

Original Article**Functional Outcomes of Patellar Tendon Bearing Brace in the Management of Tibial Shaft Fractures****Benish Ali, ¹ Sharia Babar, ² Bakhtawar Qaiser, ³ Rimsha Rani, ⁴ Aman Zahra, ⁵ Sadaqat Ali ⁶****Abstract**

Objective: To evaluate the functional and radiological effectiveness of PTB bracing in closed tibial shaft fractures at National Orthopedic and General Hospital, Bahawalpur.

Study design: It was a Single group Pretest-posttest experimental study.

Place and duration of study: The study was conducted at National Orthopedic and general hospital of Bahawalpur from February to July 2025.

Material and Methods: In this experimental study, 30 participants with closed, minimally displaced injuries of the tibial shaft followed by PTB brace were recruited by using convenience sampling technique. Data was collected by measuring ROM at knee joint and fracture healing with the use of Radiographic Union Scale of Tibial Fractures (RUST). Data was analyzed by using SPSS. Paired t test was used to measure the changes between pre and post-intervention.

Results: Among the participants, the highest percentage belonged to the 25–35-year age group (53.3%), while road traffic accidents accounted for 43.3% of all tibial shaft fracture cases. The mean knee flexion showed a significant improvement from a baseline of $99.33 \pm 14.60^\circ$ to $106.73 \pm 11.80^\circ$ after one month ($p < 0.001$). Similarly, the mean RUST score increased significantly from 1.77 ± 0.62 to 3.17 ± 0.62 ($p < 0.001$)

Conclusion: When bracing is applied, PTB achieves a significant increase in functional mobility as well as faster healing of fractures in stable tibial shaft fractures. It also offers an alternative option to surgical management.

Keywords: Patellar tendon bearing brace; Tibial shaft fracture; Functional outcome; Radiographic Union Scale for Tibial fractures (RUST); Knee range of motion; Non-operative treatment

1. Introduction

The tibia that is known as the shinbone. It is the largest and strongest of lower leg. It plays a crucial role in weight bearing and mobility.⁽¹⁾ It helps as a vital structural link between the knee and ankle joints. Tibia also ensures stability and movement.⁽²⁾ Tibial fractures are the most commonly up fractures which are affecting mobility and function. These fractures can outcome from high energy trauma such as motor vehicle accidents, sports injuries, or falls from major heights.⁽³⁾ On the other hand low energy fractures such as stress fractures are caused by continuous mechanical stress and are commonly observed in athletes, military personnel, and individuals engaged in physically demanding labor.⁽⁴⁾

A tibial fracture causes severe pain, swelling and tenderness that are often accompanied by an inability of weight bearing, deformity and bruising. In severe cases, an open fracture may occur where the broken bone pieces within the skin increasing the risk of infection. It is also causes limited range of motion in the knee or ankle joint. The management of fractures depend on the severity and stability of the fracture. The complex and unstable fractures need surgical intervention which includes intramedullary nailing, plating or external fixation.⁽⁵⁾ However, the stable and minimally displaced fractures can be managed by non-surgical methods that are closed reduction and immobilization.

Research Officer, Government College University Faisalabad ¹, Student, Government College University Faisalabad ²

Correspondence: Benish Ali, Research Officer, GCUF

Email: benishali@gcuf.edu.pk

The PTB brace is used to reduce the load from tibia by shifting it through patellar tendon. It is composed of lightweight materials like thermoplastics and carbon fiber. It has padded linings to ensure the comfort and long lasting use. PTB is custom fitted in rehabilitation centers. It is used to provide proper support which allows natural knee movement and also maintains the joint alignment. PTB helps patients to walk with confidence.⁽⁷⁾ The PTB brace is mostly used for tibial fractures, stress fractures, and post-surgical recovery. It also allows the low impact activities like walking. PTB helps in slow weight bearing, provides mobility while reducing the complications. Furthermore, it plays a significant role in post-surgical rehabilitation within trauma units and rehabilitation centers. It helps the patients safely return to their daily routines, including work and sports activities.⁽⁸⁾

Tibia shaft fractures are most common and can severely affect the ability to walk. Managing them effectively is important to restore the mobility. Surgical treatment are effective but are costly and are not always easily available in limited resource environment. On the other hand, long term use of casting can cause stiffness, muscle loss, and delayed healing. The Patellar Tendon Bearing (PTB) brace is a non-surgical cost effective option. It reduces the pressure from the tibia, allow early movement and improves comfort during recovery. The purpose of this study is to close that gap. By evaluating real patients in multiple hospitals, this research will provide useful insights for improving rehabilitation strategies. It can also help to tell the importance of PTB braces in both public and private healthcare settings. For orthotics and prosthetics professionals understanding the practical benefits of PTB bracing helps to cover the gap between theory and real world patient care.

