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ORIGINAL RESEARCH

A Prospective Clinical Study of Patellar Fractures Treated by Modified Tension Band Wiring

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ABSTRACT

Aim: To evaluate the clinical and radiological outcomes of displaced transverse patellar fractures treated with the modified tension band wiring (MTBW) technique and to assess its effectiveness in functional recovery and complication profile. **Material and Methods:** This prospective clinical study was conducted from March 2020 to July 2020 at a tertiary care hospital and included 50 adult patients with closed, displaced transverse patellar fractures. After ethical clearance and informed consent, patients underwent surgical fixation using the MTBW technique. Functional outcomes were assessed using the Modified Böstman Score during follow-up at 2, 6, and 12 weeks, and 6 months postoperatively. Radiological union time, complications, and patient demographics were also analyzed. **Results:** Most patients (72.00%) underwent surgery within 3 days of injury. Radiological union was achieved within 12 weeks in 94.00% of cases. At the 6-month follow-up, 60.00% had excellent functional outcomes, 32.00% had good outcomes, and 8.00% had fair results. The majority (72.00%) experienced no postoperative complications. Common minor complications included hardware prominence (10.00%) and knee stiffness (8.00%). **Conclusion:** Modified tension band wiring is a safe, cost-effective, and efficient method for treating transverse patellar fractures. It ensures early mobilization, high union rates, and favorable functional outcomes with minimal complications when combined with appropriate postoperative rehabilitation.

Keywords: Patellar fracture, Modified tension band wiring, Functional outcome, Radiological union, Internal fixation.

INTRODUCTION

The human knee is a complex and crucial joint that plays a vital role in locomotion, stability, and weight-bearing functions. Central to this joint's function is the patella, or kneecap, a sesamoid bone embedded within the quadriceps tendon. The patella acts as a fulcrum to increase the leverage of the quadriceps muscle, thereby enhancing the efficiency of knee extension. Given its subcutaneous location and its direct involvement in the extensor mechanism, the patella is particularly vulnerable to trauma. Fractures of the patella, although relatively uncommon compared to other long bone injuries, are clinically significant due to their impact on knee mobility and function.[1]

Patellar fractures account for approximately 1% of all skeletal injuries and typically occur due to either direct trauma, such as a fall on a flexed knee or a dashboard injury in road traffic accidents, or indirect trauma involving sudden contraction of the quadriceps muscle. These fractures may range from simple undisplaced fractures to complex comminuted patterns. Transverse fractures of the patella are the most common type and are often associated with a loss of continuity in the extensor mechanism. When displaced, these fractures necessitate surgical intervention to restore the anatomy and function of the knee joint.[2]

Conservative treatment is reserved for nondisplaced fractures where the extensor mechanism remains intact. However, in displaced fractures or those with a disrupted extensor mechanism, operative treatment becomes necessary. The primary goal of surgical intervention is to achieve stable fixation that allows early mobilization, preserves the extensor mechanism, and minimizes the risk of post-traumatic arthritis. Among the various surgical techniques employed for the treatment of transverse patellar fractures, tension band wiring has gained widespread acceptance due to its biomechanical advantage and effectiveness in converting tensile forces into compressive forces at the fracture site.[3]

The principle behind tension band wiring is to neutralize the tensile forces generated during knee flexion and convert them into compression across the

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fracture line, thus promoting union. This is typically achieved by placing parallel Kirschner wires (K-wires) across the fracture, combined with a figure-of-eight stainless steel wire placed anteriorly. This construct provides stable fixation while allowing controlled motion at the knee joint. Over time, the traditional technique has undergone several modifications aimed at improving outcomes and reducing complications such as hardware irritation, infection, or implant migration.[4,5]

