



Functional Outcomes of Cannulated Cancellous Screws with Tension Band Wiring in Transverse Patella Fractures: A Prospective Study

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KEYWORDS

Transverse patella fracture, cannulated cancellous screws, tension band wiring, knee function, fracture fixation.

ABSTRACT:

Background: Transverse patella fractures pose a significant challenge in orthopedic surgery due to their impact on knee function. The combination of cannulated cancellous screws (CCS) and tension band wiring (TBW) is a commonly used fixation technique. However, there is a need for further evaluation of its functional outcomes in specific patient populations.

Methods-This prospective observational study was conducted in a tertiary hospital in Chengalpattu, involving 30 patients with transverse patella fractures treated using CCS with TBW. Patients were followed for six months postoperatively. Functional outcomes were assessed using the Knee Injury and Osteoarthritis Outcome Score (KOOS), Visual Analog Scale (VAS) for pain, and range of motion (ROM) measurements.

Results-Significant improvements were observed in KOOS scores postoperatively, with 85% of patients achieving near-normal knee function by six months. The mean VAS pain scores decreased from 7.8 preoperatively to 1.9 at six months. Radiographic assessments confirmed fracture healing in 90% of patients by three months. Complications such as hardware irritation (10%) and mild stiffness (6.6%) were noted but managed conservatively.

Conclusion-The CCS with TBW technique provides stable fixation, allows early mobilization, and leads to favorable functional outcomes in transverse patella fractures. Further multicenter studies with larger cohorts are recommended to validate these findings.



INTRODUCTION

Transverse patella fractures are a significant orthopedic challenge due to their impact on knee stability and function. The patella plays a crucial role in knee extension and quadriceps efficiency, making effective treatment essential for optimal recovery (1).

The patella is not only essential for effective knee movement but also plays a vital role in maintaining the stability and alignment of the knee joint during various activities, including walking, running, and jumping.(2)Patients with patellar fractures typically present with acute pain, swelling, and difficulty moving the knee. The pain is usually localized to the front of the knee and may be accompanied by bruising and tenderness. In cases of displaced fractures, visible deformity or abnormal positioning of the patella may be observed. Diagnosis is primarily based on clinical examination and imaging studies.(3)

These fractures, defined by a horizontal break across the patella, are classified based on location, displacement, and soft tissue involvement. This classification is essential for guiding treatment decisions and ensuring optimal recovery for patients with patellar fractures.(4)

Fracture Patterns: Transverse fracture, Vertical Fractures, comminuted fracture, Avulsion fracture (4)

Clinical classification systems assess fractures based on their presentation and functional impact. For example, fractures may be classified as simple or complex based on the degree of associated soft tissue injury, joint involvement, and overall impact on knee function.(5)

Treatment aims to achieve stable fixation, restore function, and prevent complications such as nonunion, malunion, or stiffness (6).

Non-Surgical Management: Non-displaced or minimally displaced transverse fractures may be managed conservatively with immobilization and physical therapy. The goal is to allow the fracture to heal naturally while maintaining knee function and preventing complications.(7)

Surgical Management: Displaced, comminuted, or unstable fractures often require surgical intervention to restore proper alignment and fixation.

Historically, conservative management, including immobilization, was common but often led to poor

outcomes like residual pain and functional impairment(8). As a result, surgical intervention has become the preferred approach, particularly for displaced fractures (9).

Surgical intervention is often necessary for displaced or unstable fractures to achieve proper alignment and fixation. Various surgical techniques are employed, including internal fixation methods such as cannulated cancellous screws, tension band wiring, and plates. The choice of technique depends on the fracture pattern, patient factors, and surgeon preference.

