

Research Article

Evaluation of clinical outcomes after tension band wiring for transverse fractures of the patella

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Abstract

Background: Patella fractures constitute about 1 percent of skeletal trauma, and normally result either as a direct impact to the knee, or an abrupt and forceful drawing in of the quadriceps muscle. The position of the patella is superficial which makes it especially susceptible to trauma. It is an important aspect of the extensor mechanism of the knee, and its anatomy is important in achieving the best performance of the joints. There are many factors impacting the recovery process such as pattern of the fracture, precision of reduction, fixation stability, and quality of postoperative rehabilitation. This paper will examine functional outcomes of tension band wiring (TBW) in patients who have transverse patellar fractures.

Study design: Prospective cohort study

Duration and place of study: This study was conducted at Liaquat National Hospital and Medical College Karachi from August 2024 to August 2025

Methodology: One hundred and fifty patients (112 men and 38 women) having transverse fracture of patella were organised under the operation involving the TBW method. Knee pain scoring and Goodfellow grading system were used to measure the range of motion and the functionality of the knee in the postoperative functional outcomes.

Results: Among 150 patients, 120 of them were well-adjusted, 20 demonstrated good recovery, and 10 showed fair results. The vast majority of the participants had reliable fixation and satisfactory knee mobility with few complications. Radiological assessment at the end of the follow-up period showed that almost all fractures had healed with almost no one showing a relapse of their daily functioning.

Conclusion: TBW is a reliable and useful surgical process applied to treat transverse patella fractures. It gives good fixation stability, allows early rehabilitation and gives good functional recovery in case it is done properly and subsequently, appropriate physiotherapy is taken.

Keywords: Patellar fracture, transverse fracture, tension band wiring, functional outcome, knee rehabilitation.

INTRODUCTION

The patella is the largest sesamoid bone in the human body and a crucial part of the knee joint and is very relevant in biomechanics of lower limb movement. It is improved in the mechanical efficiency of the quadriceps muscle: improving the leverage of the quadriceps muscle during knee extension, and

guarding the anterior side of the knee against direct trauma [1, 2]. Patella fractures represent about 1 percent of all skeletal injuries, and are a frequent occurrence in persons who are engaged in road traffic accidents, falls and sports activities [3]. The patella is vulnerable to injury because it is

located subcutaneously and is exposed to external forces [4].

Patellar fracture may be caused by direct or indirect trauma. Comminuted or stellate fractures are likely to result on direct trauma to the knee, e.g., a fall or a blow, whereas transverse fractures are likely to occur as a result of indirect trauma caused by the sudden contraction of the quadriceps muscle [5]. Transverse fractures are the most commonly found pattern of fracture and tend to cause interruption of the extensor mechanism of the knee [6]. Disruption of continuity of this mechanism leads to failure to actively extend the knee, and creates severe functional disability in case of failure to treat it [7].

The principal goals in treating patellar fractures include restoration of the extensor mechanism continuity, proper anatomic articular reduction, fixation stability and early knee mobilization to prevent articular stiffness and muscle atrophy [8]. Minimally displaced fracture with an intact extensor mechanism may be treated with non-operative treatment but the majority of displaced fractures including transverse fractures would need surgical correction to get favorable results [9]. Various operative modes have been devised to fix the patella internally; they include TBW, cerclage wiring, partial patellectomy, complete patellectomy, and cannulated screw / plate fixation [10]. Among the others, TBW is the most conventional and commonly used technique, especially in transverse fractures [11]. The concept of TBW is biomechanically healthy-it transforms the tensile forces acting on the anterior patella surface into compressive forces at a fracture site during knee flexion which facilitates stable fixation and early union [12]. It enables instigating range-of-motion exercises early enough and this is a prerequisite to avoid postoperative stiffness and assure of good functional recovery [13].

The old method of tension band, suggested by the AO group, involves two parallel Kirschner wires and a stainless-steel loop of wire in a figure-of-eight arrangement [14]. Although it has been proven to be effective, the traditional TBW approach has its share of disadvantages. Some of the complications reported include wire migration, irritation of the soft tissues, hardware prominence and anterior knee pains [15]. In certain instances, hardware removal might need reoperation as a result of discomfort or infection [16]. Changes to the original method including the substitution of

Kirschner wires with cannulated screws or non-metallic material has been suggested to rectify these drawbacks and enhance patient comfort without compromising the fixation stability [17,18].