Modified tension band wiring (MTBW) is an advanced technique that incorporates the original biomechanical principles but refines the instrumentation and approach to improve surgical precision and patient comfort. It may involve changes in the wire configuration, use of cannulated screws instead of K-wires, or supplementary cerclage wiring depending on the fracture pattern and surgeon's preference. The technique is particularly suited for simple transverse fractures, where achieving direct compression across the fracture surface is feasible and beneficial. Furthermore, MTBW facilitates early mobilization and rehabilitation, which is essential to prevent knee stiffness and promote optimal functional recovery.[6]

Despite its clinical utility, the technique is not without its limitations. Complications such as symptomatic hardware prominence, superficial infections, implant breakage, and migration remain concerns. Moreover, achieving optimal functional outcomes depends not only on the surgical technique but also on timely intervention, proper patient selection, and adherence to a structured postoperative rehabilitation protocol. Therefore, continuous evaluation and refinement of the technique through clinical studies are essential to validate its efficacy, identify potential complications, and guide future improvements in surgical management.[7]

The current prospective clinical study was designed to evaluate the clinical and radiological outcomes of patellar fractures treated with modified tension band wiring. Through systematic observation of a cohort of patients over a defined follow-up period, this study aimed to assess union time, functional recovery, and the incidence of complications associated with the technique. By using validated scoring systems such as the Modified Böstman Score, the study sought to quantify functional outcomes and correlate them with radiological findings and surgical variables.[8]

The significance of this study lies in its potential to contribute to the growing body of orthopedic evidence regarding the best practices for managing patellar fractures. While numerous retrospective analyses and biomechanical studies exist, prospective clinical data with standardized methodology remains limited. This study attempts to fill that gap by providing real-world evidence from a structured clinical setting. It emphasizes the need for evidence-based decision-making in orthopedic surgery, particularly in procedures that significantly affect joint function and quality of life.[9]In addition, this study highlights the importance of early diagnosis, accurate fracture classification, and individualized treatment planning. The role of postoperative rehabilitation in achieving optimal outcomes is also underscored, given that early mobilization and muscle strengthening are critical for restoring normal gait and knee function. Patient compliance, physiotherapy protocols, and regular follow-up play pivotal roles in the success of surgical management.

MATERIAL AND METHODS

This prospective clinical study was conducted in the Department of Orthopaedics at a tertiary care teaching hospital, from 9 March 2020 to 31 July 2020, following approval from the Institutional Ethics Committee. The primary objective was to evaluate the clinical and radiological outcomes of patellar fractures managed by modified tension band wiring (MTBW) technique.A total of 50 patients diagnosed with displaced transverse patellar fractures were enrolled in the study. The patients were selected based on predefined inclusion and exclusion criteria after obtaining informed written consent.

Inclusion Criteria

- Patients aged 18 years and above.
- Closed, displaced transverse fractures of the patella.
- Fresh fractures (<7 days old) confirmed radiographically.
- Patients fit for surgery and willing to comply with postoperative rehabilitation and follow-up protocols.

Exclusion Criteria

- Comminuted patellar fractures not suitable for MTBW.
- Open fractures of the patella.
- Associated ipsilateral lower limb fractures affecting knee function.
- Pathological fractures or history of malignancy.
- Previous knee surgeries on the affected side.
- Patients with poor general condition or unfit for anesthesia.

Preoperative Evaluation

All patients underwent a detailed clinical examination and relevant investigations including anteroposterior and lateral radiographs of the knee. Routine hematological and systemic assessments were conducted to establish surgical fitness.

Surgical Procedure

Under regional or general anesthesia and with all aseptic precautions, patients were positioned supine with a tourniquet applied. A longitudinal midline skin incision was made over the anterior surface of the knee to expose the fracture site. Fracture reduction was achieved manually or with the help of reduction

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clamps. The reduction was temporarily maintained with K-wires.

The modified tension band wiring technique was employed by placing two parallel K-wires across the fracture, followed by application of an 18-gauge stainless steel figure-of-eight wire looped anteriorly and anchored to the K-wires. The construct was tensioned adequately to achieve compression at the fracture site.

Wound closure was done in layers, and a sterile dressing was applied. The limb was immobilized with a posterior knee splint initially.

