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FUNCTIONAL OUTCOME OF PROXIMAL HUMERUS FRACTURES TREATED WITH TPTS (TANGARI PRAKASH TRAUMA SYSTEM) BY MIROS VS PHILOS PLATE "A PROSPECTIVE STUDY"

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ABSTRACT

Background: Proximal humerus fractures are common injuries, particularly in the elderly population, often requiring surgical intervention for displaced fractures. While the PHILOS plate is widely used for open reduction and internal fixation, minimally invasive techniques like tangari Prakash trauma system (TPTS) by Minimally Invasive Reduction and Osteosynthesis System (MIROS) offer a less invasive alternative. This study aimed to compare the functional outcomes and complication rates between TPTS by MIROS vs PHILOS plate fixation. **Methods:** A prospective, comparative study was conducted in the Department of Orthopedics at MVASMC Mirzapur, from January to June 2025. Sixty patients with Neer 2- or 3-part displaced proximal humerus fractures were randomized into two groups: Group A (n=30) treated with TPTS/MIROS and Group B (n=30) with PHILOS plate fixation. Patients were followed up at 3 and 6 months post-operatively. Functional outcome was assessed using the Constant-Murley Shoulder Score. Operative parameters and complications were also analyzed. **Results:** Both groups showed significant improvement in shoulder function over time. At 6 months, the mean Constant score was 77.3 ± 8.2 in Group A and 74.1 ± 9.5 in Group B (p=0.14). Group A had significantly shorter operative time (46.3 ± 6.9 min vs 77.5 ± 9.8 min, p<0.001), lower intraoperative blood loss (57.6 ± 11.4 ml vs 131.2 ± 18.6 ml, p<0.001), and shorter hospital stay (4.3 ± 1.2 days vs 6.6 ± 1.5 days, p=0.002). Complication rates were lower in Group A (10%) compared to Group B (20%), though the difference was not statistically significant. **Conclusion:** TPTS by MIROS provides functional outcomes comparable to PHILOS plate fixation while offering advantages of shorter operative time, reduced blood loss, fewer complications, and shorter hospital stay. It is a viable, cost-effective, and minimally invasive alternative, particularly suitable for elderly patients and resource-limited healthcare settings.

KEYWORDS: Proximal humerus fracture, PHILOS plate, TPTS, MIROS, minimally invasive fixation, Constant-Murley score, orthopaedic trauma.

INTRODUCTION

Proximal humerus fractures are among the most common fragility fractures encountered in clinical practice, particularly in the elderly population. They constitute approximately 4%–5% of all fractures and are the third most frequent fractures in patients over the age of 65, following hip and distal radius fractures.[1] These injuries typically occur due to low-energy mechanisms such as falls in older individuals or high-energy trauma like road traffic accidents in younger adults. With the aging global population and increasing longevity, the incidence of these fractures is expected to rise substantially in the coming decades.

Management of proximal humerus fractures depends on several factors, including the fracture pattern, degree of displacement, bone quality, patient age, activity level, and associated comorbidities. While conservative treatment yields satisfactory outcomes in minimally displaced fractures, displaced or unstable fractures—particularly Neer 2-part and 3-part types—often require surgical intervention to achieve anatomical reduction, early mobilization, and optimal functional recovery.[2,3]

Several surgical techniques have been developed to treat proximal humerus fractures, including percutaneous pinning, intramedullary nailing, open reduction with

locking plate fixation, and hemiarthroplasty. Among these, the Proximal Humeral Internal Locking System (PHILOS) plate has become a widely accepted modality. It provides angular stability and is particularly effective in osteoporotic bone due to its fixed-angle construct.[4] However, PHILOS plating is not without complications, which may include screw perforation, subacromial impingement, varus malalignment, avascular necrosis, and infection.[5,6]

In contrast, minimally invasive options such as the Tension Band Percutaneous Threaded Pin with Suture (TPTS) and Minimally Invasive Reduction and Osteosynthesis System (MIROS) have emerged as viable alternatives. These techniques aim to stabilize the fracture while preserving the soft tissue envelope and periosteal blood supply, thereby reducing the risk of complications associated with open surgery. The MIROS system, in particular, uses a percutaneous external fixation concept that minimizes implant-related morbidity and facilitates fracture healing with minimal tissue disruption.[7–9] Moreover, reduced operative time, lower blood loss, and quicker rehabilitation are attractive advantages, especially in resource-constrained settings.

