

Three-Part Proximal Humerus Fracture Treated with PHILOS Plate Fixation Augmented by a Non-Vascularized Fibular Strut Autograft: A Case Report

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Abstract

Proximal humerus fractures account for a significant proportion of upper-extremity injuries and can pose challenges in achieving stable fixation, particularly when the medial calcar is comminuted. Locking-plate fixation alone may not provide adequate medial support, predisposing to varus collapse and fixation failure. Augmentation with a fibular strut graft has been proposed to enhance construct stability and improve functional outcomes.

We report a case of a 23-year-old male sustained a Neer three-part proximal humerus fracture following a road-traffic accident. Open reduction and internal fixation were performed using a PHILOS plate augmented with a non-vascularized intramedullary fibular strut autograft harvested from the ipsilateral leg. Post-operative rehabilitation included early pendulum exercises and progressive range-of-motion therapy. Radiographic union was achieved by 12 weeks. At the six-month follow-up, the patient achieved a Constant-Murley Score of 92/100, indicating excellent functional recovery. Active forward flexion reached 175°, abduction 170°, and external rotation was symmetrical to the contralateral side, with no donor-site morbidity. This case highlights the mechanical and biological advantages of fibular strut augmentation in providing medial column support, maintaining reduction, and promoting early rehabilitation. Review of similar reports and comparative studies in the literature supports the use of fibular autograft or allograft in complex proximal humeral fractures, particularly when medial comminution is present. Careful surgical technique and appropriate patient selection can minimize complications and optimize outcomes.

Keywords: Proximal humerus fracture; PHILOS plate; Fibular strut graft; Medial column support; Locking plate fixation

Introduction

Proximal humerus fractures account for approximately 4-5% of all fractures and can be challenging to manage when displaced or comminuted [1]. Locking plate fixation using the PHILOS system is a commonly employed technique; however, outcomes may be compromised in fractures with medial calcar comminution, predisposing to varus collapse and fixation failure [2,6]. Restoration of medial column support is therefore essential for maintaining reduction and implant stability.

Fibular strut graft augmentation has emerged as a useful adjunct in such cases. Biomechanical and clinical studies have demonstrated improved stability, better maintenance of alignment, and enhanced functional outcomes when fibular grafts are combined with locking plate fixation [2,3,6]. Additionally, fibular autografts provide structural support with minimal donor-site morbidity.

We report a case of a displaced three-part proximal humerus fracture successfully managed with open reduction and internal fixation using a PHILOS locking plate augmented with a non-vascularized fibular strut autograft, resulting in excellent radiological union and functional recovery.

Case Report

A 23-year-old male presented with pain and swelling over the right shoulder and wrist following a road traffic collision (motorcycle skid and fall). There was no history of head injury or loss of consciousness, and no known comorbidities.

Examination revealed swelling, deformity, and marked tenderness over the right shoulder with restricted movements. The skin was intact with no neurovascular deficits. Distal pulses and capillary refill were normal. Mild wrist tenderness was present without deformity.

Clinical Evaluation

X-Ray Findings:

AP and lateral radiographs of the right shoulder showed a displaced proximal humerus fracture involving the surgical neck with angulation and mild comminution.



Figure 1: Preoperative anteroposterior radiograph of the right shoulder demonstrating a displaced Neer three-part proximal humerus fracture with medial calcar comminution.

Computed Tomography Findings:

3D CT reconstruction revealed a comminuted, displaced three-part proximal humerus fracture involving the greater and lesser tuberosities, with anterior displacement of the humeral head. No glenohumeral dislocation was noted. Right wrist radiographs were normal.

Based on the Neer classification, the injury was classified as a Neer three-part proximal humerus fracture with medial calcar comminution.

