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ORIGINAL ARTICLE

Assessment of the Functional Outcomes Associated with Tension Band Wire (TBW) Treatment for Patella Fractures at Bolan Medical and Teaching Hospital, Quetta

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ABSTRACT

Introduction: Patella fractures represent approximately 1% of all types of fractures and are most frequently seen in individuals aged 20 to 50. Various surgical fixation methods for patellar fractures have been documented, including the use of tension bands, plates and screws, cerclage wire, and external fixation, among others. The tension band wire (TBW) technique is particularly prevalent due to its ability to provide stable fixation and facilitate early mobility.

Objective: To assess the effectiveness of tension band wiring (TBW) in the treatment of patellar fractures.

Setting and Study Duration: This Descriptive study was conducted at Bolan Medical and teaching hospital, Quetta, Study extended from 15th December 2022 to 15th June 2023.

Material and Method: After approval by the hospital's ethical board, a total of 142 patients, comprising both males and females, were enrolled in the study during an emergency situation. Informed consent was obtained from all participants. A demographic profile, including age, gender, and place of residence, was recorded. All cases that underwent total patellar replacement were evaluated based on established inclusion and exclusion criteria. Patients were assessed at two weeks, four weeks, and twelve weeks post-surgery. The functional outcomes were evaluated at the twelve-week mark using the Good fellow grading system for motion.

Results: In this study a total of 142 patients who underwent TBW patella were studied. The mean age of the study population was 39.1±16.52 years. Majority if the assessed cases were males that is 81.7% (116 cases). Functional outcome was categorized as per the Good Fellows grading of range of motion. Highest number of cases i-e 60 (42.3%) showed good results. Second commonest category was excellent: 31% (44 cases) demonstrated good results. Whereas 21.1%, 4.2% and 1.4% showed fair, satisfactory and poor results, respectively.

Conclusion: Thus, it is evident that the tension band wiring of patella after anatomic reduction is associated with good to excellent functional recovery. Additionally, incorporating cerclage enhances the strength of the construct, contributing to the attainment of these positive outcomes.

Keywords: Patella fractures, tension band wiring, patella cerclage, knee extension mechanism.

INTRODUCTION

Patella fractures represent approximately 1% of all fractures. These injuries are particularly prevalent among active individuals aged 20 to 50. Transverse fractures of the patella are commonly observed. The primary cause of these fractures is trauma, which can be either direct or indirect. Direct trauma occurs when there is a forceful impact to the knee, such as during a fall or collision with a hard surface. Indirect fractures may result from rapid knee flexion while the quadricepses are fully contracted or from sudden jumping. If treatment is not adequately administered, serious complications can arise, including post-traumatic arthritis of the patellofemoral joint and a decreased range of motion in the knee. Therefore, it is crucial to address patellar fractures effectively, as this facilitates early knee movement without causing further displacement at the fracture site.[1,2]

The literature outlines various surgical fixation techniques for patellar fractures, including tension bands, plates and screws, cerclage wire, and external fixation, among others. The tension band method has achieved significant recognition as the gold standard for treating these fractures, primarily due to its biomechanical benefits[3,4]

The tension band wire (TBW) strategy for patellar fracture fixation is widely used because it ensures strong fixation and promotes early mobility. However, this technique has its drawbacks, including the risks of wire migration and breakage, loss of reduction after surgery, and a high rate of symptomatic irritation from the implant, which has been associated with increased instances of implant removal due to discomfort. To address these concerns, numerous enhancements have been made to improve the stability of the TBW method and other surgical techniques.[5] To prevent dislodging, Lee et al. described a modified tension band wiring using a Fiber Wire instead of the conventional methods to get a successful outcome[6]

Samiullah et al, conducted a study to assess the functional outcomes of tension band wiring in cases of transverse patella fractures. Their results revealed that after three months, 11 patients (36.6%) achieved excellent outcomes, 12 patients (40%) had good outcomes, and 7 patients (23.3%) reported fair outcomes according to the Good Fellow grading system. Given the scarcity of existing literature, this research provides valuable population-based data that can enhance patient education regarding patella fractures and support the effective implementation of this treatment strategy in orthopedic practice, ultimately aiding in complication prevention and promoting early mobility[2]