Despite the growing interest in these minimally invasive methods, comparative clinical data evaluating the outcomes of TPTS/MIROS versus PHILOS plate fixation remain limited in the Indian healthcare context. There is a need for well-structured prospective studies to assess and validate the efficacy, safety, and functional outcomes of these treatment modalities.

This prospective study was conducted in the Department of Orthopaedics at Ma Vindhyawasini autonomous state medical college (MVASMC Mirzapur) over a period of six months from January 2025 to June 2025. The objective was to compare the functional outcomes, complication rates, and perioperative parameters of TPTS/MIROS and PHILOS plate fixation in patients with displaced proximal humerus fractures. The study aims to contribute valuable clinical insights for orthopedic surgeons in selecting the most appropriate and cost-effective treatment strategy for this challenging fracture type.

MATERIALS AND METHODS

This prospective, comparative, interventional study was conducted in the Department of Orthopaedics at Ma vindhyawasini autonomous state medical college (MVASMC Mirzapur) over a period of six months from January 2025 to June 2025. Ethical clearance was obtained from the Institutional Ethics Committee, and informed written consent was obtained from all participants prior to inclusion in the study.

A total of 60 patients presenting with displaced proximal humerus fractures were enrolled based on predefined inclusion and exclusion criteria. Eligible patients were between 18 and 70 years of age and presented with closed, displaced Neer 2-part or 3-part proximal humerus fractures within seven days of injury. Patients with open fractures, 4-part fractures, fracture-dislocations, pathological fractures, prior ipsilateral shoulder surgery, or significant medical comorbidities contraindicating surgical intervention were excluded from the study. Patients unwilling to participate or lost to follow-up were also excluded.

The enrolled patients were randomized into two equal groups of 30 each. Group A patients were treated using Tangari Prakash trauma system (TPTS) by Minimally Invasive Reduction and Osteosynthesis System (MIROS), while Group B patients underwent open reduction and internal fixation with a Proximal Humeral Internal Locking System (PHILOS) plate. All patients underwent a thorough clinical examination and radiographic assessment, including anteroposterior, axillary, and scapular Y views of the affected shoulder. Fractures were classified using Neer's classification system.

In Group A, procedures were carried out under general or regional anesthesia. Closed or minimally open reduction was achieved under fluoroscopic guidance, followed by percutaneous insertion of threaded pins. In the TPTS subgroup, fixation was augmented with tension band sutures, while in the MIROS subgroup, an external stabilization frame was applied. This approach minimized soft tissue dissection and preserved vascularity to the humeral head. In Group B, surgery was performed via the standard deltopectoral approach under general or regional anesthesia. The fracture fragments were anatomically reduced and temporarily stabilized using K-wires or clamps, followed by definitive fixation using a PHILOS locking plate. Screw placement and implant positioning were confirmed intraoperatively with fluoroscopy.

Postoperatively, all patients followed a standardized rehabilitation protocol. Initial immobilization in an arm pouch was maintained for approximately two weeks, after which passive pendulum and range-of-motion exercises were initiated. Active-assisted and active exercises were gradually introduced based on fracture stability and patient compliance, typically from the third postoperative week. Strengthening exercises were begun at six to eight weeks postoperatively. Patients were followed up at one, three, and six months. The primary outcome measure was functional assessment using the Constant-Murley Shoulder Score at three and six months postoperatively. Secondary outcome measures included operative time, intraoperative blood loss, duration of hospital stay, and incidence of complications such as infection, non-union, avascular necrosis, implant failure, and postoperative shoulder stiffness.