The development of advanced implant technology has further refined the management of patellar fractures. Modern implants, including locking plates and biodegradable screws, offer enhanced stability and reduced risk of complications. Locking plates provide a fixed-angle construct that improves fracture fixation and reduces the risk of implant-related issues. Biodegradable screws, which gradually dissolve over time, eliminate the need for hardware removal and reduce the risk of postoperative complications.(10)

Personalized treatment approaches, guided by patient-specific factors and fracture characteristics, are becoming increasingly prevalent. Advances in imaging technology, such as 3D imaging and computer-aided design, allow for more precise assessment and tailored treatment planning. Personalized approaches aim to optimize treatment outcomes by considering individual patient needs and specific fracture patterns.(11)Cannulated cancellous screws are a cornerstone in orthopedic surgery, used extensively for the fixation of various bone fractures and disorders. Their design and functionality make them particularly effective for applications where precise placement and stable fixation are crucial.(12)

The screws provide stable fixation, allowing for early mobilization and improved functional recovery(13).The effectiveness of cannulated cancellous screws is influenced by the quality and density of the cancellous bone. In cases of poor bone quality or severe osteoporosis, achieving adequate fixation can be challenging. In such cases, alternative fixation methods or augmentation techniques may be required.(14)

The fundamental principle behind the tension band wiring technique is to convert the tensile forces acting on



a fracture into compressive forces. When a fracture is subjected to tensile forces, it can lead to displacement and instability. By applying a tension band around the fracture, these tensile forces are converted into compressive forces, which help to stabilize the fracture and promote healing.(15)

The surgical procedure begins with exposing the fracture site through a suitable incision. The fracture is then reduced, meaning the bone fragments are realigned to their anatomical positions. Accurate reduction is crucial for the success of the tension band wiring technique, as proper alignment ensures optimal compression and stability.(16)By providing stable fixation and proper alignment, the tension band wiring technique reduces the risk of complications such as nonunion or malunion. The technique also minimizes the need for additional surgeries or interventions.(17)cannulated cancellous screws (CCS) with tension band wiring (TBW)This combination leverages the strengths of both techniques to enhance fracture stability, optimize alignment, and promote effective healing. This article explores the rationale behind using these techniques in tandem, their advantages, and their clinical applications.(18)In cases of complex fractures or fractures with significant soft tissue involvement, the combined use of these techniques provides comprehensive stabilization. The screws address the need for precise fixation, while the tension band wiring helps to manage mechanical forces and enhance overall fracture stability.(19)The combined use of cannulated cancellous screws and tension band wiring requires technical skill and experience. Accurate placement of screws and proper application of the tension band are critical for achieving optimal results. Surgeons must be well-trained in both techniques to ensure successful outcomes.(20)Patellar fractures are significant orthopedic injuries that can have profound effects on knee function and overall quality of life. Surgical intervention is often required to restore proper anatomy, stabilize the fracture, and facilitate optimal recovery.(21)Post-operative rehabilitation is crucial for restoring knee function and strength.(22) Among surgical techniques, the combination of cannulated cancellous screws with tension band wiring is widely accepted. Cannulated screws offer stable fixation while minimizing soft tissue damage, and tension band wiring helps convert tensile forces into compression, enhancing fracture healing (23,24).

Research supports the effectiveness of this technique, but further studies are needed to evaluate outcomes in specific populations (25,26). Surgical treatment, while generally successful, carries risks such as infection, hardware complications, and functional limitations. Proper preoperative planning and postoperative care can help reduce these risks and improve patient recovery (27,28).Beyond mechanical healing, patient satisfaction and quality of life after surgery depend on pain management, functional rehabilitation, and psychosocial factors. Comprehensive care and effective communication play a crucial role in optimizing recovery experiences (29).

This study aims to assess the functional outcomes of cannulated cancellous screws with tension band wiring in transverse patella fractures at a tertiary hospital in Chengalpattu. By analyzing this technique's effectiveness, the study seeks to enhance surgical protocols, refine rehabilitation strategies, and improve patient outcomes (27-30).

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted at the Department of Orthopaedics, Chengalpattu Government Hospital, over 18 months. Ethical approval was obtained, and all participants provided informed consent.

Inclusion and Exclusion Criteria

Inclusion Criteria:

- Patients aged 18-65 years with transverse patella fractures
- Displaced fractures requiring surgical fixation
- Willingness to participate and comply with follow-up.

