Percutaneous transdeltoid osteosynthesis for proximal humeral fractures with the proximal humeral internal locking system plate

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Purpose
This study was designed to evaluate clinical outcomes and complications following minimally invasive plate osteosynthesis (MIPO) with the proximal humeral internal locking system (PHILOS) for treating proximal humeral shaft fracture.
Patients and methods
Between March 2012 and March 2013, 37 patients with unilateral proximal humeral shaft fractures were treated using the MIPO technique with the PHILOS through the transdeltoid approach. All fractures were closed with no associated injuries and classified as two part (*n*=13), three part (*n*=19), and four part (*n*=5), according to the Neer's classification. Patients were followed-up for 16.9 months (range, 12–24 months), radiologically and functionally. Postoperative complications and functional constant shoulder score was used.
Results
No intraoperative complications occurred. Postoperative complications included subacromial impingement in three patients. There was no deep infection, neurovascular damage, breakage, or implant loosening. All fractures united in an average time of 10 weeks (8–12 weeks). In terms of function, the Constant–Murley score was 89 points on average (range, 75–100 points). The range of motion of the involved shoulder was satisfactory, and pain-free in 84% of patients.
Conclusion
Using the MIPO technique with the PHILOS plate through the transdeltoid approach is a valid and safe method of treating proximal humeral shaft fractures.

Keywords:
proximal humeral internal locking system plate, proximal humeral fractures, transdeltoid minimally invasive plate osteosynthesis approach

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Introduction

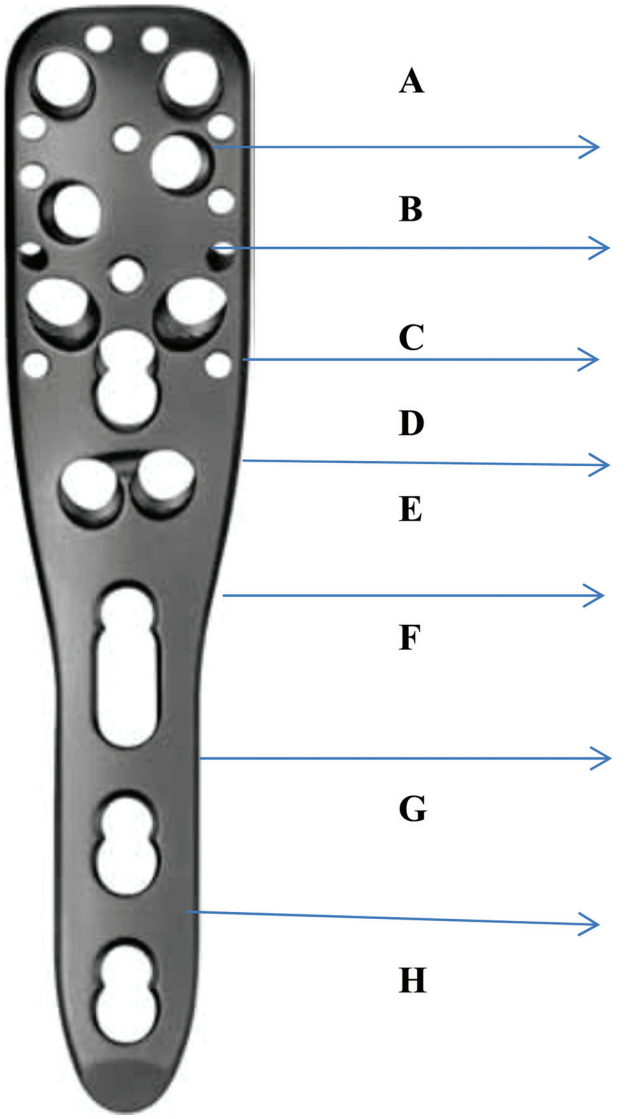
Proximal humeral fractures are a commonly diagnosed problem in upper limb injuries in adults due to high incidence of road traffic accidents and osteoporosis.

Anatomical reduction, stable fixation, and early mobilization are prerequisites for full functional recovery of the involved shoulder following displaced proximal humeral shaft fractures [1,2]. Various treatment methods have been used, including Kirschner wire (K wire) fixation, suture fixation, external fixation, tension band fixation, Rush pin fixation, intramedullary nailing, and prosthetic replacement [3–6]. The traditional open reduction and internal fixation is used to achieve accurate alignment and avoid neurovascular damage. However, extensive soft-tissue dissection can result in iatrogenic neurovascular damage, high incidence of infection, delayed or nonunion, shoulder stiffness, and avascular necrosis of the humeral head. Therefore, theoretically, minimally invasive percutaneous osteosynthesis (MIPO) should be beneficial to attain fracture union and prevent complications. Preliminary studies report that MIPO offers a valid option for treating proximal humeral shaft fractures [7]. The proximal humeral internal locking system (PHILOS; Synthes; Figs 1–3) can provide angular stability and has been used for the operative management of proximal humeral fractures for several years [8]. The system has the potential for enhanced stability of bone–plate structure that could allow early functional exercises. In addition, it can be inserted using an MIPO approach without additional damage [9,10]. This is a case series study that was designed to investigate clinical outcomes and associated complications of proximal

Figure 1

PHILOS plate lateral view. PHILOS, proximal humeral internal locking system.

