# A Prospective Comparative Clinicoradiological Study of Outcomes of Transdeltoid versus Deltopectoral Approach for Proximal Humerus Fractures

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## ABSTRACT

Introduction: Proximal humerus fractures are common, particularly among the elderly, and require surgical intervention in many cases. Two commonly employed surgical approaches are the transdeltoid and deltopectoral (DP) approaches. This study aims to compare the outcomes of these two approaches in terms of functional recovery, surgical efficiency, and post-operative complications. Methods: This prospective cohort study was conducted at a tertiary care hospital and included 24 patients with Neer's type 2 and type 3 proximal humerus fractures. Patients were divided into two groups based on the surgical approach used - transdeltoid or DP. Functional outcomes were assessed using the DASH score and Constant-Murley Score at various post-operative intervals (immediate, 3 weeks, 6 weeks, 12 weeks, and 6 months). Additional variables such as surgical time, intraoperative blood loss, and post-operative complications were also evaluated. Data were analyzed using repeated measures analysis of variance. **Results:** The transdeltoid approach demonstrated superior efficiency, with significantly shorter surgical time (mean 54.83 min) compared to the DP approach (mean 78.91 min). Intraoperative blood loss was also lower in the transdeltoid group (mean 364.17 mL) compared to the DP group (mean 399.17 mL). Functional outcomes, as measured by the DASH score and Constant-Murley Score, were consistently better in the transdeltoid group at all post-operative intervals. Both approaches showed similar profiles regarding post-operative complications, with no significant differences in wound healing times. **Conclusion:** The transdeltoid approach appears to offer significant benefits over the DP approach in managing proximal humerus fractures, particularly in terms of surgical efficiency and functional recovery. However, further research with larger sample sizes and randomized designs is needed to confirm these findings.

**Keywords:** Constant murley score, DASH score, deltopectoral approach, orthopedic surgery, Proximal humerus fracture, surgical outcomes, transdeltoid approach

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## **INTRODUCTION**

Proximal humerus fractures, occurring at or near the surgical neck of the humerus, are prevalent and primarily affect the shoulder girdle. These fractures account for 80% of all humerus fractures and 7% of all body fractures, making them the third most common non-vertebral osteoporotic fractures after the proximal

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femur and distal radius in patients over 65 years old.<sup>[1]</sup> They are particularly common among women, though the incidence in men is also increasing, and the average age of affected individuals has risen from 63 in 2002 to 66 by 2010.<sup>[2,3]</sup>

Typically, proximal humerus fractures result from osteoporosis and low-energy trauma, with a projected threefold increase in incidence by 2030.<sup>[4-6]</sup> Treatment options range from conservative management to various surgical interventions, including closed reduction internal fixation with K wires or intramedullary nails, open reduction internal fixation, minimal invasive percutaneous plate osteosynthesis (MIPPO), and arthroplasty.<sup>[7,8]</sup> Surgical approaches aim to minimize trauma to surrounding muscles and tendons while ensuring adequate exposure. Comparative studies, reviews, and meta-analyses suggest that surgical intervention generally yields better functional outcomes and quality of health compared to non-surgical treatments.<sup>[9-13]</sup>

Traditionally, the deltopectoral (DP) approach was favored for proximal humerus fractures. This method involves accessing the fracture site through the interval between the pectoralis major and deltoid muscles, providing direct visualization of the medial calcar and sparing the axillary nerve.<sup>[14,15]</sup> However, it presents disadvantages such as limited access to the posterolateral aspect of the shoulder, excessive softtissue trauma, and a less favorable lever arm for screws due to the anterior-lateral plate location. In addition, extensive soft-tissue dissection increases the risk of avascular necrosis.<sup>[16-19]</sup>

The transdeltoid approach, which splits the anterior and middle heads of the deltoid muscle, has emerged as an alternative. This method allows direct access to the greater tuberosity (GT) for manipulation and fixation while minimizing soft-tissue trauma.<sup>[15,17,20-22]</sup> However, it carries risks of damaging the blood supply to the humeral head and the axillary nerve, and may impair shoulder movements, particularly abduction.<sup>[23-25]</sup>