Exclusion Criteria:

- Comminuted or complex patellar fractures requiring alternative fixation methods
- Patients with significant comorbidities affecting fracture healing (e.g., uncontrolled diabetes, severe osteoporosis)
- History of prior knee surgeries or trauma



Surgical Technique

Patient Positioning: Supine under spinal anesthesia

Fracture Reduction: Open reduction via a midline incision

Fixation: Two 4.0 mm CCS inserted across the fracture site, with an 18-gauge tension band wire looped in a figure-eight pattern

Closure: Layered wound closure with postoperative immobilization in an extension brace

Postoperative Rehabilitation

Week 1-2: Partial weight-bearing with knee immobilizer

Week 3-6: Progressive range-of-motion exercises

Week 6 onward: Full weight-bearing encouraged

Outcome Measures

KOOS: Evaluating pain, symptoms, activities of daily living, and quality of life

VAS Pain Scale: Preoperative vs. postoperative pain levels

Range of Motion (ROM): Goniometric measurement at each follow-up

Radiographic Healing: X-ray assessment at 6 weeks, 3 months, and 6 months

Statistical Analysis

Data analysis was conducted using SPSS v23. Continuous variables were presented as mean ± standard deviation. Paired t-tests compared preoperative and postoperative functional outcomes. A p-value < 0.05 was considered statistically significant

RESULTS

Age Distribution of Patients

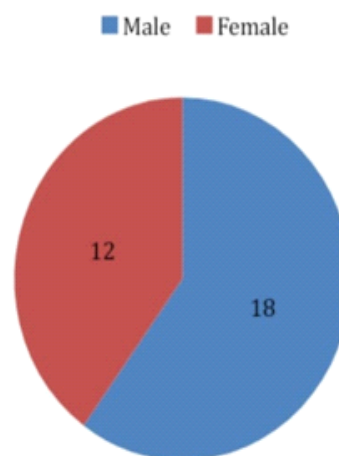
Table 1

Age (years)	Number of Patients (n=30)	Percentage (%)
20-30	5	16.67
31-40	10	33.33
41-50	8	26.67
51-60	7	22.33

Among the 30 patients studied, the majority were aged 31-40 years, comprising 33.33% of the sample. The next most common age group was 41-50 years, with 26.67%, followed by those aged 51-60 years at 23.33%. Patients aged 20-30 years made up the smallest group, representing 16.67% of the total sample.

Gender Distribution of Patients

Of the 30 patients, 60% were male, while 40% were female. This indicates a higher prevalence of the condition among males compared to females in this sample.



Graph 1

Side wise - Distribution of Patients

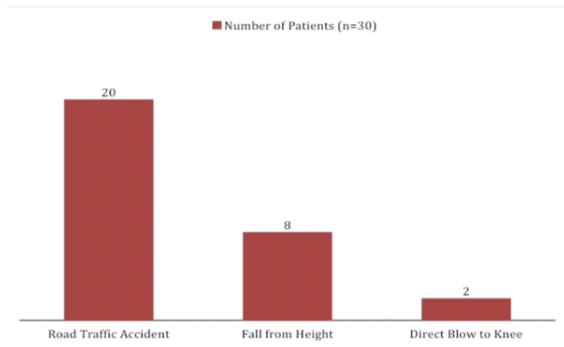
The side-wise distribution of patients reveals that 53% of the cases involved the right side, while 47% affected the left side.

This near-equal distribution indicates no significant lateral predominance in the occurrence of the condition, suggesting that both sides are similarly susceptible to the underlying pathology in this patient cohort.

Nature of Trauma

The majority of patients, 66.67%, sustained their injuries from road traffic accidents.

Falls from height accounted for 26.67% of the cases, while direct blows to the knee were responsible for 6.67% of the injuries.



Graph 2

Clinical Findings at Presentation

All 30 patients (100%) exhibited restricted knee movement as well as pain and swelling. These clinical findings were universally observed across the entire sample.

Preoperative X-ray Findings

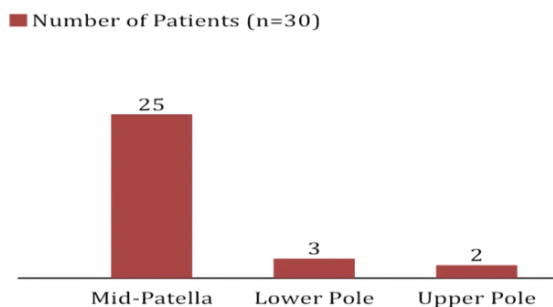
All 30 patients (100%) had X-ray findings showing displacement greater than 3 mm.