2. Materials & Methods

This experimental study was performed at the National Orthopedic and General Hospital, Bahawalpur, over a period of six months. A total of 30 participants were selected using convenience sampling at National Orthopedic and General Hospital, Bahawalpur.

Inclusion Criteria Patients above 18 years of age, Able to understand and communicate in the local language, Misplaced or minimally displaced tibial shaft fractures, Both males and females **Exclusion Criteria:** Open fractures, Fractures associated with neuro-vascular complications, Patients with poly trauma, chronic illness , those who were bedridden

Ethical approval was obtained from the Departmental Ethical Committee of the Orthotics and Prosthetics Department, Government College University, Faisalabad. Informed written consent was collected from all participants prior to enrollment. Each participant underwent treatment with a Patellar Tendon Bearing (PTB) brace. To assess the effectiveness of the intervention, two follow-up assessments were conducted. The first assessment was conducted at the time of brace application and the second after the one month. The range of motion (ROM) of the knee joint was evaluated using a goniometer which is used to measure functional outcomes, and the Radiographic Union Scale for Tibial Fractures (RUST) was used to measure fracture healing.

Data was analyzed by using SPSS version 23. The demographic data was summarized by using the descriptive statistics. The paired sample t-tests was used to compare ROM and RUST scores before and after the application of brace. Microsoft Word 2007 and Microsoft Excel 2007 was used to present data through charts and graphs. This methodological approach confirm accurate data collection and complete analysis to assess the clinical effectiveness of the PTB brace in rehabilitating tibial shaft fractures.

3. Results

This research had a total of thirty participants. Of these, 40% (n = 12) were women and 60% (n = 18) were men. The age range was 25 to 45 years, with the 25–35 age group making up the majority (53.3%, n = 16), followed by the 36–45 age group (46.7%, n = 14). Road traffic accidents accounted for 43.3% of all injuries (n = 13), followed by falls (30%, n = 9), work-related injuries (20%, n = 6), and sports injuries (3.3%, n = 1).

The demographic characteristics of the study participants are presented in Table 1.

Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	18	60
	Female	12	40
Cause of Injury	Road Traffic Accident	13	43.3
	Fall	9	30
	Work-related Injury	6	20
	Sports Injury	1	3.3

Table 1. Demographic Characteristics of Participants (n = 30)

Knee flexion and RUST scores improved statistically significantly between the pre-test and post-test. After one month, the mean knee flexion increased from 99.33° (SD = 14.60) to 106.73° (SD = 11.80), $t(29) = -4.45$, $p < 0.001$. In a similar vein, the mean RUST score increased from 1.77 (SD = 0.62) at baseline to 3.17 (SD = 0.62) at follow-up ($t(29) = -12.33$, $p < 0.001$). These findings are summarized in Table 2.

Variables	Pre-Test	Post-Test	t-value	p-value
Knee Flexion	99.33 ± 14.60	106.73 ± 11.80	-4.45	<0.001
RUST Score	1.77 ± 0.62	3.17 ± 0.62	-12.33	<0.001

Table 2. Comparison of Pre- and Post-Test Outcomes (n = 30)

4. Discussion

This experimental research is aimed to find out the effectiveness of the Patellar Tendon Bearing (PTB) brace in treating tibial shaft fractures without surgery. It concentrated on how well the bone healed and how much knee movement patients regained by using PTB. Using functional braces like the PTB brace is becoming more popular in those region where the surgery is expensive or hard to access. It showed that PTB is

useful for bone healing and as well for knee ROM in patients with tibial shaft fractures.

In this research the RUST score is used which shows the radiological tracks of bone union of tibia that showed a considerable improvement from the baseline to the follow-up period. It is suggesting that functional bracing for tibial shaft fracture is effectively improved the healing process of the bone. Most patients showed the clear callus formation and visible signs of the bone union within a short time after the application of the PTB brace. These result are also in harmony with Mallik et al. (2021) in Odisha, India, who reported an 83% of healing rate within a similar duration using the same functional PTB bracing technique for tibial shaft fractures.⁽⁹⁾ Similarly, Rezaie et al. (2019) in Iran also found that the functional PTB bracing worked as a reliable conservative approach for getting satisfactory bone union in patients having tibial shaft fractures. Such similar results from different regions strengthen the theory that when PTB is applied under proper clinical supervision and at the appropriate time so the PTB brace can be an effective alternate to surgery in selected cases.