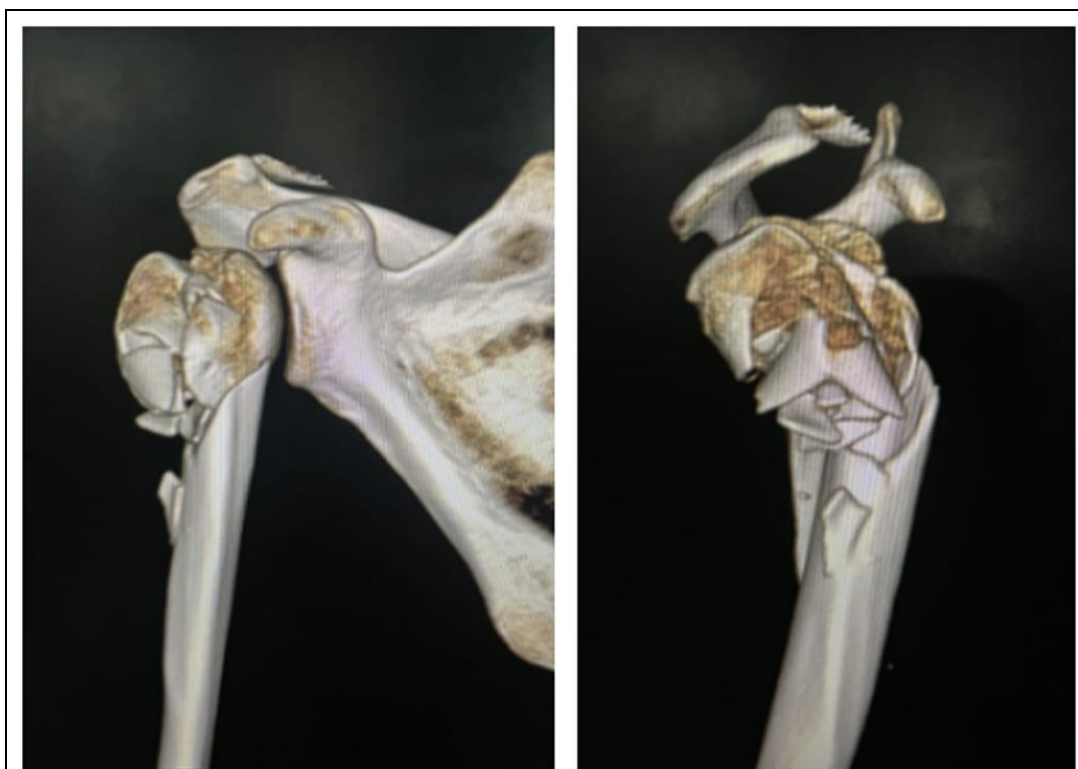


Figure 2: Three-dimensional CT reconstruction demonstrating fracture configuration, displacement of the proximal fragments, and medial column comminution, facilitating preoperative surgical planning.

Surgical Procedure:

The procedure was carried out with the patient in the supine position. A deltopectoral approach was utilized after marking key anatomical landmarks extending from the coracoid process to the humeral shaft. A skin incision was made, and subcutaneous tissues were carefully dissected to expose the deltopectoral groove. The cephalic vein was identified and retracted laterally for protection. Dissection continued to expose the joint capsule, which was incised to visualize the rotator cuff tendons. These tendons were gently manipulated to achieve accurate fracture reduction. Fracture reduction was achieved under direct visualization using traction and temporary Kirschner wire fixation. Fluoroscopy was used intraoperatively to confirm anatomical reduction in both anteroposterior and axillary views. Restoration of the medial calcar was carefully assessed before graft insertion.

For structural support, an intramedullary fibular graft was used. The graft was harvested through a lateral approach to the fibula, approximately at the middle third level, around 13 cm above the tibio-talar joint. After incision and dissection of the subcutaneous tissues, the posterior border of the peroneal fascia was accessed, and the bone surface was exposed. A 6 cm segment of fibular shaft was then harvested. The harvested fibular graft was fashioned appropriately and inserted intramedullary into the humeral shaft to reconstruct the medial column and provide structural support beneath the humeral head. The graft acted as an internal buttress to prevent varus collapse and improve construct stability.

