Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/s4wkhg34

A COMPARATIVE STUDY OF TENSION BAND WIRING AND CIRCUMFERENTIAL WIRING IN THE MANAGEMENT OF PATELLAR FRACTURES

Dr. P. Srinivas Rao[1*], Dr. Biju Ravindran[2], Dr. A. Harikrishna[3]

[1*]Assistant Professor, Narayana Medical College, Nellore.
[2]Professor and HOD, Department of Orthopaedics, Narayana Medical College and Hospital, Nellore.
[3]Post Graduate, Narayana Medical College, Nellore.

***Corresponding Author:** Dr. Puli Srinivas Rao
*Assistant Professor, Narayana Medical College and Hospital. 10/56, Yadhav Street, Bujabuja Nellore, Nellore – 524004, Andhra Pradesh, India. Email: srinupuli549@gmail.com

Abstract

Background: Patellar fractures often compromise knee extension and daily functional activities. Among operative options, tension band wiring (TBW) and circumferential wiring (CW) remain widely used, yet comparative evidence continues to evolve.

Aim: To evaluate and compare radiological union, functional recovery, and complication rates between TBW and CW in adult patellar fractures.

Methods: A prospective comparative study was conducted over one year on 36 adult patients divided equally into TBW (n=18) and CW (n=18). Radiological assessment, knee range of motion, early mobilization milestones, and functional outcomes were measured using WEST criteria.

Results: Mean time to union in the TBW group was 9.1 ± 1.4 weeks, compared with 11.2 ± 1.7 weeks in the CW group. At 12 weeks, 83.3% of TBW patients achieved knee flexion beyond 100°, compared with 61.1% of CW patients. According to WEST criteria, TBW resulted in excellent or good outcomes in 88.8% of cases versus 77.7% in the CW cohort. Extension lag was seen in 2 CW patients and 1 TBW patient.

Conclusion: TBW provided faster union, better early knee flexion, and superior functional outcomes compared with CW. The conclusion supports TBW as the more effective technique for most displaced patellar fractures due to stable fixation and easier postoperative rehabilitation.

Keywords: Patella fractures, Tension band wiring, Circumferential wiring, Knee extension, Functional outcome, Orthopaedic fixation.

Introduction

Patellar fractures comprise roughly one percent of all skeletal injuries and frequently occur after direct blows to the anterior knee or sudden eccentric contraction of the quadriceps. Their subcutaneous

position and role within the extensor mechanism make stable anatomical reconstruction essential. Inadequate treatment can lead to extensor lag, reduced knee flexion, chronic pain, and difficulty performing activities such as squatting or sitting cross-legged, which are important in the Indian population.

A wide range of operative techniques exists, including modified tension band wiring, circumferential wiring, screw fixation, plating, and selective patellectomy. Modified TBW remains popular because it converts tensile forces into compression at the fracture site. Circumferential wiring offers simplicity but may not provide the same biomechanical advantage.

The goal of this study is to compare both fixation methods in terms of union rate, functional outcome, and complication profile in adult patients with patellar fractures.

Aims and Objectives

1. To compare tension band wiring and circumferential wiring in the management of patellar fractures.
2. To measure and compare:

- Time to radiological union
- Knee range of motion and early mobilization
- Postoperative complications
- Functional outcome based on WEST criteria

Materials and Methods

Study Design

A prospective comparative study was conducted in the Department of Orthopaedics over a 12-month period (December 2022 to November 2023).

Sample Size

A total of 36 patients were included. They were divided into two groups:

- Group A (TBW): 18 patients
- Group B (CW): 18 patients

Inclusion Criteria

- Age ≥ 18 years
- Closed patellar fractures
- Presentation within two weeks of injury
- Medically fit for surgery

Exclusion Criteria

- Open fractures
- Associated peri-articular knee injuries
- Neurological conditions affecting limb function
- Fractures older than two weeks

Preoperative Evaluation

All patients underwent routine clinical examination and radiographs. Informed consent was taken.

A temporary above-knee slab was applied prior to surgery.