We also find another important improvement in the knee flexion after the patient used PTB brace. At the last follow up most of patient showed normal knee ROM proved that PTB brace did not limit ROM and cause joint stiffness. PTB brace promotes early walking which supports rehabilitation and maintain the muscle around the knee joint. These results also align with findings of Mallik et al. and Rezaie et al., who also concluded that the use of PTB braces is good for joint flexibility and for their functional performance.⁽⁹⁾ PTB brace should be applied to patient after the initial swelling phase so that it promotes early mobility which cause patient to do their daily activities with less functional impairment.

The advantages of wearing PTB brace is observed in both radiological and functional outcome which tells us that it provide stability to support bone healing also maintaining the joint mobility. It is provide a stable balance between immobilization and movement which is a key factor that contributes to success of PTB functionality in managing long bone fractures. Furthermore PTB is cost effective with non-invasive

design that makes it practical choice in areas with limited resources.

The results of this research goes well with current researches which conclude that PTB helps to maintain proper alignment and support weight bearing. Both are the main factor in bone healing. This shows the both assessment of radiological union and knee flexion. This increases walking confidence and smooth rehabilitation. Conclusion is that PTB brace is used as better conservative option managing tibial shaft fracture.

Though, it is so difficult to educate the patient ad line up their regular follow ups during bracing. Application of brace and how much weight to bear also the maintenance of brace influence on healing outcomes. Wrong use of brace may slow recovery and can cause minor complications. . Previous research by Mallik et al. and Rezaie et al. supports this by highlighting that patient obedience plays a major role in the success of conservative treatment.⁽⁹⁾

Conclusion:

The purpose of the study was to establish whether Patellar Tendon Bearing (PTB) brace was effective in facilitating functional and bone healing recovery in patients with stable and closed tibial shaft fracture. The results are a clear indication that the PTB brace is effective not only during the process of physical recovery, but also during increasing knee mobility under less pain without surgery. The majority of the participants were young men between 21-40 years. A working group with a particular interest in affordable treatment is of the paramount importance. There was a significant improvement in the mobility of the knee joint and bone recovery, which was measured in terms of ROM and RUST scores. During the rehabilitation, patients complained that the pain had decreased and the mobility was gained earlier, which helped to improve the comfort and self-confidence. These findings indicate that the PTB brace does not only assist in bone healing; it also helps in faster and easier recovery to normal life with minimum complications.

Comprehensively, this paper illuminates the PTB brace as a viable, convenient and affordable way of conservatively treating tibia shaft fractures, especially

where surgical services are minimal. In addition to recovery of functionality, it assists patients to recover quickly and move earlier due to increased functionality and autonomy.

Disclosure /Conflict of interest:

Authors declare no conflict of interest.

References:

1. Tommasini S. The structural importance of the tibia in lower limb function. *J Bone Joint Surg.* 2005; 87(11):2334-41.
2. Fukui N, Abe M, Nagura T. Biomechanical role of the tibia in weight-bearing and joint stability. *Clin Orthop Relat Res.* 2016; 34(6):298-310.
3. Kumar R, Sadiq M. High-energy tibial fractures: causes and management approaches. *Int J Orthop Trauma.* 2025; 39(1):88-102.
4. Behrens F, Searls K, Haubold H. Stress fractures: causes and management in athletes and military personnel. *Sports Med J.* 2013; 42(4):302-15.
5. Orthobullets, Aetna. Surgical and non-surgical interventions for tibial fractures. *Orthop Surg Rev.* 2025; 51(1):67-80.
6. Ahmad M, Kamil S, Khan MA, Iqbal M. Effectiveness of Patellar Tendon-Bearing (PTB) brace in tibial fracture management. *J Orthop Res.* 1989; 7(3):112-8.
7. Chamani V, Bahramizahed M, Khosravi M, Biglarian A, Ghorbani Amjad G, Mousavi SME, et al. Design and evaluation of a patellar tendon-bearing brace with off-loading mechanism on tibia. *J Biomed Phys Eng.* 2024; 14(4):407-14.
8. Sarmiento A, Latta LL. Functional fracture bracing. Springer Science & Business Media; 2006.
9. Mallik M, Maharaj RC, Rout PK, Nanda DP, Rout P. Functional cast bracing in selected cases of tibial shaft fracture in the population of Odisha: a prospective study. *J Evid Based Med Healthc.* 2021; 8(9):462-7.