Data were compiled and analyzed using SPSS software version 25.0 (IBM Corp., Armonk, NY, USA).

Continuous variables were expressed as mean ± standard deviation (SD) and compared using the unpaired Student's t-test. Categorical variables were analyzed using the Chi-square test or Fisher's exact test as appropriate. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 60 patients with displaced proximal humerus fractures were included in this study, with 30 patients each allocated to Group A (TPTS/MIROS) and Group B (PHILOS plate fixation). Baseline demographic characteristics and fracture classifications were comparable between the two groups, as detailed in **Table 1**.

Table 1: Baseline Characteristics of Study Participants.

Variable	Group A (TPTS BY MIROS)	Group B (PHILOS)	*p*-value
Number of Patients	30	30	--
Mean Age (years)	51.7 ± 11.2	53.3 ± 12.6	0.58
Gender (Male: Female)	18: 12	17: 13	0.79
Neer Type 2-part: 3-part	14: 16	13: 17	0.84

Table 1 shows that there was no statistically significant difference between the two groups in terms of age, gender distribution, or fracture type.

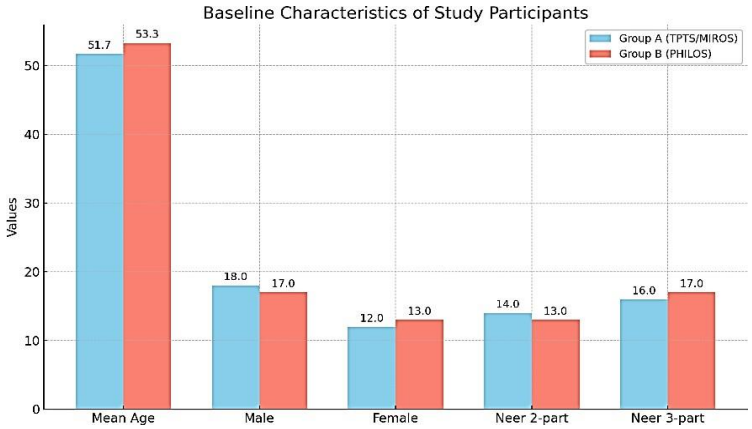


Figure 1: This bar graph compares Group A (TPTS/MIROS) and Group B (PHILOS) in terms of mean age, gender distribution, and fracture type (Neer 2-part and 3-part). The differences between the two groups were not statistically significant ($p > 0.05$), indicating that both groups were comparable at baseline.

Perioperative variables showed significant differences. Group A had a shorter mean operative time, lower intraoperative blood loss, and shorter hospital stay, as summarized in **Table 2**.

Table 2: Comparison of Perioperative Parameters Between Groups.

Parameter	Group A (TPTS BY MIROS)	Group B (PHILOS)	*p*-value
Operative Time (minutes)	46.3 ± 6.9	77.5 ± 9.8	<0.001
Blood Loss (ml)	57.6 ± 11.4	131.2 ± 18.6	<0.001
Hospital Stay (days)	4.3 ± 1.2	6.6 ± 1.5	0.002

Table 2 demonstrates statistically significant reductions in operative time, intraoperative blood loss, and duration of hospitalization in the TPTS/MIROS group compared to the PHILOS group.

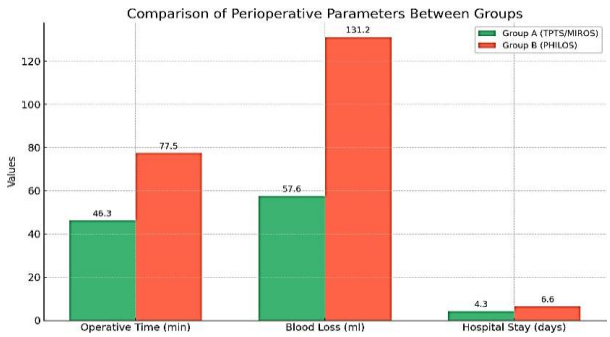


Figure 2: This bar graph highlights statistically significant differences in operative time, intraoperative blood

loss, and hospital stay between Group A (TPTS/MIROS) and Group B (PHILOS). Group A demonstrated superior perioperative efficiency with significantly reduced surgical duration, minimal blood loss, and shorter hospitalization ($p < 0.05$ for all parameters).