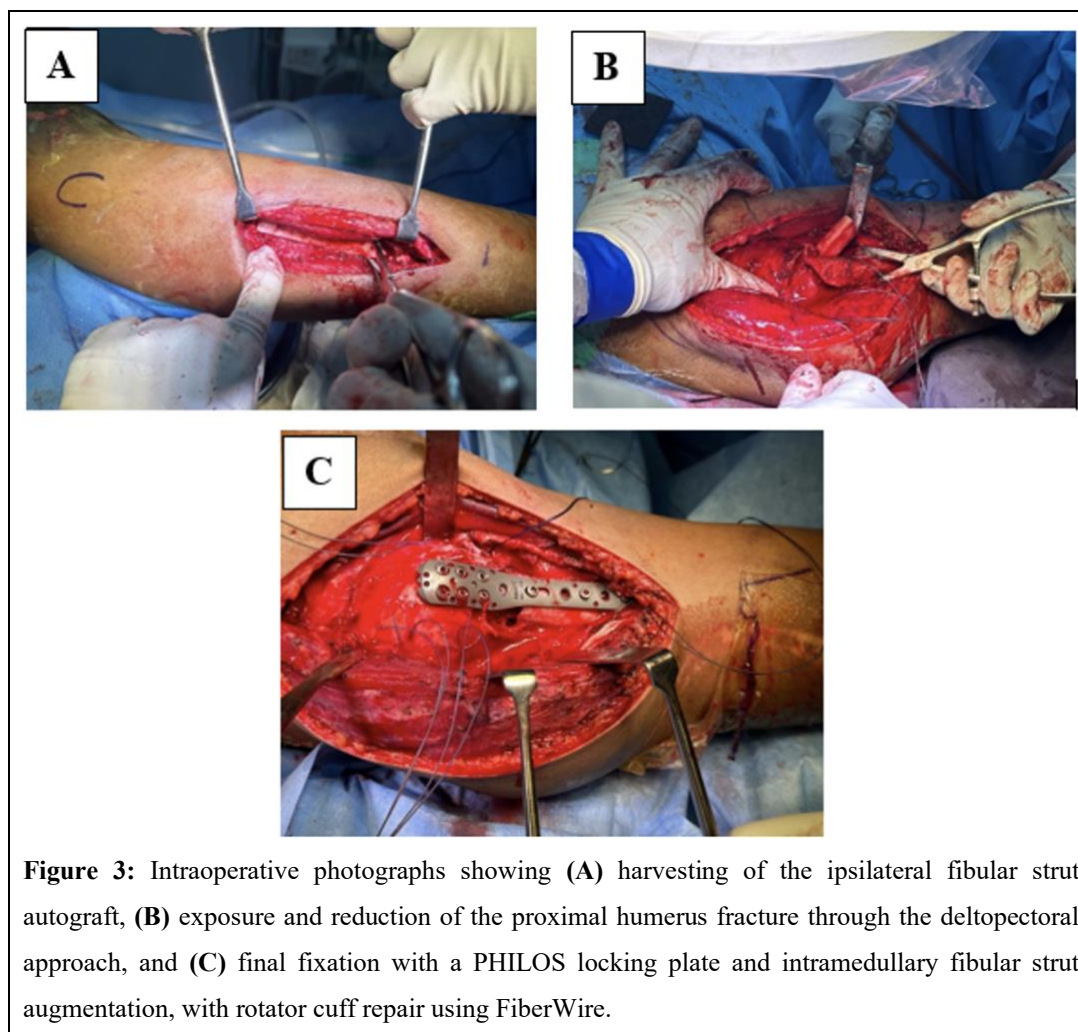


Figure 3: Intraoperative photographs showing (A) harvesting of the ipsilateral fibular strut autograft, (B) exposure and reduction of the proximal humerus fracture through the deltopectoral approach, and (C) final fixation with a PHILOS locking plate and intramedullary fibular strut augmentation, with rotator cuff repair using FiberWire.

Definitive fixation was performed using a 4-hole proximal humerus internal locking system (PHILOS) plate. The PHILOS plate was positioned approximately 5-8 mm distal to the tip of the greater tuberosity and slightly posterior to the bicipital groove. Locking screws were inserted into the humeral head under fluoroscopic guidance while avoiding joint penetration. Notably, the inferior calcar screws were directed through the intramedullary fibular strut, engaging the graft to augment purchase within the humeral head and enhance mechanical stability of the medial column. Final reduction and implant position were confirmed fluoroscopically before wound closure secured with locking screws. 1.6 mm Kirschner wires were employed temporarily to maintain reduction during fixation. The rotator cuff was repaired using Fiber Wire sutures passed through the suture holes of the PHILOS plate to restore soft tissue integrity. The wound was closed in layers, and an arm sling (or shoulder immobilizer) was applied postoperatively.

Postoperative Follow-up

Postoperative rehabilitation followed a structured, progressive protocol. Pendulum exercises were initiated on the first postoperative day. Shoulder abduction was restricted to 30° during the first postoperative week. From the second week, abduction was progressed to 30-60°, advancing beyond 90° from the fourth week. Full range-of-motion exercises were permitted from the sixth week onward, all under physiotherapy supervision. At the six-month follow-up, the patient achieved a Constant-Murley Score of 92/100, indicating excellent functional recovery. Active forward flexion reached 175°, abduction 170°, and external rotation was symmetrical to the contralateral side. No donor-site morbidity or implant-related complications were observed.