The outcome of functional recovery after repairing patella fractures is related to the presence of a number of factors such as the age of the patient, fracture type and the quality of repair, stability of the fixation, surgical methods, and quality of postoperative rehabilitation [19]. It has been demonstrated that early mobilization after stable fixation has been associated with better nutrition in the joint, adhesion prevention, and enhancement of muscle strength resulting in quicker recovery [20]. Conversely, long term immobilization can result into stiffness, quadriceps wasting and delayed recovery [21]. Therefore, the key to successful management is the attainment of stable fixation enabling unhindered movement at an early age.

Recent clinical and biomechanical research revealed that TBW is associated with great stability and functioning outcomes in simple transverse fracture of the patella [22,23]. High fracture union rates, low complication rates and satisfactory long-term knee function have been reported after such a procedure by several authors [24]. Nevertheless, the inconsistency in results of various populations, and surgical environments makes it clear that its clinical efficacy needs to be assessed constantly [25].

Moreover, the growing interest in patient reported outcomes and the quality of life postoperative has made a shift to radiological union alone to functional assessment parameters like knee pain, range of motion and return to daily activities [26]. Objective assessment of postoperative function and recovery has been done using scoring such as the Goodfellow grading and knee pain score, which have been used widely [27].

Even though surgical practices have improved in recent years, the treatment of patellar fractures continues to be difficult because the knee joint is complex and the patient has to have stability and mobility at the same time. The effectiveness of treatment is a result of a complex of careful surgical operation, firm fixation, and rehabilitation organization [28]. Knowledge of the impact of TBW in a high number of patients may be a useful indicator of reliability and replications of this method in a variety of clinical conditions.

The current study will be aimed at assessing the functional effects of TBW on 150 patients with transverse patella fractures. Through measuring the postoperative pain, range of motion, and knee function, this study aims to confirm the clinical relevance of TBW as a reliable fixation technique and help to add to the body of evidence supporting the continued use of this technique in orthopedic practice [29].

METHODOLOGY

The sample size to be used in this prospective cohort study was 150 patients, 112 males, and 38 females, all diagnosed to experience transverse fractures of the patella. All the patients were subjected to the TBW technique. They included patients between 20-60 years of age who had no history of spinal surgeries or open transverse fracture of the patella; however, they had to be medically fit to undergo surgery and give informed consent. Patients that had comminuted or pathological fractures, severe injuries to the soft tissue, or were not fit or willing to undergo surgery were excluded.

It was a meticulous clinical history taken of each patient and a comprehensive physical and radiological examination was performed. To confirm and classify the pattern of the fracture, the standard anteroposterior and the lateral knee radiographs were carried out. The knee brace or an anterior splint was used to produce temporary immobilization until operations followed and all the required preoperative investigations performed prior to the operation.

Every procedure was carried out using spinal anesthesia where the patient was lying supine on an operating table. A pneumatic tourniquet was put on the upper thigh and the midline longitudinal incision was made on the anterior part of the knee, to reveal the site of fracture. The skin and subcutaneous tissues were reflected attentively and the region was flushed with a high volume of normal saline and the blood clots and debris were washed off. Patellar clamps or towel clips were used as anatomical reduction of the fracture fragments. Two parallel 2 mm Kirschner wires were placed through the superior to inferior pole of the patella about 5 mm deep to the anterior surface. A figure-of-eight setup using 18 gauge stainless steel wire was then carried out over anterior surface of patella and under K-wires to ensure that the fragments were held in compression. The K-wires were bent at

the ends and shortened in order to fix them into the patella to prevent migration. Repair of retinacular tears was done, and the wound was sewn in layers following adequate irrigation. Postoperative immobilization was done to the operated limb using a long knee brace.

Patients were advised to initiate the use of quadriceps strengthening and light knee mobilization exercises when they felt fit. It was followed by the regular evaluations. Knee pain scores, range of motion, extension lag and Goodfellow knee functionality were documented during each follow-up. X-rays were conducted to determine bone fracture healing and implantation. The assessment of postoperative functional results was done on the basis of the knee pain grading system and the Goodfellow grading system in terms of range of motion, stability and the overall functioning of the knee. Radiological unions and complications like being infected, implant failure or loss of fixation were reported as well.