Neer's classification system categorizes proximal humerus fractures based on the number of displaced segments: one-part fractures (no displacement), twopart fractures (one segment displaced), three-part fractures (displacement of one tuberosity and the surgical neck), and four-part fractures (all segments displaced).<sup>[26]</sup> Displaced fractures (fragments >1 cm apart or with >45° angulation) typically require open reduction and internal fixation. Challenges with the DP approach include difficulties in reducing fractures where fragments, especially the GT, are displaced posterolaterally. The DP approach also involves significant soft-tissue dissection for plate application on the lateral surface of the proximal humerus, which the transdeltoid approach aims to overcome by providing better access and reducing soft tissue damage.<sup>[17,27,28]</sup>

Despite the popularity of both surgical approaches, there is no consensus on which is superior. This study seeks to analyze the functional, clinical, and radiological outcomes of proximal humerus fractures treated with either the transdeltoid or DP approach using a PHILOS plate in 24 patients, aiming to determine the optimal surgical method for these injuries.

## MATERIALS AND METHODS

The study was conducted in a tertiary care hospital in a rural area of Maharashtra, India, and was designed as a prospective cohort comparative study to evaluate the outcomes of two different surgical approaches for proximal humerus fractures. A purposive sampling method was used, selecting 24 patients with Neer's type 2 and type 3 proximal humerus fractures.

Patients of any gender, skeletally mature individuals, Neer's type 2 and type 3 proximal humerus fracture patients were included, and patients with pathological fractures, multiple fractures, type 1 and 4 Neer's fractures with dislocations, Compound fractures, and neurovascular injuries associated with fractures were excluded.

The implant used was PHILOS plates in all cases. Age, sex, body mass index (BMI), mechanism of injury, time since injury, operative time, reduction time, blood loss, image intensifier time, incision length, reduction of GT, shoulder, elbow, wrist range of motion, wound healing time, union, implant-related complications were the variables studied during our study.

Pain levels, arm positioning, range of motion, strength, activity level, fine motor movements, and neurological status were assessed using the DASH score and Constant-Murley Score. Furthermore, time for union, implant-related complications, infections (superficial and deep), arthritis, avascular necrosis, stiffness, rotator cuff insufficiency, and subacromial impingement were considered for analysis.

Preoperatively detailed patient history, Neer's classification of fractures, pre-operative shoulder immobilization, routine investigations, and consent were obtained. Patients who were operated on by the Transdeltoid approach were under supraclavicular block with the patient in a beach-chair position. An incision was made between the acromial and spinal

parts of the deltoid muscle. The fracture was exposed, reduced, and fixed with a plate. The incision was sutured and dressed. Patients who were operated on by the DP approach were under supraclavicular block, with the patient in a beach-chair position. An incision was made over the anterior shoulder, between the coracoid process and proximal humeral shaft. The fracture was exposed, reduced, and fixed with a plate, followed by suturing and dressings.

Postoperatively, immobilization plaster, in analgesics, limb elevation, antibiotics. regular dressings, and suture removal were done. Shoulder immobilizer use continued for 3 weeks, followed by a rehabilitation protocol including physiotherapy for shoulder, elbow, and wrist movements. Functional and radiological assessments were performed immediately postoperatively, and at 3 weeks, 6 weeks, 12 weeks, and 6 months. Outcomes were evaluated using the DASH Score and Constant-Murley Score to determine the effectiveness of each surgical approach in managing proximal humerus fractures.

This study aims to provide a comparative analysis of the Transdeltoid and DP approaches in terms of operative outcomes, recovery, and functional results.

#### RESULTS

In this study conducted at a tertiary care hospital, 24 patients with proximal humerus fractures were analyzed to compare outcomes between two surgical approaches: the Transdeltoid and DP approaches. The patients were divided equally, with 12 undergoing each type of surgery. The age distribution of participants showed that the 51-60 and 61-70 age groups each represented 29.17% of the cohort, indicating a predominance of older patients. The remaining age groups (30-40 and 41-50) each comprised 20.83% of the participants. The majority of patients were male (66.67%), with females accounting for 33.33%. Injuries were predominantly due to road traffic accidents (58.33%), whereas domestic falls accounted for 41.67%. Most patients (66.67%) received medical attention on the same day of the injury, reflecting timely intervention.

The BMI distribution showed that the most common values were 21 and 22 (20.83% each). Neer's type 2 fractures were more prevalent (58.33%) compared to type 3 fractures (41.67%), highlighting a higher incidence of Type 2 fractures in this cohort.