Functional outcomes were evaluated using the Constant-Murley Shoulder Score at 3 and 6 months post-operatively. Both groups showed progressive improvement over time, with slightly better results in Group A, though the differences were not statistically significant (Table 3).

Table 3: Comparison of Functional Outcomes (Constant-Murley Score).

Time Point	Group A (TPTS BY MIROS)	Group B (PHILOS)	*p*-value
3 months	62.4 ± 9.1	58.7 ± 10.2	0.18
6 months	77.3 ± 8.2	74.1 ± 9.5	0.14

Table 3 highlights the functional recovery in both groups, with slightly higher Constant scores in the TPTS/MIROS group at both time points, though without statistical significance.

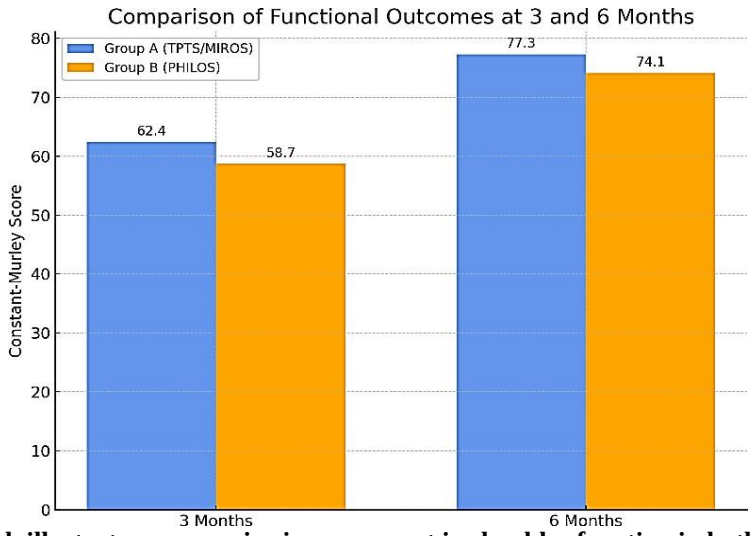


Figure 3: This bar graph illustrates progressive improvement in shoulder function in both groups, with Group A (TPTS/MIROS) consistently achieving slightly higher Constant-Murley scores than Group B (PHILOS) at both time points. However, the differences were not statistically significant ($p > 0.05$), indicating comparable long-term functional outcomes.

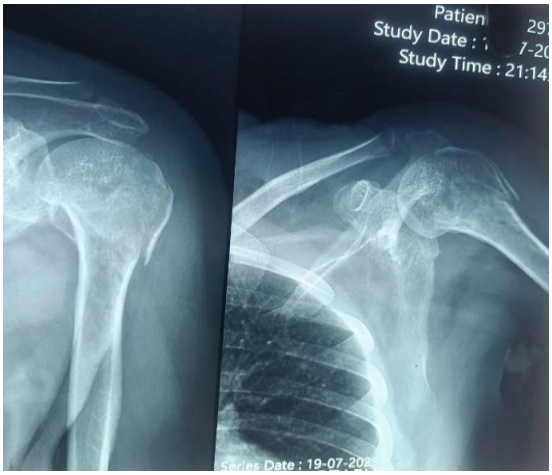
Post-operative complications were recorded and compared between the two groups (Table 4). Group B had a higher complication rate, including more severe complications requiring reintervention.