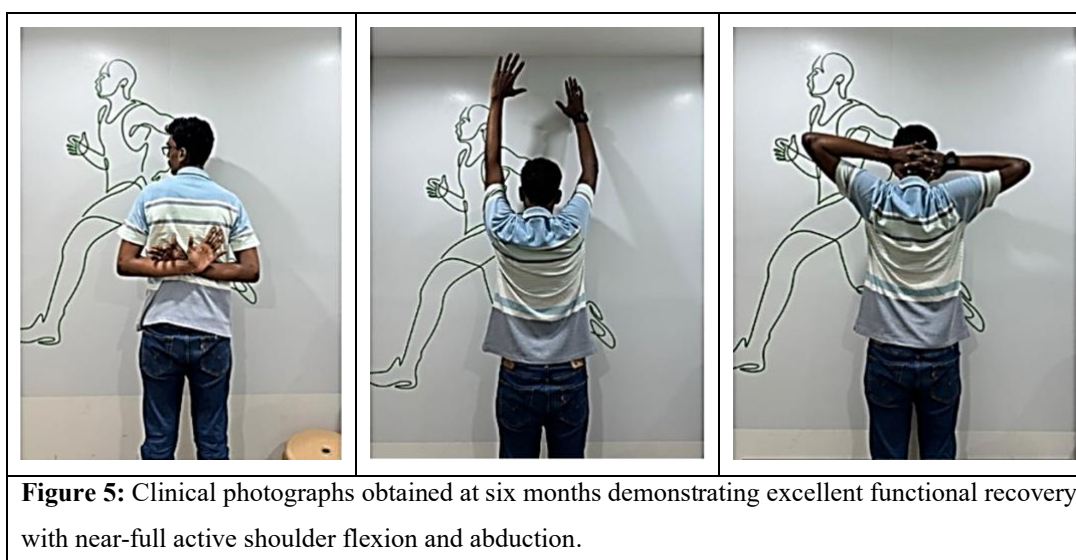
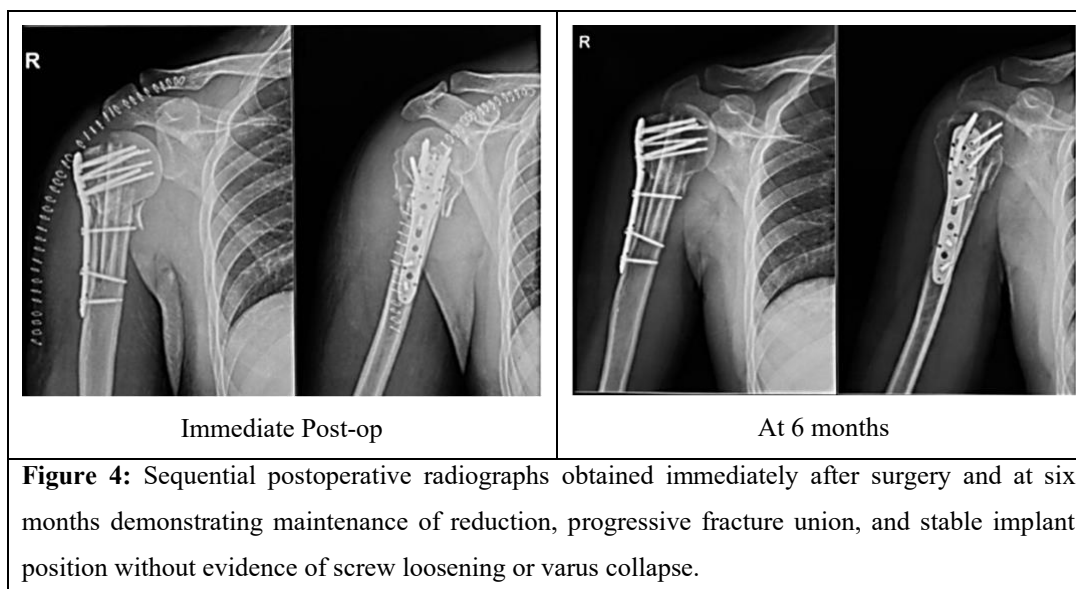


Table 1: Postoperative Clinical and Radiological Outcomes.