RESULTS

This was done on 150 patients with transverse fractures of the patella who were surgically fixed with TBW. Patients were aged between 20 and 60 years and the average age was 37.2 years. Among them, 112 (74.66) were men and 38 (25.33) were women, which means that the prevalence of patella fractures was higher in men. Knees at the right were involved in 92 (61.33) patients and right knee in 58 (38.66) patients. Most fractures were indirectly caused (90 patients, 60%), but 60 patients had direct causes (40%), mostly because of falls or road traffic accidents.

The average time of operation by TBW was 85 minutes. Extension lag was identified in 48 (32) patients during the first postoperative follow-up, and it improved fully by the 6 th month in all patients. The range of motion of the knee (ROM) improved gradually with time of follow-up. At the first follow-up, 120 (80%) of the patients had a ROM below 90 degrees. At 6 th month, 5 (3.33) patients had ROM 90 120 degrees, 23 (15.33) patients had ROM over 120 degrees, and 122 (81.33) patients had full flexion and extension past 120 degrees.

The pain evaluation with the help of modified knee pain score revealed that on the 2nd week, 110 (73.33) patients were having mild pain and 40 (26.66) patients were having no pain. However, after 6 months, 10 (6.66)

patients experienced mild pain, and the rest 140 (93.33) patients did not experience any pain. All patients showed radionuclotiner fracture union in the 3rd month, which means that fracture healing with TBW is reliable.

The evaluation of functional outcomes was based on the Goodfellow criteria of knee range

of motion (Table 1). The overall results showed that most patients made an outstanding improvement in the 6th month, which can be attributed to the restoration of the functionality of the joint and pain-free movement.

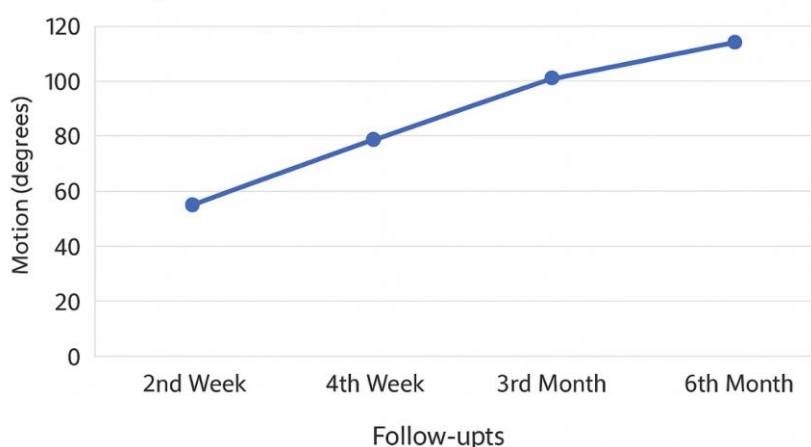
Table 2: Functional Results According to Goodfellow Grading (n=150)

Grading	2 nd week	4 th week	3 rd month	6 th month
Poor	60 (40%)	35 (23.33%)	0 (0%)	0 (0%)
Satisfactory	25 (16.66%)	40 (26.66%)	5 (3.33%)	0 (0%)
Fair	20 (13.33%)	30 (20%)	30 (20%)	10 (6.66%)
Good	0 (0%)	15 (10%)	40 (26.66%)	15 (10%)
Excellent	0 (0%)	0 (0%)	75 (50%)	125 (83.33%)

Overall, TBW provided stable fixation, effective fracture healing, and excellent functional recovery in the majority of patients. Postoperative rehabilitation was smooth, with most patients regaining near-normal knee function and returning to routine daily

activities by the 6th month follow-up. Pain relief and restoration of knee mobility were consistent, confirming the reliability and efficacy of this technique for transverse patellar fractures.

Improvement of Knee Range of Motion Over Time in Patients with Transverse Patella Fractures Treated with Tension Band Wiring



DISCUSSION

In this study of 150 patients with transverse patellar fractures treated via TBW, we observed a high rate of excellent functional outcomes (120/150, 80%) and universal radiographic union by 3 months. Knee range of motion improved steadily, and complications were minimal. These results generally compare favorably with prior reports, though some differences are worth exploring. Hsu et al. analysed 170 patients treated with modified TBW and reported a low failure rate (5%) and infection rate (2%) overall, though nearly half of patients ultimately had implant

irritation requiring removal [30]. Their findings affirm that TBW is generally reliable, but implant irritation remains a common issue. Our series similarly noted minimal complications and did not emphasize implant removal, but longer follow-up may yet reveal more hardware removals.