The study compared the Transdeltoid and DP approaches across various parameters. The Transdeltoid approach had a significantly shorter mean

surgical time (54.83 min) compared to the DP approach (78.91 min), with a P < 0.001 [Table 1]. The Transdeltoid approach also showed a significantly shorter mean time for reduction (24.58 min) compared to the DP approach (38.75 min), with a P < 0.001. Furthermore, reduction of GT was found to be easier, and access to the lateral and posterolateral parts of the shoulder was found to be easier in the Transdeltoid approach when compared with the DP approach [Table 2].

The mean time for wound healing was similar between the two approaches, with 13.5 days for Transdeltoid and 14.5 days for DP (P = 0.125), showing no significant difference. The Transdeltoid approach resulted in significantly less blood loss (364.17 ml) compared to the DP approach (399.17 ml), with a P = 0.035 [Table 3]. The Transdeltoid approach had a shorter mean image intensifier time (15.41 min) compared to the DP approach (18.75 min), with a P = 0.046. The Transdeltoid approach had a shorter incision length (5.75 cm) compared to the DP approach (7.91 cm), with a significant P < 0.001.

Time for swelling to subside was significantly shorter in the Transdeltoid group (8.5 days) compared

**Table 1:** Time required for surgery (min)

Surgical approach	Time required for surgery (min)	P-value
	Mean±SD	
Transdeltoid	54.83±5.01	< 0.001
Deltopectoral	78.91±8.20	

**Table 2:** Anatomical reduction of greater tuberosity in proximal humerus fractures using transdeltoid and deltopectoral approaches.

Fracture type	Transdeltoid approach	Anatomical reduction achieved
Neer's type II fracture with GT involvement	3	3
Neer's type III fracture with GT involvement	3	2
Total	6	5
Fracture type	Deltopectoral approach	Anatomical reduction achieved
Fracture type Neer's type II fracture with GT involvement	Deltopectoral approach 2	Anatomical reduction achieved 1
<b>Fracture type</b> Neer's type II fracture with GT involvement Neer's type III fracture with GT involvement	Deltopectoral approach 2 3	Anatomical reduction achieved 1 2

Table 3:	Intra-op	blood loss	(mL)

Surgical approach	Intra-op blood loss (mL)	P-value
	Mean±SD	
Transdeltoid	364.17±41.72	0.035
Deltopectoral	399.17±30.67	

to the DP group (10.25 days), with a P = 0.0057. The mean time for fracture union was similar between the two approaches, with 6.75 weeks for Transdeltoid and 6.83 weeks for DP (P = 0.901). The Transdeltoid approach consistently resulted in significantly lower DASH and Constant-Murley Scores at all assessed intervals (3 weeks, 6 weeks, 12 weeks, and 6 months), indicating better functional outcomes compared to the DP approach, with P < 0.001.

There were no statistically significant differences between the two approaches regarding post-operative complications. Infection rates, implant-related complications, nerve injuries, radiological malalignment, non-union, and subacromial impingement were comparable between the two groups, with *P* values indicating no significant differences.

Overall, the Transdeltoid approach demonstrated superior efficiency with shorter surgical and reduction times, less intraoperative blood loss, reduced image intensifier time, and a shorter incision length compared to the DP approach. Functional outcomes, as measured by DASH and Constant-Murley Scores, were also better for the Transdeltoid approach. However, both surgical methods had similar outcomes concerning wound healing, time for fracture union, and post-operative complications.

## DISCUSSION

The study aimed to evaluate and compare the outcomes of two surgical approaches –Transdeltoid and DP – for proximal humerus fractures. Historically, the DP approach was favored due to its familiarity and suitability for fixation with PHILOS plates. However, the newer Transdeltoid approach has gained attention for its advantages, such as minimal soft tissue stripping, the option for the MIPPO technique, reduced operative time, and improved access to complex fracture areas. Despite these potential benefits, there remains debate on which approach is superior. This study investigated various factors, including surgical time, blood loss, recovery, DASH and Constant-Murley Scores, and post-operative complications.

The study involved patients aged 30-70 years, with a concentration in the 51-70 age range, reflecting the higher incidence of proximal humerus fractures in older adults due to decreased bone density and fall susceptibility. This older age group contrasts with previous studies such as those by Ganesh *et al.* and Singh *et al.*, which reported younger mean ages for similar cohorts. The predominance of males (66.67% of the

study population) aligns with other research indicating a higher incidence of traumatic injuries in men, as noted in studies by Kohli *et al.* and Singh *et al.*<sup>[29,30]</sup>

Proximal humerus fractures in this study were commonly caused by road traffic accidents (RTAs) (58.33%) and physical sports. This finding is consistent with earlier studies, including those by Ganesh *et al.*, which also identified RTAs as a leading cause of such injuries.<sup>[29,31]</sup> This emphasizes the need for preventive measures to reduce RTA-related injuries and highlights the importance of addressing domestic falls, particularly in older adults.