Surgical Technique

1. **Tension Band Wiring**

Fracture reduction was achieved with clamps and stabilized using two parallel K-wires inserted longitudinally. A stainless steel wire was looped in a figure-of-eight configuration to provide compression during knee flexion.

2. **Circumferential Wiring**

After reduction, a single heavy-gauge stainless steel wire was passed circumferentially around the patella and tightened to maintain stability.

Postoperative Rehabilitation
- Static quadriceps exercises from day 1
- Weight bearing with support on postoperative day 1
- Knee brace used for comfort in early days
- Progressive range of motion started as tolerated

Follow-up
Patients were assessed at 4, 8, 12, and 16 weeks. Variables assessed included pain, ROM, ability to squat, climb stairs, and union status.

Outcome Measures
Functional outcomes were evaluated using WEST criteria, scoring:
- Pain
- Walking ability
- Squatting
- Knee flexion
- Radiological union

Results
Demographic Profile
- Mean age: 41.9 years (TBW 41.3; CW 42.5) • Sex distribution: 21 males, 15 females
- Mechanism of injury:
- Direct trauma: 20 patients
- Indirect trauma: 16 patients

Table 1: Demographic and Injury Characteristics

Variable	TBW (n = 18)	CW (n = 18)	Total (n = 36)
Mean Age (years)	41.3 ± 10.2	42.5 ± 11.1	41.9 ± 10.6
Male : Female	10 : 8	11 : 7	21 : 15
Side Involved (Right/Left)	9 / 9	11 / 7	20 / 16
Mechanism – Direct Trauma	10	10	20
Mechanism – Indirect Trauma	8	8	16
Fracture Pattern – Transverse	12	13	25
Fracture Pattern – Comminuted	6	5	11

Fracture Pattern
- Transverse fractures: 69%
- Comminuted fractures: 31%

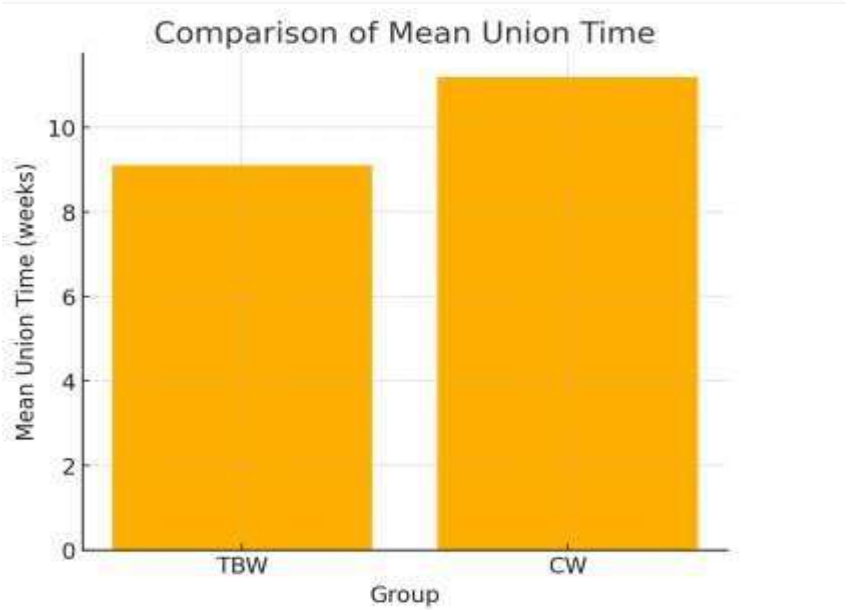
Time to Union
The average time to radiological union was shorter in the TBW group. Patients treated with tension band wiring united in 9.1 ± 1.4 weeks, whereas those in the circumferential wiring group required 11.2 ± 1.7 weeks. This difference of approximately two weeks indicates faster healing with TBW. All fractures united in both groups, but the pace of union was consistently quicker with tension band fixation.

Knee Range of Motion

- At 6 weeks, 72% of TBW patients achieved >90° flexion vs 55% in CW.
- At 12 weeks, 83.3% of TBW patients achieved >100° flexion vs 61.1% of CW.