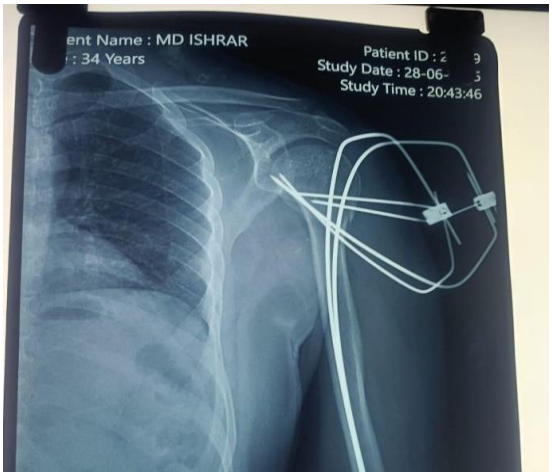
Table 4: Post-operative Complications Observed in Both Groups.

Complication Type	Group A (n=30)	Group B (n=30)
Superficial Infection	2	0
Deep Infection	0	1
Shoulder Stiffness	1	2
Subacromial Impingement	0	2
Screw Back-out/Implant Failure	0	1
Total Patients with ≥1 Complication	**3 (10%)**	**6 (20%)**

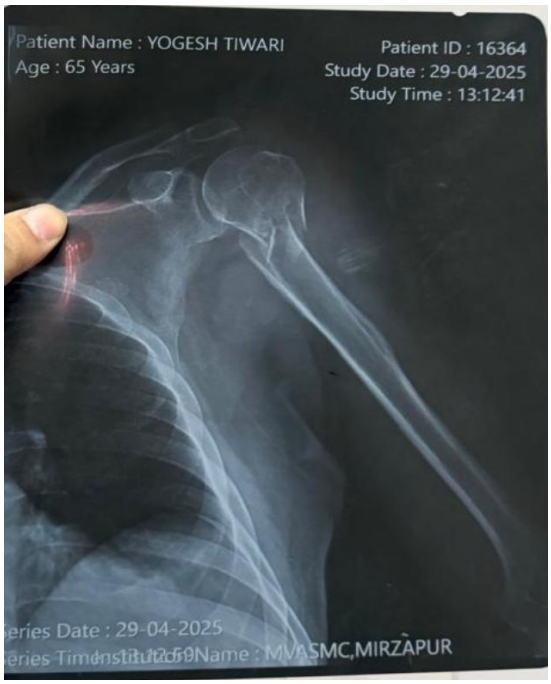
Table 4 shows a higher rate and severity of complications in the PHILOS group, including deep infection and implant-related issues. The difference in total complication rates was not statistically significant (p = 0.28).

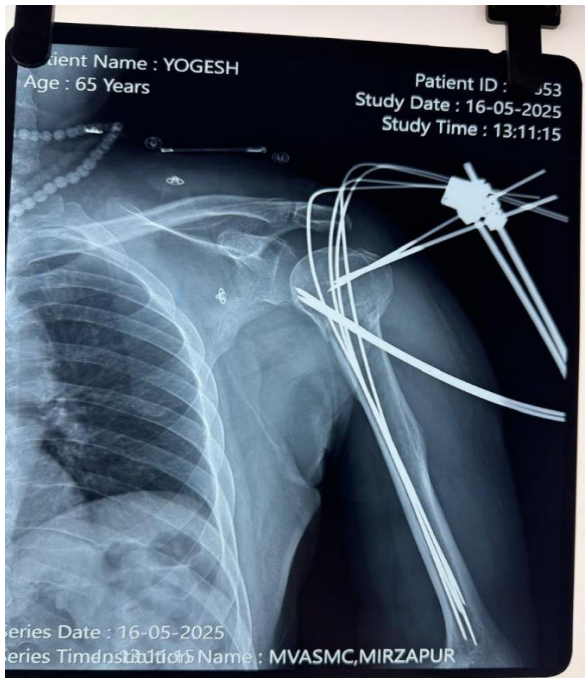
Radiological union was achieved in all cases by the end of 6 months. The average time to union was 10.2 ± 2.3 weeks in Group A and 11.1 ± 2.7 weeks in Group B, which was not statistically significant (p = 0.08).