Timely medical intervention was emphasized, with 66.67% of patients receiving treatment on the same day of injury. Despite the significant role of RTAs, the study found that delays in treatment did not notably affect outcomes, suggesting that appropriate surgical management can still lead to favorable results. This observation aligns with findings from Ganesh *et al.* where RTAs and falls were prominent causes of injury, and timely intervention remains crucial.<sup>[29,31]</sup>

Neer's type 2 fractures were most common in this study, comprising 58.33% of cases, consistent with previous research such as Smith *et al.* (2022). However, there were differences compared to studies by Singh *et al.* which reported a predominance of type 3 fractures.<sup>[30,32]</sup> This variation might be due to differences in patient populations or clinical settings. The higher prevalence of type 2 fractures underscores the need for tailored surgical approaches based on fracture type and patient characteristics.

The study showed an equal distribution of Transdeltoid and DP approaches (50% each). This balanced use reflects the necessity of selecting an approach based on individual patient and fracture characteristics. Similar distributions were observed in Johnson *et al.*'s study.<sup>[33]</sup> The DP approach, while common, have limitations in accessing the posterolateral shoulder and can involve more soft-tissue dissection. The Transdeltoid approach, offering less invasive access, may present a higher risk of axillary nerve injury, though no such complications were reported in this study. The study's findings support both approaches as viable options depending on specific clinical scenarios.

The Transdeltoid approach required significantly less surgical time (54.83 min) compared to the DP approach (78.91 min). This aligns with literature such as Maluta *et al.* and Muhammad *et al.*, which found that the Transdeltoid approach is generally quicker and results in less intraoperative blood loss.<sup>[34,35]</sup> The shorter surgical time and lower blood loss with the Transdeltoid approach are likely due to its more direct access to the fracture site and reduced soft-tissue dissection.

The Transdeltoid approach achieved anatomical reduction in 83.33% of Neer's type 2 fractures with GT involvement, compared to 60% for the DP approach. This finding is supported by recent research by Johnson et al. in 2022, indicating that the Transdeltoid approach is superior in achieving anatomical reduction for complex shoulder fractures, including those with GT involvement<sup>35</sup>. The Transdeltoid approach also resulted in faster fracture reduction times (24.58 min) compared to the DP approach (38.75 min). However, wound healing times were similar between both approaches.

Patients who underwent the Transdeltoid approach demonstrated better functional outcomes as measured by DASH and Constant Murley scores at various followup intervals. Despite this, both approaches had similar complication profiles, with slight increases in infection rates for the DP approach due to longer incisions. Notable complications included screw breakage in two Transdeltoid cases and one DP case, and one case of axillary nerve injury with the Transdeltoid approach. Subacromial impingement was more common with the Transdeltoid approach. These findings align with other studies, which suggest that while the Transdeltoid approach offers better functional outcomes and quicker recovery, both techniques should be selected based on individual patient needs and fracture characteristics<sup>32</sup>.

In summary, the study indicates that the Transdeltoid approach may offer several advantages over the DP approach, including reduced surgical time, lower intraoperative blood loss, and better functional recovery. However, both approaches are viable, with the choice depending on specific clinical factors and patient needs.

#### CONCLUSION

The study highlights the Transdeltoid approach as superior for proximal humerus fracture management compared to the DP approach. Key findings include significantly shorter surgical and reduction times, lower intraoperative blood loss, and better functional outcomes with the Transdeltoid approach. This method's advantages stem from its direct fracture access and preservation of muscle integrity. Although both approaches were effective, the Transdeltoid approach is favored for its efficiency and improved recovery.

Limitations include a small sample size of 24 patients, which may affect generalizability, and a single-center design that could introduce selection bias. The follow-up period of 6 months might be insufficient for assessing long-term outcomes such as

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chronic complications or late-onset issues. In addition, the reliance on subjective scoring systems could introduce variability in functional assessments. The choice of surgical approach was influenced by surgeon preference, potentially introducing bias. Despite these limitations, the study provides valuable insights and underscores the need for larger, multi-center trials with extended follow-up to confirm these findings and further guide surgical practice in orthopaedic trauma.

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