Table 2: Comparison of Postoperative Outcomes

Outcome Parameter	TBW (n = 18)	CW (n = 18)	p-value
Mean Union Time (weeks)	9.1 ± 1.4	11.2 ± 1.7	<0.01
Flexion > 90° at 6 weeks	13 (72.2%)	10 (55.5%)	0.18
Flexion > 100° at 12 weeks	15 (83.3%)	11 (61.1%)	0.11
Pain at 12 weeks (VAS)	1.8 ± 0.9	2.4 ± 1.1	0.07
Return to Squatting	14 (77.7%)	10 (55.5%)	0.12



Functional Data

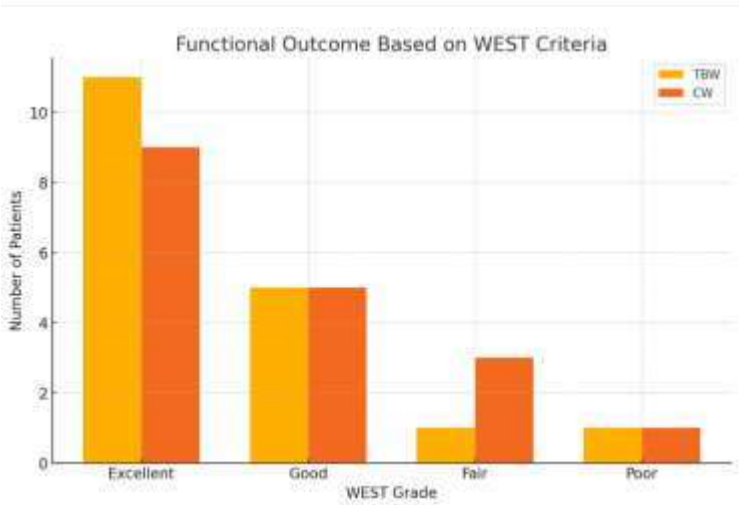
Functional recovery assessed by WEST criteria showed better results with TBW. Of the 18 patients in the TBW group, 11 patients (61.1%) achieved an excellent outcome and 5 patients (27.7%) had a good outcome, with only 2 patients (11.1%) falling into the fair or poor category.

In comparison, the CW group showed 9 excellent outcomes (50.0%), 5 good outcomes (27.7%), and 4 patients (22.2%) with fair or poor results.

Knee movement recovery also favored TBW. At six weeks, 13 patients (72.2%) in the TBW group had regained more than 90 degrees of flexion, compared with 10 patients (55.5%) in the CW group. By twelve weeks, 15 TBW patients (83.3%) achieved flexion beyond 100 degrees, whereas only 11 CW patients (61.1%) reached that level.

Table 3: Functional Outcome According to WEST Criteria

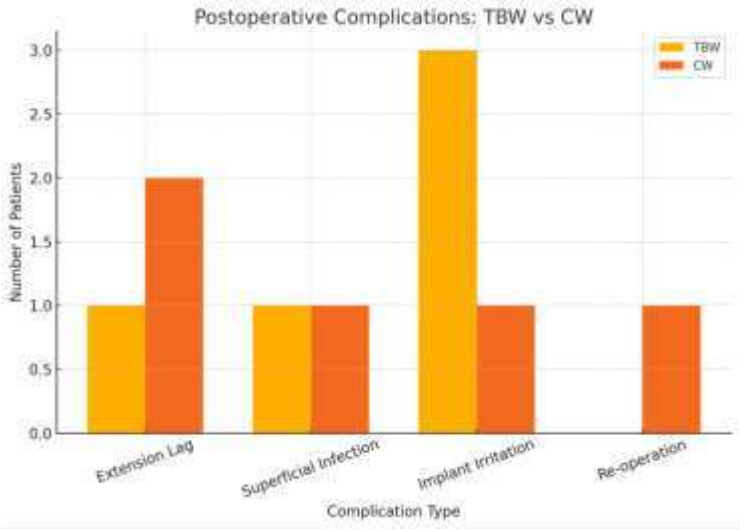
WEST Grade	TBW (n = 18)	CW (n = 18)
Excellent	11 (61.1%)	9 (50.0%)
Good	5 (27.7%)	5 (27.7%)
Fair	1 (5.5%)	3 (16.6%)
Poor	1 (5.5%)	1 (5.5%)