Figure 2



Locking compression plate (LCP) locking screws 3.5 mm, self-tapping locking screw lengths.

humeral shaft fractures treated with the PHILOS using the percutaneous minimally invasive deltoid-splitting approach. The study was approved by the Institutional Ethical Board.

Patients and methods

Between March 2012 and March 2013, 37 adult patients with proximal humeral fractures were included in this study; 27 of them were men and 12 were women. Their ages varied from 29 to 67 years with an average of 40 years. The inclusion criteria were adult patients with proximal humeral fractures, and, according to Neer [11] classification, 13 had two-part, 19 had three-part, and five had four-part fractures. Pathological fractures, polytrauma patients, and fracture dislocation of the shoulder were excluded from this study.

Surgical technique

In the operating theater and under general anesthesia, patients are positioned on a beach chair radiolucent table. The shoulder region is scrubbed and draped; palpate the lateral part of the acromion, make an incision starting from the middle part of the acromion tip and extending downwards in the lateral aspect of the arm about 3–4 cm. Split the deltoid fibers in their plane with a dissecting scissor to reach the lateral aspect of the proximal humerus. With blunt finger dissection, pass your finger downwards on the medial aspect of the deltoid muscle to palpate the axillary nerve and vessels, which are usually in direct relationship to the undersurface of the deltoid muscle. Protect the neurovascular structure with your finger

and pass a tunneler deep to your finger in relation to the lateral aspect of the proximal humerus to prepare a bed to incorporate the PHILOS (Synthes, Synthes. Co, UK) plate. Through this incision, insert the PHILOS plate, usually within 10 mm distal to the tip of the acromion. Indirect reduction of the fracture was performed at this stage. The small PHILOS plate 90 mm was used in all patients. The PHILOS plate was applied over the proximal humeral fractures. Under radiography control, insert two preliminary K wires through sections A and E of the plate to assist in indirect reduction of the proximal humeral fractures. When the relationship of the plate to the acromion and the shoulder joint was assessed and accepted, fixation of the plate to the humerus was started. The first screw to be fixed is the nonlocked screw, which is distal to the fracture lines. The first screw is usually fixed through another small skin incision about 1 cm, distal to the level of the axillary nerve, that is, distal to distal end of the proximal incision by about 3–4 cm. Now, there is an intimate relationship between the PHILOS plate and the proximal humerus; remove the proximal K wire and fix a proximal locked screw. Complete proximal screw fixations from the proximal incision; usually, four to five screws are sufficient. Fix the remaining two distal screws through another two snip skin incisions opposite the distal holes of the plate. The total time of this surgery ranged from 40 to 50 min with minimal blood loss from 20 to 40 cm. Close the split deltoid fibers, subcutaneous tissues and skin. No drain was required. Apply sterile skin dressing and broad-arm sling. Patients were discharged from hospital on the second day of surgery and were advised to start passive and assisted shoulder motion. On outpatient department, patients were followed-up for removal of stitches and referred to physiotherapy programs to assist functional restoration of shoulder motion as soon as possible.