More recently, Noothan et al. compared TBW using stainless steel wire versus FiberWire in a randomized study (n=32) and found that although outcomes (union time, ROM, function) were comparable between the two groups, the stainless steel group had significantly higher rates of hardware

prominence, soft tissue irritation, and need for removal ($p = 0.023$) [31]. Their results reinforce the notion that the choice of the band material may impact implant-related symptoms more than union or motion per se. While our study used conventional metallic TBW, our low revision/complaint rates may reflect careful intraoperative placement and postoperative care.

Lin et al. performed a randomized trial between TBW and cannulated screw fixation (in presence or absence of cables) in cases of displacement of mild cases ($< 8\text{mm}$). They determined that the cannulated screw group experienced fewer complications (implant migration, painful hardware, reoperation), and lower displacement (11.5) than the ORTF (open reduction + tension band) group [32]. Their data indicates that TBW is effective, but can have a risk of increased hardware related problems, in comparison with screw techniques. Conversely, our series was associated with low complication rate and did not involve numerous revisions, which may be indicative of extremely standardized surgical approach and high-scrupulous post-operative care.

In LeBrun et al., 40 patients treated over two different operative procedures (which includes TBW) were followed (mean follow up 6.5 years) and it was observed that there exist persistent functional impairments (52 -percent needed to remove hardware, 38 -percent had pain in their implants, 20 -percent had an extensor lag of more than 5 degrees, many had limited flexion/extension) [33]. Its design of study is different (they have mixed forms of fixation, more follow-up years), but it highlights the fact that even positive initial outcomes can be marred by functional sequelae and long term hardware symptoms. Such late complaints were not captured in our medium term follow up and this is a limitation. Equally, in modified TBW, Hanumantharaya et al. ($n = 32$) found 24 (75) excellent outcomes and 6 (18.8) good outcomes [34]. They have slightly fewer excellent results (80 % vs. 75 %) which can be attributed to the differences in patient demographics, variations in surgical techniques, or in rehabilitation protocols.

Samiullah et al. studied 30 TBW patients with transverse patellar fractures and found 24 excellent, 4 good and 2 fair outcomes 6 months later [35] (i.e. 80% excellent + good). Their findings are quite comparable to ours in terms of proportions, which confirms high

success rates in a relatively young noncomminuted fracture are reproducible.

In these six studies of comparison, therefore, the general finding is that TBW is associated with high union rates and excellent functional recovery among transverse patellar fractures, particularly when performed with technical accuracy. The variations in the rate of complications and removal of hardware usually depend on the detail of surgery (wire placement, depth, bending technique) and the selection of materials.

The high percentage of good results in our series probably is due to a number of positive factors: a large sample population, inclusion of transverse (noncomminuted) fracture exclusively, uniformity of the surgical procedure, and high-quality postoperative rehabilitation. The fact that we have had a very low complication rate can be explained by careful positioning of the wires (no superficial k wire positioning or too distant bands), soft tissue handling and constant follow-up.

Our small fixation failures compared with the results of Hsu et al. would lead us to believe that our method perhaps focused on the best wire depth or band position. Hsu et al. warned that K wires that were laid too shallowly increased the rate of minor loss of reduction, and positioning tension bands far away increased the breakage risk [30]. Following such design principles could have been one of the reasons of our success.

The comparison with the study conducted by Lin et al. points to the fact that an alternative fixation (e.g. cannulated screws) can decrease complications of implantation, but TBW is less complex and economical [32]. The reason that we have fewer hardware issues than LeBrun et al. in the long term is that early follow-up might not be adequate to determine the burden of symptomatic hardware and delayed functional decline [33].

Similarly, Noothan et al. imply that other materials (e.g. FiberWire) can minimize the number of irritations, however, maintaining the quality of fixation [31]. We did not test nonmetallic bands; however, this is a good direction to work on in the future.

CONCLUSION

TBW is an effective and reliable surgical method in management of transverse patellar fractures. It offered an alternative fixation, enabled early mobilization, and offered excellent functional outcomes in most of the cases in our investigation of 150 patients.

Three months later, radiological union occurred in all patients and most of them had almost normal knee range of motion with minimum pain. Doing surgery in a proper manner accompanied by postoperative rehabilitation is necessary to ensure the highest functional recovery and minimum of complications. On the whole, TBW is a reliable technique of knee functional recovery in patients with transverse patellar fractures.

Source of Funding

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Permission

Ethical approval obtained

Conflict of Interest

None

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