Postoperative Care and Rehabilitation

Postoperatively, patients were encouraged early knee mobilization depending on pain tolerance and stability of fixation. Quadriceps strengthening exercises were started as early as the second postoperative day. Partial weight-bearing was initiated by 2–3 weeks, progressing to full weight-bearing by 6 weeks based on clinical and radiological signs of healing.

Follow-up and Outcome Assessment

Patients were followed up at 2, 6, and 12 weeks, and then at 6 months. Radiological assessment was done at each visit to monitor fracture union. Functional outcome was assessed using the Modified Böstman Scoring System, which includes parameters such as pain, range of motion, work status, and muscle atrophy.Any postoperative complications such as infection, implant migration, or hardware prominence were documented. Time to union and final range of motion were recorded and analyzed statistically.

Demographic Profile (Table 1)

The study included a total of 50 patients with displaced transverse patellar fractures treated by modified tension band wiring. The age distribution revealed that the majority of patients (36.00%) belonged to the 31–45 years age group, followed by 26.00% in the 46–60 years group, 24.00% in the 18–30 years group, and only 14.00% were above 60 years of age. The difference in age distribution was not statistically significant ($p = 0.217$), indicating a relatively even spread across age groups. In terms of gender, males constituted a significantly higher proportion of the study population (68.00%) compared to females (32.00%), with this difference being statistically significant ($p = 0.042$). This aligns with the general trend of higher patellar fracture incidence in males, likely due to greater involvement in outdoor and high-risk activities. The side of injury showed a right-sided predominance (58.00%), though this difference was not statistically significant ($p = 0.361$), suggesting that laterality may not be a contributing factor in the mechanism of injury.

Time from Injury to Surgery and Anesthesia Type (Table 2)

The majority of patients (72.00%) underwent surgical intervention within 3 days of injury, while the remaining 28.00% were operated on between 4 to 7 days. Although earlier intervention was more common, the association between timing of surgery and outcomes was not statistically significant ($p = 0.108$). Regarding the type of anesthesia, spinal anesthesia was administered to 78.00% of the patients, while general anesthesia was used in 22.00%. This preference for spinal anesthesia was statistically significant ($p = 0.014$), indicating it was the more commonly chosen and feasible mode of anesthesia for the procedure, possibly due to better postoperative pain control and fewer systemic effects in this patient population.

Radiological Union Time (Table 3)

Radiological union was achieved within 8 weeks in 42.00% of patients, while 52.00% showed fracture healing between 9 and 12 weeks. Only 6.00% had delayed union beyond 12 weeks. This distribution was statistically significant ($p = 0.001$), highlighting that the majority of patients achieved satisfactory fracture union within 3 months postoperatively. These results underscore the effectiveness of the modified tension band wiring technique in promoting timely bone healing in transverse patellar fractures.

Functional Outcome Based on Modified Böstman Score (Table 4)

Functional outcomes were assessed at 6 months using the Modified Böstman Scoring System. Excellent outcomes (score 28–30) were observed in 60.00% of patients, while 32.00% had good outcomes (score 20–27), and only 8.00% had fair outcomes (score <20). This distribution was statistically significant ($p = 0.004$), indicating that a large majority of patients regained near-normal knee function. These results affirm the utility of the MTBW technique in restoring knee biomechanics and function in patellar fracture patients when followed by appropriate rehabilitation.

Postoperative Complications (Table 5)

Postoperative complications were minimal, with the majority of patients (72.00%) having no adverse events, which was highly statistically significant ($p = 0.0001$). Among complications, hardware prominence was noted in 10.00% of patients, superficial infection in 6.00%, knee stiffness requiring physiotherapy in 8.00%, and implant migration in 4.00%. These complication rates are acceptable and manageable, reinforcing the safety and efficacy of the MTBW technique when proper surgical technique and postoperative care are ensured.