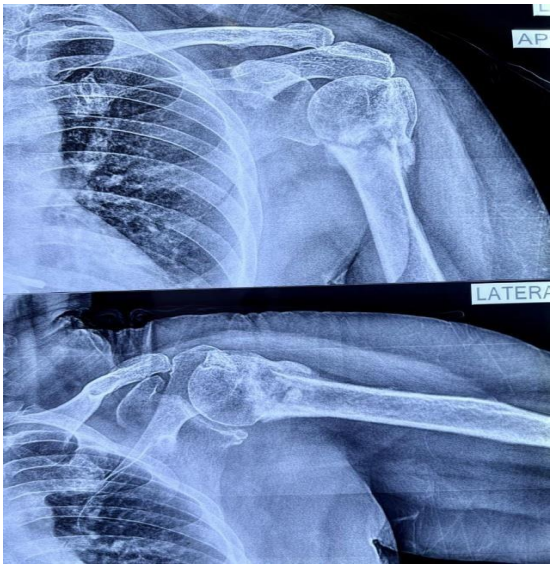


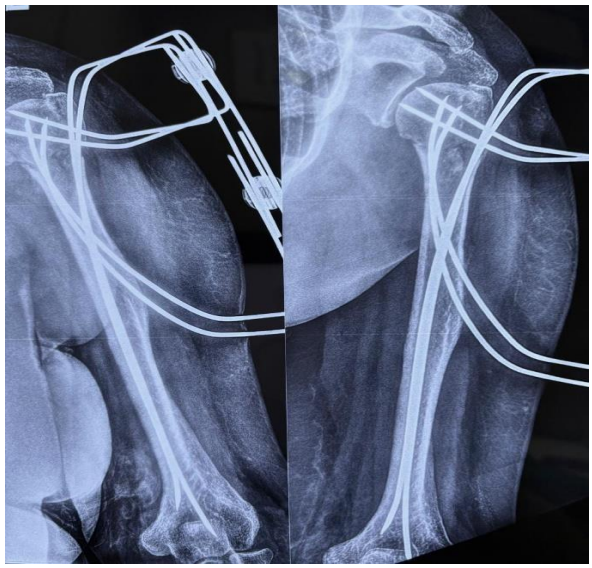
case 1 PREOP **Post-Op (Tangari Prakash trauma system)**





Case 2 Pre-Op **Post-Op**





Case 3 Preop **Post-Op**

DISCUSSION

The management of displaced proximal humerus fractures continues to pose a challenge in orthopaedic practice, especially in elderly individuals with osteoporotic bone and in healthcare settings with limited surgical infrastructure. These fractures account for approximately 5% of all fractures and have shown a rising incidence with increasing life expectancy.[1] Although various treatment modalities exist, the choice between open reduction and internal fixation (ORIF) using locking plates like the PHILOS and minimally invasive techniques such as TPTS by MIROS remains controversial.[2,3]

In our prospective study, we aimed to compare the functional outcomes and perioperative parameters of two fixation strategies—TPTS/MIROS and PHILOS plating—for displaced Neer 2- part and 3-part proximal humerus fractures. Both groups showed progressive functional improvement, as measured by the Constant-Murley Shoulder Score at 3 and 6 months. While Group A (TPTS/MIROS) had slightly better scores at both intervals, the differences were not statistically significant. These findings align with previous reports, including studies by Koval et al.[4] and Gupta et al.[9], which demonstrated comparable functional outcomes between minimally invasive and conventional plating techniques, with the added benefit of reduced soft tissue disruption in the former.

Significant differences were, however, observed in perioperative parameters. Group A had notably shorter operative time, lower intraoperative blood loss, and reduced hospital stay—all statistically significant. This is consistent with the literature emphasizing the advantages of minimally invasive approaches in reducing surgical morbidity, particularly in elderly and comorbid patients.[8,11] Yoon et al.[11] and Jiang et al.[8] similarly reported improved perioperative profiles with percutaneous or minimally invasive strategies.