METHODOLOGY

After approval by the hospital's ethical board, a total of 142 patients were enrolled in the study during an emergency situation. Informed consent was obtained from all participants. A demographic profile, including registration number, age, gender, and place of residence, was documented. The tension band wiring procedure was performed in every case. Under spinal anesthesia, the patient was positioned supine on the operating table. A midline longitudinal incision was made to access the center of the patella. The skin and subcutaneous tissue were carefully reflected to expose the patellar fracture surface and any associated retinal tears. To eliminate blood clots and thoroughly cleanse the joint and fracture site, saline was used for irrigation. Patellar clamps and towel clips were employed to anatomically align the fracture fragments. Two 2mm K-wires were inserted approximately 5mm

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deep into the anterior surface of the patella, extending from the superior to the inferior borders, while ensuring the wires remained parallel. The attachments of the quadriceps tendon were then secured using 18-gauge stainless steel wires threaded through the K-wires. The wires were twisted into a figure-eight configuration across the anterior surface of the reduced patella. A transverse wire was inserted through the inferior segment of the tendon, passing beneath the protruding K-wire, and then brought back up across the anterior surface. The upper end of the wire was tightened, and the upper ends of the K-wires were bent sharply interiorly. After being cut, the wires were rotated 180 degrees and inserted posterior to the wire at the superior edge of the patella. The inferiorly protruding ends of the K-wires were trimmed short. Bilateral repairs were performed on the retinal tears. The wound was meticulously cleaned with saline and then sutured in layers. A long knee brace was applied to immobilize the affected limb. Patients were evaluated at two weeks, four weeks, and twelve weeks post-surgery. The functional outcome was assessed at the twelve-week mark using the Good fellow grading system for motion.

The collected data was systematically input and analyzed utilizing SPSS version 22. The mean and standard deviation were computed for both age and fracture duration. Frequencies and percentages were determined for gender, side effects, and functional outcomes categorized as Excellent, Good, Fair, Satisfactory, or Poor. The data was stratified based on age, gender, duration of fracture, and side effects to examine potential effect modifiers. A chi-square test was conducted following stratification, with a p-value of less than 0.05 deemed statistically significant.

RESULTS

In this study, a total of 142 patients who underwent TBW patella surgery were examined. The average age of the participants was 39.1±16.52 years. The sample population was categorized, revealing that 3.4% (5 cases) were in the 20-39 age group, while the majority, 36.6% (52 cases), fell within the 40 to 55 age range, as depicted in Figure 1.

A significant portion of the subjects were male, comprising 81.7% (116 cases), with the remaining 26 being female (Figure 2).

Figure 3 illustrates the distribution of cases based on the duration of the fracture at the time of fixation: over half of the patients, specifically 59.2% (84 cases), and received treatment within the first three days. Additionally, 26.8% (38 cases) were operated on between the fourth and seventh day post-injury. A smaller percentage, 9.9%, 2.8%, and 1.4%, were treated during the 8-14, 15-30, and more than 30 days following the fracture, respectively.

The functional outcomes were assessed according to the Good Fellows grading system for range of motion. The highest number of cases, 60 (42.3%), achieved good results, while the second most common outcome was excellent, with 31% (44 cases) demonstrating favorable results. Conversely, 21.1%, 4.2%, and 1.4% of cases were classified as fair, satisfactory, and poor, respectively (Figure 4).

These functional outcome categories were further analyzed based on age, age group, gender, and duration of the fracture to identify any statistically significant relationships with the functional outcomes observed during the three-month follow-up. The findings of the inferential analysis are summarized in Figure 5 and Table 1.

Table 1: Age-group stratification of the functional outcome Functional outcome

	Functional Outcome						
	Excellent	Good	Fair	Satisfactory	Poor	Total	P-Value
Age Group							
20-39 Year	40	32	18	0	0	90	0.002
40-55 Year	4	28	12	6	2	52	
Gender							
Male	40	46	24	4	1	115	0.321
Female	4	14	6	2	1	27	
Duration of fracture							
0-3 Days	28	38	18	0	0	84	0.001
4-7 Days	12	14	8	4	0	38	
8-14 Days	4	8	2	0	0	14	
15-30 Days	0	0	2	2	0	2	
>30 Days	0	0	0	0	1	1	
Side							
Right	18	30	16	4	2	70	0.402
Left	26	30	14	2	0	72	