Follow-up	Clinical Findings	Radiological Findings	Outcome
Immediate Postoperative	Mild pain; wound healthy; no infection/hematoma; intact neurovascular status; immobilized with early passive mobilization	Anatomical reduction; PHILOS plate and screws well positioned; fibular graft in situ; no implant-related complications	Stable; discharged with physiotherapy advice
6 Weeks	Pain-free at rest; improved ROM (abduction 150°, flexion 160°); no complications	Callus formation with maintained alignment; no loosening/displacement	Satisfactory recovery
3 Months	No pain; further improved ROM (abduction 160°, flexion 170°); no tenderness/complications	Bridging callus with fracture consolidation; stable implant	Good union with excellent functional outcome
6 Months	Pain-free; near-normal ROM (abduction 170°, flexion 175°); full functional recovery	Complete cortical union with remodelling; no hardware failure	Excellent outcome

Discussion

Proximal humerus fractures constitute around 4-5% of all fractures and are commonly treated with locking plate fixation, especially in displaced or comminuted patterns [1]. In this case, a 23-year-old male with a three-part proximal humerus fracture achieved excellent clinical and radiological outcomes after open reduction and internal fixation (ORIF) using a PHILOS plate augmented with a non-vascularized fibular strut autograft. This result is consistent with growing evidence supporting the role of fibular grafts in providing additional medial column support and improving construct stability in complex proximal humerus fractures.

Biomechanical studies have demonstrated that intramedullary fibular strut augmentation significantly enhances varus and torsional stiffness and increases failure loads compared to locking plate fixation alone, thereby reducing the risk of secondary displacement and varus collapse [2]. Chang et al. [2] reported improved biomechanical stability in models with medial column deficiency when a fibular strut was used, providing a strong mechanical basis for its application in such fractures.

Several clinical studies and case reports have supported this biomechanical advantage with favorable outcomes. Panchal et al. [3] and Pop et al. [4] reported successful union, satisfactory alignment, and good shoulder range of motion in patients treated with a combination of PHILOS plate and fibular autograft augmentation. Similarly, Liu et al. [5] demonstrated early fracture union and improved shoulder function when fibular autograft was used to restore the medial column.

Comparative cohort studies reinforce these findings. Cui et al. [6] observed that fibular allograft augmentation with locking plate fixation resulted in improved maintenance of reduction and reduced varus collapse in comminuted fractures. Likewise, Wang et al. [7], in a randomized study, showed significantly better radiological alignment and fewer complications in patients receiving fibular allograft augmentation compared with locking plate fixation alone. These findings collectively support the mechanical and clinical benefits of fibular augmentation in fractures with medial comminution.

Our case utilized a non-vascularized fibular autograft, which offers both biological and mechanical advantages over allografts. Mukhopadhyaya et al. [8] and Lim et al. [9] similarly reported excellent outcomes using fibular autografts, noting reliable union, maintenance of reduction, and low rates of implant failure when anatomic reduction and medial support were achieved. Importantly, donor-site morbidity was minimal, consistent with prior large series reporting low complication rates following fibular harvest when careful technique and limited graft length are employed [10]. This is further supported by a retrospective series of 13 patients with three- and four-part fractures treated with PHILOS plating and fibular autograft, in which all patients achieved union at an average of 5.2 months, reinforcing the reliability of union with this construct even in comminuted fracture patterns [11]. Our patient's radiological union within six months is consistent with this reported timeline. In our patient, no donor-site complications were noted during follow-up.

While PHILOS plate fixation alone has shown good results, studies indicate higher rates of varus malunion and screw cut-out in fractures with calcar comminution when medial support is lacking [6,7]. By contrast, our patient achieved early radiological union and excellent functional recovery, with a Constant-Murley Score of 92/100 at six months. Active forward flexion reached 175°, abduction 170°, and external rotation was symmetrical to the contralateral side, underscoring the benefit of fibular strut augmentation in maintaining fracture alignment and restoring shoulder function. This case highlights the importance of fibular strut autograft augmentation in managing displaced, comminuted proximal humerus fractures, demonstrating its role in enhancing medial support, enabling early rehabilitation, and optimizing outcomes.

