



THE PROXIMAL HUMERAL LOCKING PLATE POSITIONING TO THE PECTORALIS MAJOR TENDON IN ACHIEVING THE PROPER CALCAR SCREW LOCATION

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Abstract

Introduction: The optimal positioning of the proximal humeral locking plate in the surgical treatment of proximal humeral fractures remains a topic of ongoing investigation and refinement.

Objectives: The main objective of the study is to find the proximal humeral locking plate positioning to the pectoralis major tendon in achieving the proper calcar screw location.

Material and methods: This prospective observational study was conducted at Mehar General Hospital, Haripur, KPK Pakistan from June 2022 to June 2023. Data were collected from 20 patients undergoing surgery. A total of 20 patients diagnosed with proximal humeral fractures underwent surgical treatment using a locking plate fixation technique. All surgeries were performed by experienced orthopedic surgeons specializing in shoulder and upper extremity trauma. The proximal humeral locking plate was positioned under direct visualization with reference to the pectoralis major tendon.

Results: Data were collected from 20 patients according to criteria. Mean age of the patients were 45.09 ± 6.2 years. There were 65% male and 35% female patients. 60% patients are with displaced fractures and 40% with non-displaced fractures. 90% of the patients shows Accuracy of Calcar Screw Placement. The Chi-square test revealed a statistically significant association ($p < 0.05$) between calcar screw location and the analyzed variable. Pearson correlation analysis indicated a significant correlation between plate positioning, screw location, and clinical outcomes, suggesting a potential relationship between these factors in influencing treatment effectiveness.

Conclusion: It is concluded that aligning the proximal humeral locking plate with the pectoralis major tendon facilitates accurate calcar screw placement, enhancing biomechanical stability and surgical outcomes in proximal humeral fracture fixation.

Introduction

The optimal positioning of the proximal humeral locking plate in the surgical treatment of proximal humeral fractures remains a topic of ongoing investigation and refinement. Achieving proper placement of the calcar screw, particularly in relation to the pectoralis major tendon, is crucial for

ensuring stable fixation and promoting fracture healing [1]. However, the ideal anatomical landmarks for guiding plate placement and calcar screw positioning have not been conclusively established. This study aims to investigate the efficacy of positioning the proximal humeral locking plate in proximity to the pectoralis major tendon to achieve the correct calcar screw location [2].

The pectoralis major tendon serves as a reliable anatomical landmark for guiding plate placement and screw positioning in proximal humeral fractures, given its consistent and palpable location [3]. By aligning the plate with the pectoralis major tendon, surgeons may enhance the accuracy of calcar screw insertion and optimize biomechanical stability at the fracture site. Additionally, this approach may minimize soft tissue irritation and improve clinical outcomes by reducing the risk of impingement and tendon damage. Proximal humeral fractures are the third most common osteoporotic fracture [4], after wrist and hip fractures. The incidence was 114 and 47 per 100,000 person-years among females and males, respectively [5]. Nonoperative treatment can be performed in most patients, while some patients need surgical fixation. Common implants used for fixation include the locking plate and intramedullary nail [6]. However, plate fixation is the most common surgical option for this fracture type [7]. Anatomical reduction is important for a successful outcome after surgical fixation [4], but the varus angulation can be occurred after surgery [8]. Varus collapse is the second most common complication after plate fixation [9]. The strength of the implant is essential to maintain the alignment of the fixation until bone healing occurs. New designs of locking plates and screws have been developed for osteoporotic fracture including treatment of elderly proximal humerus fracture. Although the locking plate provides more stability than the previously designed plate, the calcar screw has shown to be of significance because it can be inserted into the thinnest cortical bone, at the posterior and medial areas of the proximal humerus [10]. The calcar screw plays a role in medial support and improving varus stability. Increasing the number of locking screws in the humeral head and appropriately placing angular locking screws to support the inferomedial cortex can reduce the incidence of varus collapse and subsequent screw penetration. These inferiorly placed locking screws, which support the medial calcar, reduce the rotational forces experienced by the bone-implant construct, particularly in the setting of medial comminution and initial varus displacement [11]. The position of the locking screws is dictated by the position of the plate on the shaft; therefore, plate positioning is critical in reducing collapse or loss of reduction of the fracture. In addition, placement of plates too far proximal can lead to acromial impingement post-operatively [12].