When considering post-operative complications, Group B (PHILOS) had a higher rate (20%) compared to Group A (10%). Complications in the PHILOS group included deep infection, implant failure, and subacromial impingement—issues that have been frequently associated with the use of locking plates in prior studies.[3,5] Agudelo et al.[5] and Sudkamp et al.[3] noted similar complications, with some requiring reoperation. In contrast, the TPTS/MIROS group encountered only minor issues, such as superficial infection and transient stiffness, all managed conservatively. These findings reinforce the biomechanical and biological advantages of soft tissue-sparing fixation.[10]

Although not statistically significant, the TPTS/MIROS group also exhibited slightly earlier radiographic union. This could be due to the preservation of periosteal blood supply and reduced fracture site disruption, both of which are critical for bone healing. Fankhauser et al.[6] and Zhang et al.[7] reported delayed union and higher complication rates in PHILOS fixation, especially in osteoporotic patients, supporting our observations.

From a clinical standpoint, the selection of fixation technique must consider not only fracture complexity and bone quality but also patient comorbidities, surgeon expertise, and healthcare resource availability. In developing regions and high-volume trauma centers, TPTS/MIROS presents as a cost-effective, efficient, and reliable alternative to PHILOS plating. Additionally, as an external fixator-based system, MIROS reduces the need for a secondary implant removal surgery and requires minimal intraoperative imaging, which adds to its utility in low-resource environments.[9,10]

However, the current study has limitations. The relatively small sample size and short follow-up duration (6 months) limit the ability to assess long-term outcomes, including avascular necrosis or late hardware complications. Furthermore, although procedures were standardized, variations in surgical skill and intraoperative judgment could have influenced outcomes. Future studies with larger multicenter cohorts and extended follow-up are essential to validate these results and potentially influence clinical guidelines.

In summary, our findings support the use of TPTS/MIROS as a minimally invasive, efficient, and clinically effective option for managing displaced proximal humerus fractures. It offers functional outcomes comparable to PHILOS plating, with the added benefits of shorter operative time, reduced blood loss, fewer complications, and quicker recovery—especially valuable in elderly patients and resource-constrained healthcare settings.

CONCLUSION

This prospective study demonstrates that both TPTS by MIROS and PHILOS plate fixation are effective surgical options for the management of displaced proximal humerus fractures, yielding comparable functional outcomes over a 6-month follow-up period. However, TPTS/MIROS offers distinct advantages in terms of significantly reduced operative time, minimal intraoperative blood loss, shorter hospital stay, and a lower rate of implant-related complications. These benefits make it a particularly valuable option in elderly patients with poor bone quality and in resource- constrained settings where access to advanced operative facilities may be limited.

While PHILOS plating remains, a standard approach offering stable internal fixation, the findings of this study suggest that TPTS/MIROS can serve as a minimally invasive, biologically favorable, and cost-effective alternative without compromising functional recovery. Further large-scale, long-term studies are warranted to validate these results and assess durability, patient satisfaction, and quality-of-life outcomes.

LIMITATIONS

This study has several limitations that should be acknowledged. Firstly, the sample size was relatively small, and the study was conducted at a single tertiary care center, which may limit the generalizability of the findings. Secondly, the follow-up period was limited to 6 months, which may not be sufficient to assess long-term complications such as avascular necrosis, post- traumatic arthritis, or implant failure over time. Thirdly, the functional outcomes were assessed using the Constant-Murley Score, which, although widely used, may not fully capture patient- reported satisfaction or quality-of-life measures. Additionally, surgeon-related bias cannot be entirely excluded, despite standardization of techniques, as differences in surgical expertise may have influenced outcomes. Future multicentric studies with larger cohorts, longer follow-up, and additional functional scales are recommended to confirm and expand upon these findings.

CONFLICT OF INTEREST

The authors declare no conflicts of interest related to this study. There was no financial support, sponsorship, or involvement of any commercial organization in the design, conduct, or reporting of this research.

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