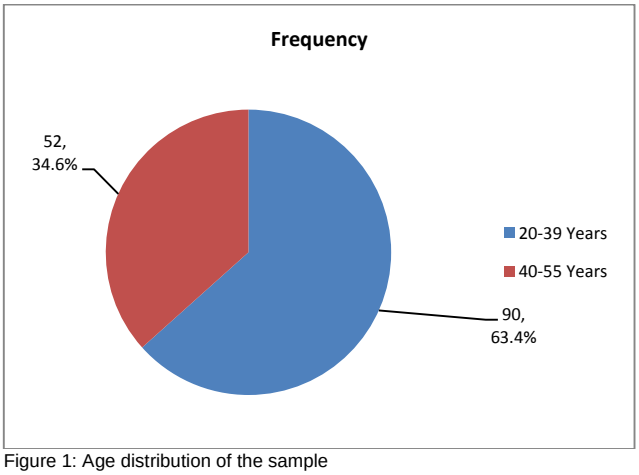

Figure 1: Age distribution of the sample

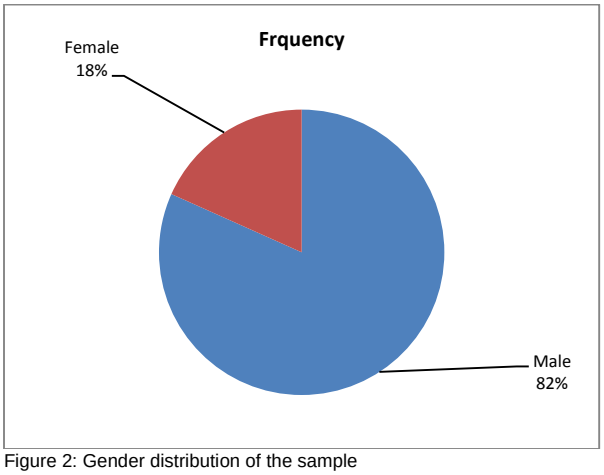

Figure 2: Gender distribution of the sample

Mean age of the sample was 39.1±16.52 years

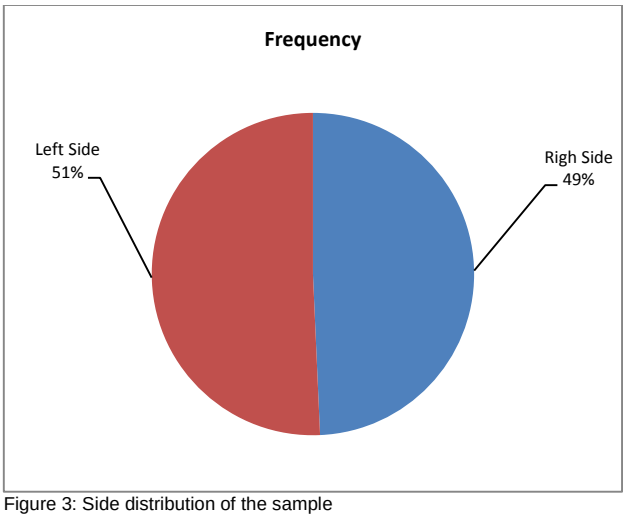

Figure 3: Side distribution of the sample

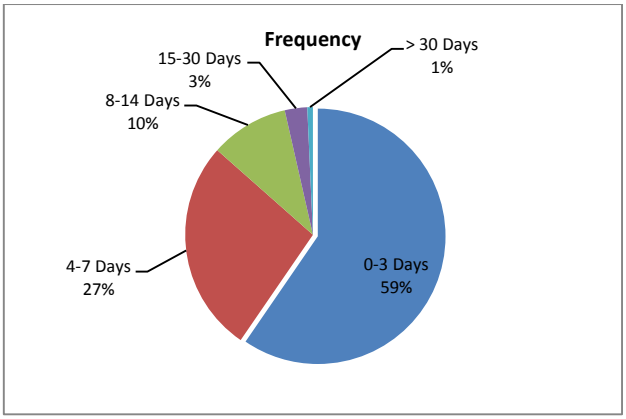

Figure 4: Duration of fracture distribution of the sample

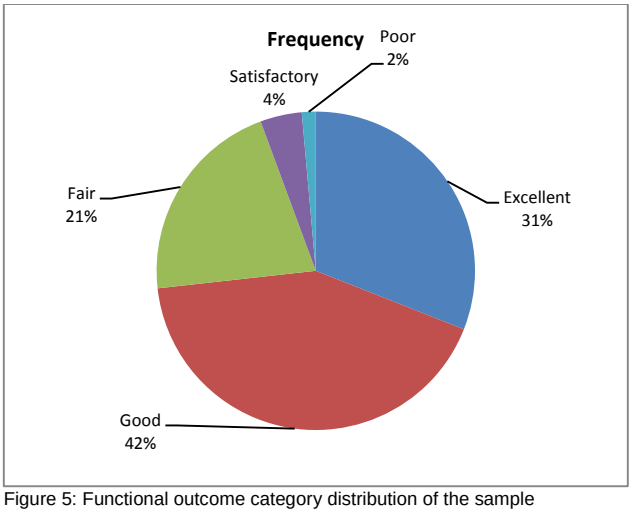

Figure 5: Functional outcome category distribution of the sample

DISCUSSION

The patella serves a crucial role by functioning as a pulley for the quadriceps tendon while also forming the patella-femoral joint with the femoral condyle. These dual functions underscore its significance in the lower limb's mechanics. Therefore, any compromise to the integrity of the patella must be addressed with precise anatomical fixation due to its connection with the femoral condyles. This fixation should facilitate early knee motion, as extended immobilization can lead to joint stiffness. Properly executed tension band wiring of the patella can achieve these objectives. As a tension band construct, it transforms shearing forces acting on the patella into compressive forces, which not only aids in healing but also encourages knee joint movement, essential for generating the compressive forces necessary for fracture healing. Consequently, tension band wiring (TBW) has emerged as the most widely accepted technique for fixing patellar fractures, having been extensively studied and adopted globally. In their research, Mehdi et al. reported that good to excellent outcomes from tension band wiring were observed in 203 patients[7]

Similarly, Gardner et al. examined the Total Body Water (TBW) construct concerning the attainment of union and clinical enhancement. They noted that this construct is essential for the fixation of patella fractures, particularly in the most prevalent fracture pattern: transverse patellar fractures[8] The TBW construct can be further reinforced through the application of cerclage. This technique not only secures the fragmented segments but also facilitates the transformation of tensile forces into compressive forces, which is the fundamental principle behind the tension band construct. Curtis MJ and colleagues conducted a comparison between standard TBW constructs and those enhanced with cerclage. Their findings demonstrated that the cerclage-enhanced constructs exhibit greater strength, leading to improved radiological and functional outcomes[9]