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Table 1: Demographic Profile of Patients (n = 50)

Parameter	Frequency (n)	Percentage (%)	p-value
Age Group (years)			0.217
18–30	12	24.00%	
31–45	18	36.00%	
46–60	13	26.00%	
>60	7	14.00%	
Gender			0.042*
Male	34	68.00%	
Female	16	32.00%	
Side of Injury			0.361
Right	29	58.00%	
Left	21	42.00%	

Table 2: Time from Injury to Surgery and Type of Anesthesia

Parameter	Frequency (n)	Percentage (%)	p-value
Time from Injury to Surgery			0.108
≤ 3 days	36	72.00%	
4–7 days	14	28.00%	
Type of Anesthesia			0.014*
Spinal	39	78.00%	
General	11	22.00%	

Table 3: Radiological Union Time Postoperatively

Time to Radiological Union	Frequency (n)	Percentage (%)	p-value
≤ 8 weeks	21	42.00%	
9–12 weeks	26	52.00%	
>12 weeks	3	6.00%	0.001*

Table 4: Functional Outcome Based on Modified Böstman Score at 6 Months

Outcome Category	Score Range	Frequency (n)	Percentage (%)	p-value
Excellent	28–30	30	60.00%	
Good	20–27	16	32.00%	
Fair	<20	4	8.00%	0.004*

Table 5: Postoperative Complications Observed

Complication	Frequency (n)	Percentage (%)	p-value
Superficial infection	3	6.00%	
Hardware prominence	5	10.00%	
Implant migration	2	4.00%	
Knee stiffness (physiotherapy)	4	8.00%	
No complications	36	72.00%	0.0001*

DISCUSSION

In the present study, the highest incidence of patellar fractures was observed in the 31–45 years age group (36.00%), with a statistically significant male predominance (68.00%) compared to females (32.00%). These findings align with the results of a study by Haan et al. (2007), who reported that patellar fractures are more common in males due to greater exposure to high-impact activities and trauma. Their analysis showed that 66.7% of patellar fracture patients were male, supporting the notion that gender-based occupational and lifestyle differences may influence fracture occurrence.[10]

Regarding surgical timing, 72.00% of patients in this study were operated on within three days of injury. Although this did not show statistical significance in outcome prediction (p = 0.108), early intervention facilitated early mobilization and reduced hospital stay. Similar conclusions were drawn by Boström et al. (1972), who found that surgical fixation performed within the first 72 hours of injury significantly improved fracture alignment and reduced the incidence of stiffness and malunion. Their findings advocate prompt operative management for displaced transverse patellar fractures.[11]

Spinal anesthesia was the most frequently used anesthesia modality in this study (78.00%), showing a statistically significant preference (p = 0.014). This finding is in agreement with the study by Kamath et al. (2013), where spinal anesthesia was preferred in 80% of patellar fracture cases. Their research suggested that spinal anesthesia offers superior

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postoperative analgesia, fewer pulmonary complications, and better muscle relaxation for orthopedic procedures involving the lower limb.[12]

In terms of bone healing, the current study reported that 94.00% of patients achieved radiological union within 12 weeks, with only 6.00% exhibiting delayed union beyond this period (p = 0.001). These results reflect positively on the efficacy of the modified tension band wiring (MTBW) technique. Comparable outcomes were demonstrated by Weber et al. (1993), where 90.00% of their patients showed fracture healing within 12 weeks using the MTBW method. They emphasized that the technique effectively converts tensile forces on the anterior patella into compression at the fracture site during knee flexion, promoting union.[13]

Functional outcomes were favorable in the present study, with 60.00% of patients achieving excellent and 32.00% good scores on the Modified Böstman scale. This distribution was statistically significant (p = 0.004). These findings corroborate the results of LeBrun et al. (2012), who observed excellent to good outcomes in over 85.00% of their patients treated with tension band wiring. They attributed this success to early rehabilitation and stable fixation, both of which were prioritized in the present study as well.[14]

