fractures. *J Orthop Trauma*. 1997;11(3):183-187.