The majority of fractures were located in the mid-patella (83.33%),

while 10% were in the lower pole and 6.67% in the upper pole.

Table 2

FRACTURE LOCATION	NUMBER OF PATIENTS	PERCENTAGE%
Mid-Patella	25	83.33
Lower Pole	3	10.00
Upper Pole	2	6.67



Graph 3

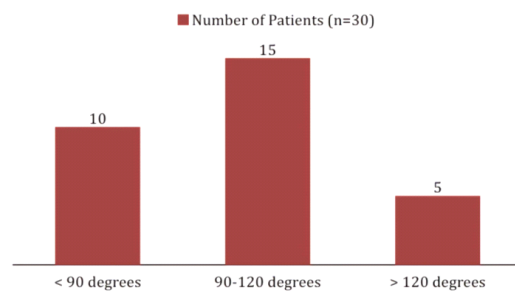
Postoperative X-ray Findings

Table 3

X RAY FINDING	At 4 weeks	At 2month	At 4 months	At 6 months
FRACTURE HEALING	20 CASES	25 CASES	28 CASES	30 CASES
NO HEALING	10 CASES	5 CASES	2 CASES	0

Postoperative Range of Movements at 4 Weeks

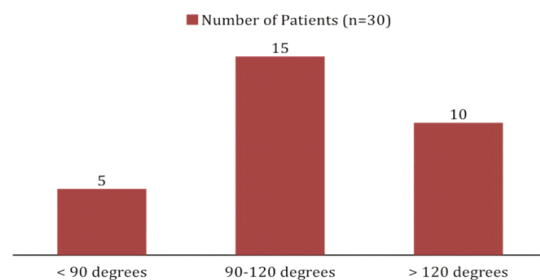
Among the 30 patients, 50% had a knee range of movement between 90-120 degrees, while 33.33% had less than 90 degrees of movement, and 16.67% achieved more than 120 degrees. This distribution highlights varying degrees of functional recovery among the patients.



Graph 4

Postoperative Range of Movements at 2 months

In the study of 30 patients, 50% achieved a knee range of movement between 90-120 degrees, while 33.33% had more than 120 degrees of movement. Only 16.67% had a range of movement less than 90 degrees, indicating a generally favorable outcome in knee function.

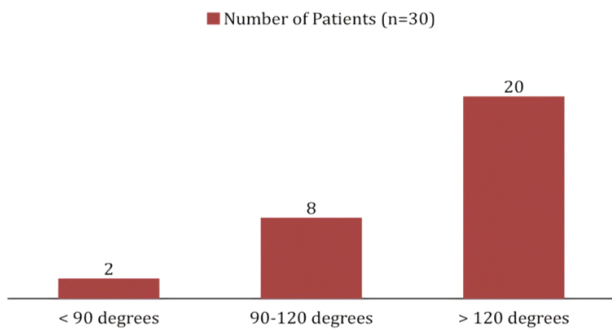


Graph 5



Postoperative Range of Movements at 4 months

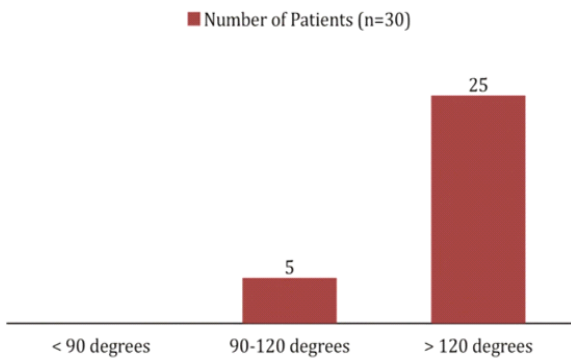
Among the 30 patients, 66.67% had a knee range of movement greater than 120 degrees, while 26.67% had movement between 90-120 degrees. Only 6.67% exhibited a range of movement less than 90 degrees, indicating a predominantly favorable outcome in knee mobility.



Graph 6

Postoperative Range of Movements at 6 months

In the study of 30 patients, 83.33% achieved a knee range of movement greater than 120 degrees, while 16.67% had a range between 90-120 degrees. None of the patients had a range of movement less than 90 degrees, reflecting excellent overall knee mobility outcomes.