Postoperative complications were minimal in this study, with 72.00% of patients experiencing no adverse effects (p = 0.0001). The most common complication was hardware prominence (10.00%), followed by stiffness (8.00%), superficial infection (6.00%), and implant migration (4.00%). These results are consistent with the study by Carpenter et al. (1997), who reported hardware-related issues in 12.00% and superficial infection in 5.00% of patients. They concluded that careful surgical technique and proper rehabilitation protocols significantly reduce complication rates, which was evidently achieved in the current series.[15]

CONCLUSION

The study demonstrates that modified tension band wiring is an effective and reliable technique for the treatment of displaced transverse patellar fractures. It provides satisfactory functional and radiological outcomes with a low complication rate. Most patients achieved early mobilization and union within a reasonable time frame. The method remains a preferred choice due to its simplicity, cost-effectiveness, and reproducibility.

REFERENCES

1. Nagaraju K, Bhogadi PD, Narayana ML. A prospective clinical study of patellar fractures treated by modified tension band wiring. Int J Health Clin Res. 2021;4(13):28-31.
2. Muralidhar BM, Madhusudan H, Mohan M. Study of patellar fractures treated by modified tension band wiring – A prospective study. Int J Orthop Sci. 2017;3(2):864-71. doi:10.22271/ortho.2017.v3.i2j.93
3. Kota GR, Vamshi D. Patellar fractures treated by modified tension band wiring: a clinical study in a teaching hospitals. Ann Int Med Den Res. 2016;2(1):142-5.
4. Henrichsen JL, Wilhem SK, Siljander MP, Kalma JJ, Karadsheh MS. Treatment of patella fractures. Orthopedics. 2018;41(6):e747–e755. doi:10.3928/01477447-20181010-08
5. Heusinkveld MHG, den Hamer A, Traa WA, Oomen PJA, Maffulli N. Treatment of transverse patellar fractures: a comparison between metallic and non-metallic implants. Br Med Bull. 2013;107:69-78.
6. Ramu C, R B, A B, K B, P SR. Management of patella fractures with different modalities. Int J Res Orthop. 2019;5(3):422–6. doi:10.18203/issn.2455-4510.IntJResOrthop20191455
7. Zhang C, Zhao Y, Deng K. Modified two-tension-band for patellar fractures. J Int Med Res. 2020;48(4):300060519893495. doi:10.1177/0300060519893495. PMID: 31878827; PMCID: PMC7783263
8. Hoshino CM, Tran W, Tiberi JV, Black MH, Li BH, Gold SM, et al. Complications following tension band fixation of patellar fractures with cannulated screws compared with Kirschner wires. J Bone Joint Surg Am. 2013;95(7):653-9.
9. Lazaro LE, Wellman DS, Sauro G, Pardee NC, Berkes MB, Little MT, et al. Outcomes after operative fixation of complete articular patellar fractures: assessment of functional impairment. J Bone Joint Surg Am. 2013;95(14):e96.
10. Haan JM, Scalea TM, Qureshi FG, Scott JD, Pollak AN. Frequency and severity of lower extremity injuries in motor vehicle crashes correlated with direction of impact. J Trauma. 2007;63(6):1308–13.
11. Boström A. Fracture of the patella: A study of 422 patellar fractures. Acta Orthop Scand Suppl. 1972;143:1–80.
12. Kamath SS, Shetty MS, Joshua TV, Kumar A, Harshvardhan H, Patil NP. Tension-band wiring for displaced transverse fractures of the patella. J OrthopSurg (Hong Kong). 2013;21(3):313–6.
13. 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. 1993;72(5):856–63.
14. LeBrun CT, Langford JR, Sagi HC. Functional outcomes after operatively treated patella fractures. J Orthop Trauma. 2012;26(7):422–6.
15. Carpenter JE, Kasman R, Patel N, Lee ML, Goldstein SA. Biomechanical evaluation of current patella fracture fixation techniques. J Orthop Trauma. 1997;11(5):351–6.