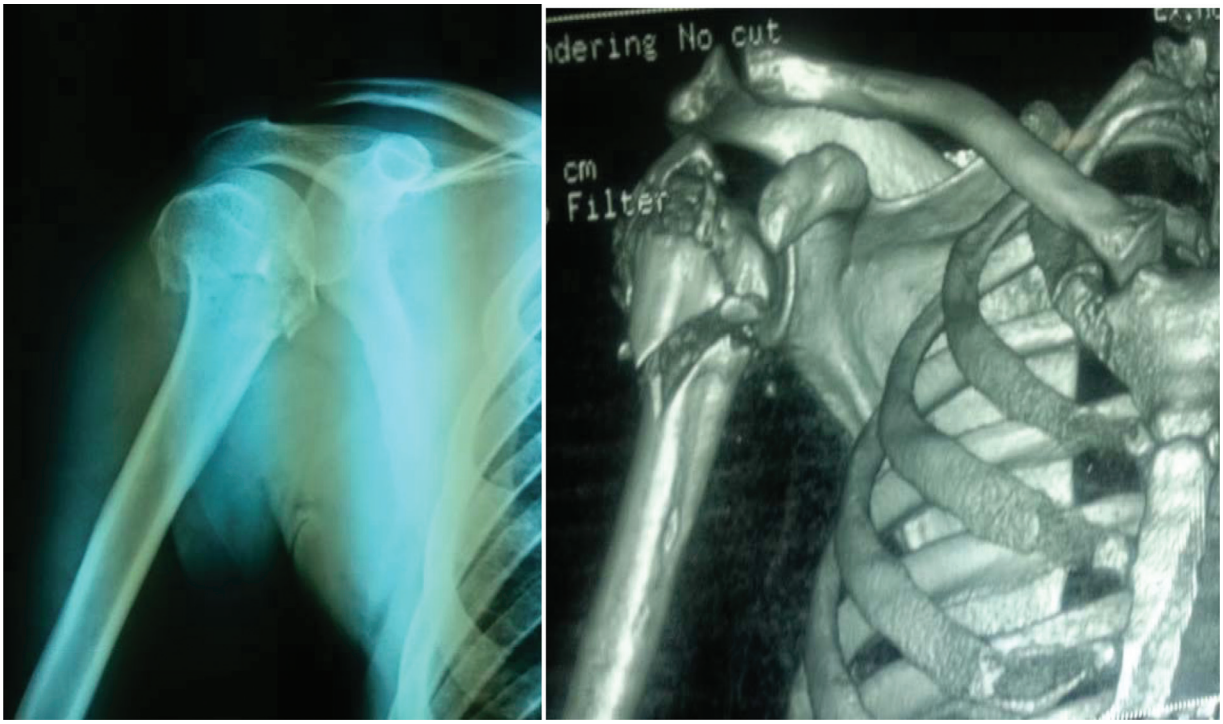
Figure 3

Locking compression plate (LCP) locking screws 3.5 mm, self-tapping locking screw lengths.

Results

No postoperative complications were recorded in all patients. Proximal humeral fractures can be reduced in all patients. The displaced fractures of the humeral tuberosity were successfully reduced; two patients had small medially displaced bone fragment, and it cannot be reduced. Union of the proximal humeral fracture was recorded in an average of 8–12 weeks with an average score of 10. There is gradual improvement of the shoulder motion and daily activities. All patients returned to their prefracture

Figure 4



Preoperative plain radiograph and computed tomography of the shoulder for assessment and fracture classification.

Figure 5

Intraoperative percutaneous transdeltoid approach.

Figure 6

Postoperative radiography.

Figure 7

Shoulder motion within 4 weeks after surgery.

daily working activities within 3 months. Constant functional scoring of shoulder [12] function consists of four variables, which are two subjective (35 points) and two objective (65 points) variables. The subjective variables are pain (absence of shoulder pain gets the maximum score of 15) and limitation of daily activity such as work and recreation (no limitation of daily activity gets the maximum score of 20). The objective variables are the range of shoulder motion (normal range of shoulder motion gets the maximum score of 40) and strength of shoulder (normal shoulder strength gets the maximum score of 25). Constant functional scoring of the shoulder for all patients varied from 75 to 100 with an average of 89. Five patients over the age of 55 with three and four parts according to Neer classification had lower functional constant score of about 75 (Figs 4–7).

Discussion

There are a lot of treatment options for proximal humeral fractures, which vary from conservative to surgical treatment. Moreover, patients' satisfaction varies according to their prefracture functional activities and fracture personality [13]. The recorded functional results and complication of treatment of three-part and four-part fractures of the proximal humerus varied from good to poor with other lines of treatment such as conservative methods or the ordinary open reduction and internal fixation using nonlocked plated or multiple cancellous screws or tension band wiring [6,14–16]. The results of hemiarthroplasty were recorded to be unpredictable with lack of shoulder strength [17,18]. Some complications were recorded with surgical fixation of locked plates, such as nonunion and infection avascular

necrosis of bone fragments, particularly with open surgery [19–22]. In our study, PHILOS plate fixation provided stable fixation with minimal metal work problems and enabled early range-of-motion exercises to achieve acceptable functional results. At the same time, we have used the new percutaneous lateral deltoid-splitting technique, which has many advantages such as preservation of fracture hematoma and biological function of the bone fragments and soft tissues, in addition to the advantages of the locked angle stable PHILOS plate. The only technical difficulty in this technique is difficulty in reduction of the displaced medial fragments. After frequent surgeries by this technique, it is more applicable to perform indirect reduction of the medial bone fragments, particularly in recent fractures. Limitations of this study are the small sample of patients and short follow-up.

Conclusion

Proximal humeral fractures are difficult to treat due to the high incidence of complications, such as shoulder stiffness and neurovascular complications. With the introduction of locked low-profile angle and rotationally stable PHILOS plate and the advanced minimally invasive orthopedic surgery such as the percutaneous transdeltoid approach, complications of treatment of proximal humeral fractures can be avoided, and better functional results can be achieved.

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Nil.

Conflicts of interest

None declared.

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