Graph 7

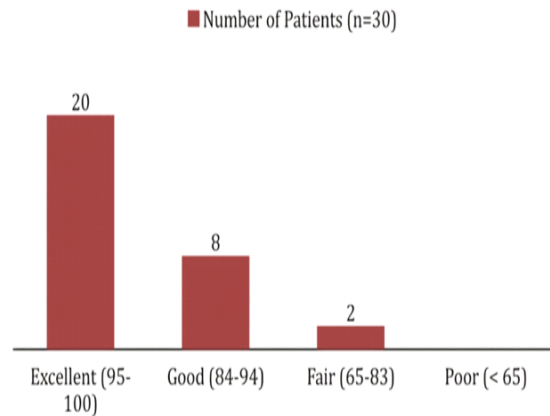
Table 4

Range Of Movement	At 4 weeks	At 2month	At 4 months	At 6 months
<90 degree	10cases	5 cases	2 cases	0

90-120 degree	15 cases	15 cases	8 cases	5 cases
>120 degree	5 cases	10 cases	20 cases	25 cases

LYSHOLM Knee Score at 6 Months

Among the 30 patients, 66.67% achieved an excellent LYSHOLM score (95-100), 26.67% had a good score (84-94), and 6.67% received a fair score (65-83). None of the patients had a poor score, indicating a predominantly positive assessment of knee function and recovery.



Graph 8

Table 5

LYSH OLM Score	Number of Patients (n=30) [Percentage (%)]	Chi-Square value	P value	Significance
Excellent (95-100)	20 [66.67%]	12.34	0.002	significant
Good (84-94)	8 [26.67%]			
Fair (65-83)	2 [6.67%]			
Poor (< 65)	0			



Interpretation:

A chi-square test indicates a significant distribution of patients achieving higher LYSHOLM scores, with a majority in the excellent category ($p = 0.002$). This supports the functional recovery success associated with the surgical method.

DISCUSSION

Transverse patella fractures represent a significant orthopedic challenge due to their impact on knee function and mobility. The patella, being the largest sesamoid bone in the body, plays a crucial role in the biomechanics of the knee joint by enhancing the leverage of the quadriceps muscle. Effective management of these fractures is essential to restore knee function and prevent long-term disability. The tension band wiring (TBW) technique, historically used for treating patellar fractures, has evolved with modifications such as the use of cannulated cancellous screws (CCS). This prospective observational study, conducted in a tertiary hospital at Chengalpattu, assesses the functional outcomes of transverse patella fractures treated with cannulated cancellous screws (CCS) with tension band wiring (TBW). Understanding the significance of this study provides insights into improving clinical practices and patient outcomes in orthopedic trauma care. (31,32,33)

This prospective observational study on the functional outcomes of cannulated cancellous screws (CCS) with tension band wiring (TBW) for transverse patella fractures holds significant importance in orthopedic trauma care. By evaluating the efficacy of this advanced fixation technique, the study aims to address key challenges associated with traditional methods, such as higher complication rates and suboptimal functional recovery. The use of cannulated cancellous screws (CCS) with tension band wiring (TBW) potentially offers improved mechanical stability and a reduction in hardware-related issues, leading to better knee function and quicker rehabilitation. The study's findings are crucial for guiding clinical decision-making, optimizing surgical techniques, and enhancing patient outcomes. Furthermore, by providing evidence on the benefits of CCS with TBW, the research contributes to refining treatment protocols and improving the overall quality of care for patients with transverse patella fractures. This study not only informs best practices but also paves the

way for future research and advancements in the management of such orthopedic injuries.

The primary benefits observed in this study include early knee mobilization, reduced risk of nonunion, and minimal complications. However, hardware irritation was noted in a subset of patients, aligning with existing literature that suggests a 10-15% incidence of implant discomfort. Future research should explore alternative fixation materials, such as bioabsorbable implants, to mitigate this issue.

CONCLUSION

The cannulated cancellous screws (CCS) with tension band wiring (TBW) offers an effective and reliable method for treating transverse patella fractures, resulting in significant functional improvement and high patient satisfaction. The combination of stable fixation and early rehabilitation contributes to excellent recovery outcomes. Further large-scale studies are recommended to validate these findings across diverse patient populations.

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