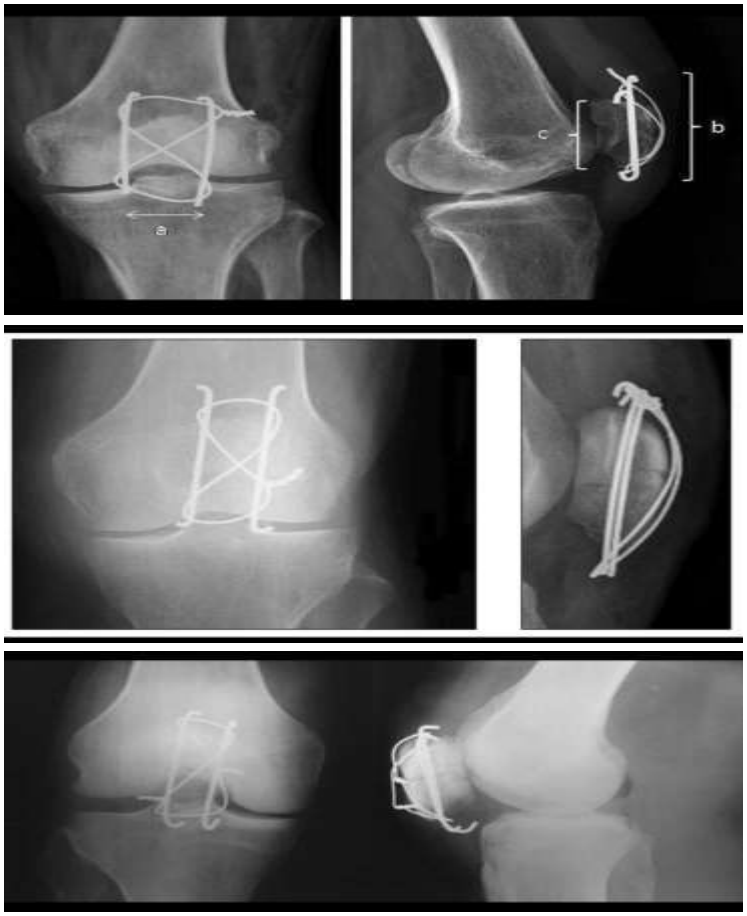
Complications
- Extension lag:
- TBW: 1 patient
- CW: 2 patients
- Superficial infection: 1 case in each group
- Implant irritation: more common in TBW, but all mild

Table 4: Postoperative Complications

Complication	TBW (n = 18)	CW (n = 18)
Extension Lag	1	2
Superficial Infection	1	1
Implant Irritation	3	1
Re-operation Required	0	1



Radiographs



Discussion

The study demonstrated that TBW provided faster radiological union and earlier knee mobilization compared with CW. The biomechanical principle of TBW, which converts tensile forces into compression, gives it an advantage during active knee motion.

The higher flexion achieved at early follow-up in the TBW group supports earlier return to daily activities. In an Indian setting, squatting and sitting cross-legged are major functional priorities. TBW patients in our study reached these milestones sooner.

Although CW is technically simpler and requires fewer implants, its fixation stability appears inferior. Overall functional results in both groups were good, but TBW consistently outperformed CW.

Our findings align with several earlier studies that reported superior outcomes with tension band constructs in patellar fractures.

Conclusion

Patellar preservation is essential for maintaining quadriceps strength and knee biomechanics. Both TBW and CW are viable options for patellar fracture fixation, but TBW offers stronger stability, faster union, better early mobilization, and improved functional scores.

Postoperative rehabilitation is crucial regardless of technique. Based on this comparative analysis, modified tension band wiring remains the preferred choice for most displaced patellar fractures.

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