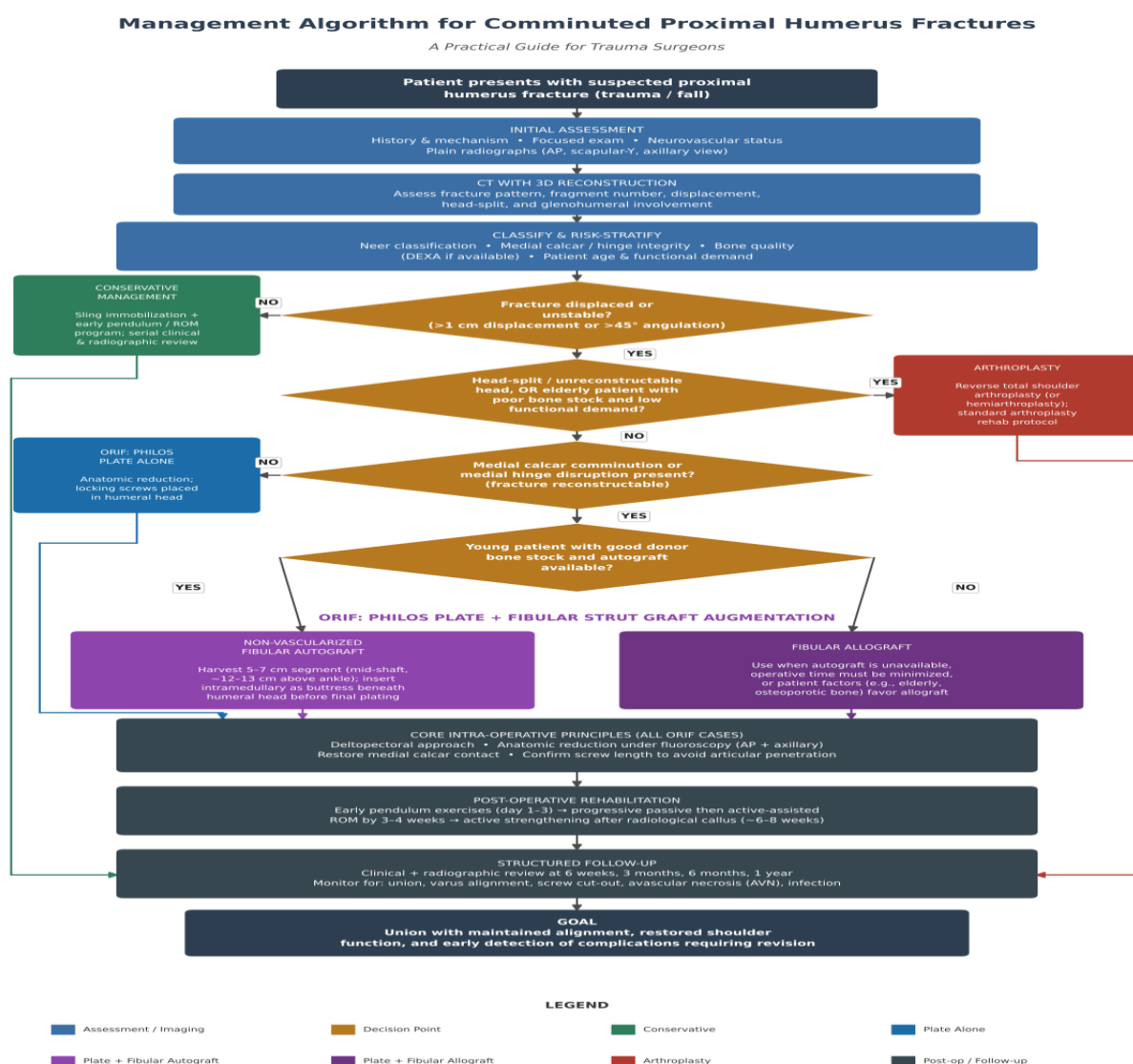
Although this report describes a single patient, it supports existing evidence that fibular strut augmentation provides additional medial column support and may improve functional outcomes in young patients with unstable proximal humerus fractures. Larger prospective studies are required to further validate these findings.

Limitations

This report is limited by its single-patient design, which restricts generalizability and precludes statistical comparison with plate-alone or allograft-augmented cohorts. Additionally, the follow-up duration of six months, while sufficient to assess early union, alignment, and functional recovery, is inadequate to detect late complications. In particular, avascular necrosis (AVN) of the humeral head typically manifests over a period of one to several years following fracture and fixation, and a six-month evaluation window cannot reliably exclude its later development. Similarly, longer-term outcomes such as implant-related complications, adjacent joint degeneration, and delayed loss of fixation cannot be assessed within this follow-up period. Extended clinical and radiological surveillance, ideally beyond two years, would be required to confirm the durability of the results reported here and to detect AVN or other late sequelae should they occur.

Conclusions

Open reduction and internal fixation with a PHILOS plate augmented by a fibular strut autograft provides robust medial support and stable fixation in comminuted proximal humerus fractures. It enables early mobilization with excellent functional outcomes and should be strongly considered in young, active patients with medial calcar deficiency.



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