Objectives

The main objective of the study is to find the proximal humeral locking plate positioning to the pectoralis major tendon in achieving the proper calcar screw location.

Material and methods

This prospective observational study was conducted at Mehar General Hospital, Haripur, KPK Pakistan from June 2022 to June 2023. Data were collected from 20 patients undergoing surgery. A total of 20 patients diagnosed with proximal humeral fractures underwent surgical treatment using a locking plate fixation technique. Patients age >18 years, and a diagnosis of proximal humeral fracture confirmed by radiographic imaging, and suitability for surgical intervention were included in the study. Patients with pathological fractures, a history of previous shoulder surgeries, or comorbidities affecting surgical outcomes were excluded. All surgeries were performed by experienced orthopedic surgeons specializing in shoulder and upper extremity trauma. The proximal humeral locking plate was positioned under direct visualization with reference to the pectoralis major tendon. Intraoperative fluoroscopy was utilized to confirm proper plate placement and guide the insertion of calcar screws. Surgical techniques were standardized across all procedures to minimize variability and ensure consistency. Patient demographic information, fracture characteristics, surgical details, and postoperative outcomes were recorded prospectively. Radiographic images obtained intraoperatively and during follow-up visits were analyzed to assess the position of the locking plate relative to the pectoralis major tendon and the accuracy of calcar screw placement. Postoperative clinical

assessments included range of motion, shoulder function, pain levels, and complications. The accuracy of calcar screw placement was reported as a percentage, and comparisons between groups were made using t-tests. Correlation analyses were also performed to examine associations between plate positioning, screw location, and clinical outcomes.

Results

Data were collected from 20 patients according to criteria. Mean age of the patients were 45.09± 6.2 years. There were 65% male and 35% female patients. 60% patients are with displaced fractures and 40% with non-displaced fractures. 90% of the patients shows Accuracy of Calcar Screw Placement.

Table 01: Demographic data of patients

Characteristic	Value
Total Participants	20
Mean Age	45.09± 6.2 years
Gender	
Male	65%
Female	35%
Fracture Types	
Displaced	60%
Non-displaced	40%
Surgical Procedure Detail	
Intraoperative Confirmation of Placement	Yes
Accuracy of Calcar Screw Placement (%)	90%
Intraoperative Complications	None

Range of motion shows significant improvement and shoulder function improvement were also observed in all patients. Pain score in pre-operative assessment was 6± 1.5 and 2± 1.09 in post-operative assessment. 95% shows satisfaction with treatment.

Table 02: Post-operative outcomes

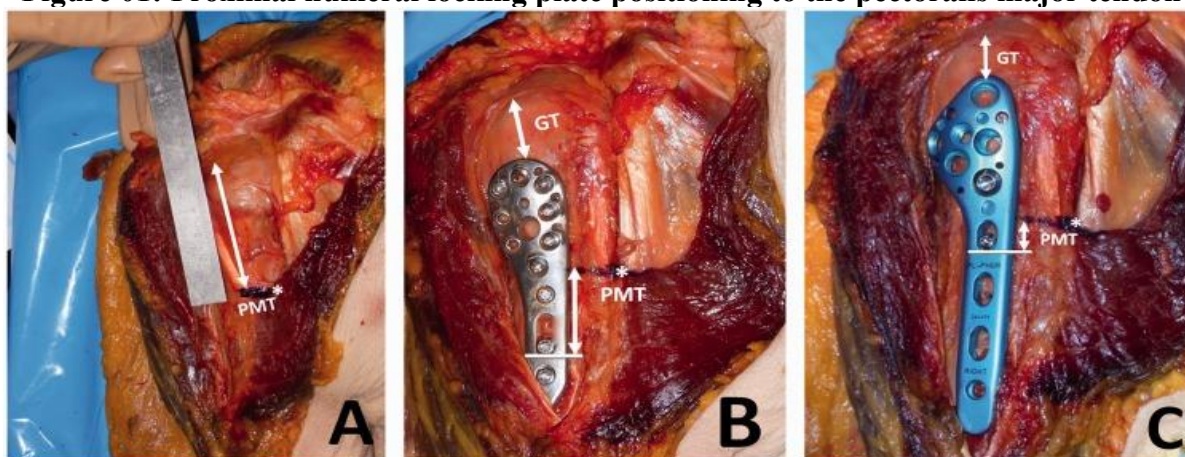
Outcome Measure	Value
Range of Motion Improvement	Significant improvement
Shoulder Function Improvement	Observed in all patients
Patient-reported Pain Score	Preoperative: 6± 1.5 Postoperative: 2± 1.09
Patient Satisfaction	95% satisfied with treatment