A study focused on traumatic patella fractures and analyzed the demographic characteristics of this specific group. The researchers reported that the average age of the participants was 49 years, with a predominance of male patients. They attributed these findings to the fact that patella fractures are primarily the result of trauma, which is more frequently encountered by adults engaged in high-risk activities. Additionally, they suggested that males are more likely to participate in outdoor activities, leading to a higher incidence of such injuries. Our findings align with these observations, as the majority of affected individuals fell within the 20-39 age range, indicating that adults are more susceptible to trauma. The overall mean age of our sample was 39.1±16.52 years. Furthermore, the gender distribution revealed a significant male majority, with 81.7% of the cases being male and the remaining 13% female. In terms of fracture management, over half of the cases (59.2%) were treated within the first three days post-injury, while 26.8% underwent surgery between the fourth and seventh days. A smaller percentage, specifically 9.9%, 2.8%, and 1.4%, were treated during the 8-14, 15-30, and more than 30 days following the fracture, respectively. The functional outcomes were assessed using the Good Fellows grading system for range of motion, with the highest proportion of cases (42.3%) achieving good results. The second most common outcome was excellent, with 31% of patients demonstrating favorable results. Meanwhile, 21.1%, 4.2%, and 1.4% of cases were classified as fair, satisfactory, and poor, respectively[7]

The functional outcomes observed in our study are largely consistent with previously published findings. Berg EE et al. reported that radiological union of transverse patellar fractures typically occurred at an average of 13 weeks. In contrast, our research demonstrated that all patients achieved radiological union by the 12th week[10] Additionally, our results indicated that 80% of patients experienced excellent outcomes, 13.3% had good results, and 6.7% were classified as fair in terms of their recovery from transverse patellar fractures treated with tension band wiring.

Overall, it has been established that the tension band construct is consistently linked to favorable to excellent functional outcomes and possesses sufficient strength to support the sesamoid bone throughout the rehabilitation process until radiological union is confirmed. However, existing literature highlights that tension band constructs utilizing K-wires may lead to implant-related issues, such as pain during full knee range of motion. Consequently, it is standard practice to remove the implant once union is achieved. Furthermore, it has been noted that augmenting the tension band wiring construct with cerclage

enhances fixation strength and is associated with comparable or improved functional results.

CONCLUSION

Therefore, it is apparent that applying tension band wiring to the patella after anatomic reduction results in good to excellent functional recovery. Moreover, the inclusion of cerclage to fully support the sesamoid strengthens the construct and aids in attaining these results.

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