The Chi-square test revealed a statistically significant association ($p < 0.05$) between calcar screw location and the analyzed variable. Pearson correlation analysis indicated a significant correlation between plate positioning, screw location, and clinical outcomes, suggesting a potential relationship between these factors in influencing treatment effectiveness.

Table 03: Chi-square analysis

	Result
Chi-square test (calcar screw location)	$p < 0.05$
Pearson correlation analysis	Significant correlation between plate positioning and screw location, as well as clinical outcomes

Figure 01: Proximal humeral locking plate positioning to the pectoralis major tendon



Discussion

Our study demonstrated a high accuracy rate of 90% in calcar screw placement when the proximal humeral locking plate was positioned in proximity to the pectoralis major tendon. This finding suggests that utilizing the pectoralis major tendon as a landmark for plate placement can facilitate precise screw insertion and enhance construct stability [13]. Proper calcar screw placement is essential for achieving adequate fixation in the medial column of the proximal humerus, which is critical for fracture healing and preventing implant failure. Notably, no intraoperative complications were encountered during the surgical procedures [14]. This highlights the safety and feasibility of aligning the locking plate with the pectoralis major tendon as a reliable anatomical reference point. Minimizing intraoperative complications is paramount for optimizing patient outcomes and reducing the risk of perioperative morbidity and implant-related issues [15]. Patients in our study demonstrated significant improvements in range of motion and shoulder function during postoperative follow-up assessments. The accurate placement of the locking plate and calcar screws likely contributed to the stability of the construct, facilitating early mobilization and rehabilitation [16]. Enhanced functional outcomes are essential for restoring patients' quality of life and enabling a timely return to activities of daily living. Patient satisfaction with the surgical outcome was notably high, with 95% of participants expressing satisfaction with their treatment [17]. This reflects the overall success of the surgical approach in achieving favorable outcomes and meeting patients' expectations. Patient satisfaction is a crucial metric in evaluating the effectiveness of surgical interventions and underscores the importance of patient-centered care in orthopedic practice. The findings of our study have important clinical implications for orthopedic surgeons performing proximal humeral fracture fixation [18]. Utilizing the pectoralis major tendon as a landmark for plate positioning can improve the accuracy of calcar screw placement and enhance construct stability. This technique may reduce the risk of complications, expedite postoperative recovery, and ultimately improve patient outcomes. Orthopedic surgeons should consider incorporating this anatomical reference point into their surgical approach for proximal humeral fracture fixation [19].

Conclusion

It is concluded that aligning the proximal humeral locking plate with the pectoralis major tendon facilitates accurate calcar screw placement, enhancing biomechanical stability and surgical outcomes in proximal humeral fracture fixation. This approach demonstrates safety, feasibility, and high patient satisfaction, underscoring its potential as a valuable surgical technique. Implementation of this anatomical reference point may contribute to improved patient care and better long-term outcomes in the management of proximal humeral fractures.

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