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Case report

REVERSED PROXIMAL HUMERUS INTERNAL LOCKING SYSTEM (PHILOS) PLATE TECHNIQUE AS ALTERNATIVE OSTEOSYNTHESIS METHOD IN THE MANAGEMENT OF BIFOCAL MIDDLE AND DISTAL THIRD DIAPHYSEAL HUMERUS FRACTURE

Petrevski Dimitar, Andonovski Antonio, Veseli Iljasa, Arapinovski Andrijan, Trpeski Simon

University Clinic for Traumatology, Orthopedic Diseases, Anesthesiology, Reanimation, Intensive Care and Emergency Center, Faculty of Medicine, Ss. Cyril and Methodius University in Skopje, Republic of North Macedonia
e-mail: dimitarpetrevskidoc@gmail.com

Abstract

Introduction: Humeral shaft fractures account for 2% of all fractures in adults with approximately 30% of them being located in the distal third. AO OTA 12.C2 type(s) fractures are rare injuries usually caused from high-energy trauma. Stable and rigid osteosynthesis is suggested with consequent early mobilization and rehabilitation protocol thus outweighing the conservative treatment complication rates, particularly elbow contracture. Multiple implants, approaches and techniques have been published in the literature with reversed (upside-down) "Proximal Humerus Internal Locking System"(PHILOS) plate technique as a new and alternative osteosynthesis method, which is presented in this article.

Case report: A 37-year-old female patient was presented to our emergency department by the emergency medical services (EMS) after motor-vehicle collision (MVC) as unrestrained front passenger with right zygomatic arch, right maxillary, sphenoidal and ethmoidal sinus fractures, nasal bones fracture, bilateral lung contusions, open grade IIIA right patellar multifragmentary fracture as well as right bifocal middle and distal third diaphyseal humerus fractures. An urgent open reduction and internal fixation (ORIF) with cerclage wire technique of the open multifragmentary right patellar fracture grade IIIA according to Gustilo-Anderson classification was done, followed by ORIF of the right bifocal middle and distal third diaphyseal humerus fracture using reversed (upside-down) "Proximal Humerus Internal Locking System" (PHILOS) plate technique.

Conclusion: The reversed PHILOS plate technique in the management of middle and distal humeral extra-articular diaphyseal fractures is feasible and should be further investigated.

Keywords: humeral shaft fracture, distal metaphyseal fracture, reversed PHILOS plate technique, alternative osteosynthesis method

Introduction

Bifocal (segmental) or multifragmentary humeral shaft fractures classified by AO Foundation/Orthopaedic Trauma Association (AO/OTA) as 12.C2 type(s) are rare injuries usually resulting from a high-energy trauma. In general, humeral shaft fractures account for 2% of all fractures in adults with approximately 30 % of them being in the distal third[1]. Due to a high incidence of elbow contracture in prolonged conservative treatment and inability to

control the fragments, a stable and rigid osteosynthesis with consequent early mobilization and rehabilitation protocol is advised for this type of injuries. Depending on the distal humeral anatomy and biomechanics in correlation with the fracture morphology, patient status, etc., multiple techniques, approaches and implants have been described in the literature with their complication rates respectively. The most widely used are: extra-articular distal humerus plate (EADHP), orthogonal and parallel plating, intramedullary nailing and various hybrid techniques[2-7]. In this paper, we present an alternative osteosynthesis method in the management of bifocal middle and distal third diaphyseal humerus fractures (AO OTA 12C2(c)) using a reversed (upside-down) "Proximal Humerus Internal Locking System" (PHILOS) plate technique.

Case report

A 37-year-old female patient was presented to our Emergency Department by the emergency medical services (EMS) after motor-vehicle collision (MVC) as unrestrained front passenger. At presentation, Glasgow coma score (GCS) was 14, facial deformity with intact airway, right upper arm deformity as well as open patellar fracture were noted. Neurovascular status was not compromised. Following the primary and secondary survey and initial resuscitation measures with temporary fracture management (immobilization), a full body trauma computed tomography (CT) scan as well as additional conventional x-ray imaging for the injured extremities was indicated. Diagnostics revealed right zygomatic arch, maxillary, sphenoidal and ethmoidal sinus fractures, nasal bones fracture, bilateral lung contusions, open right patellar multifragmentary fracture as well as right bifocal middle and distal third diaphyseal humerus fractures. The patient was transferred to the Intensive care unit (ICU) for further management awaiting surgery. An urgent open reduction and internal fixation (ORIF) of grade IIIa according to Gustilo-Anderson classification multifragmentary patellar fracture was done using cerclage wire technique with second surgery in two days following the initial to address the bifocal middle and distal third diaphyseal technique using the reversed (upside-down) "Proximal Humerus Internal Locking System"(PHILOS) plate technique.

Treatment

The patient was placed in a beach chair position. Adequate prepping and draping followed by anterolateral approach to the middle and distal third humeral diaphysis (Figure 1). Intraoperative adequate reduction and anterior humeral plate placement was fluoroscopically confirmed (Figures 2 and 3). Wound closure in layers and dressing with consequent above elbow backslab immobilization was later converted to articulated elbow joint orthotic in 90˚ elbow flexion. Postoperative roentgenography in antero-posterior and lateral views confirmed the reduction and stable internal fixation.

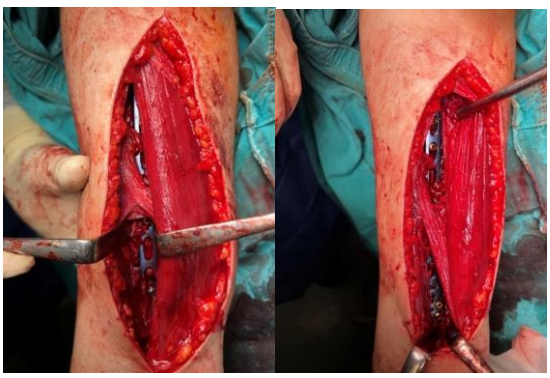

Fig. 1. Anterolateral approach to the humerus with reversed PHILOS plate *in situ*

Follow-up and outcome

Postoperatively, the patient was closely monitored at our institution for additional 3 days as per standard postoperative protocol. There was no neurovascular compromise. On the tenth postoperative day, sutures were removed. Two weeks following ORIF, early physiotherapy and rehabilitation protocol were initiated. Two months post-injury, we noted painless full range of motion of the affected elbow with laudable patient satisfaction as a result of the return to painless everyday activities.

Fig. 2. Intraoperative elbow range of motion (ROM)

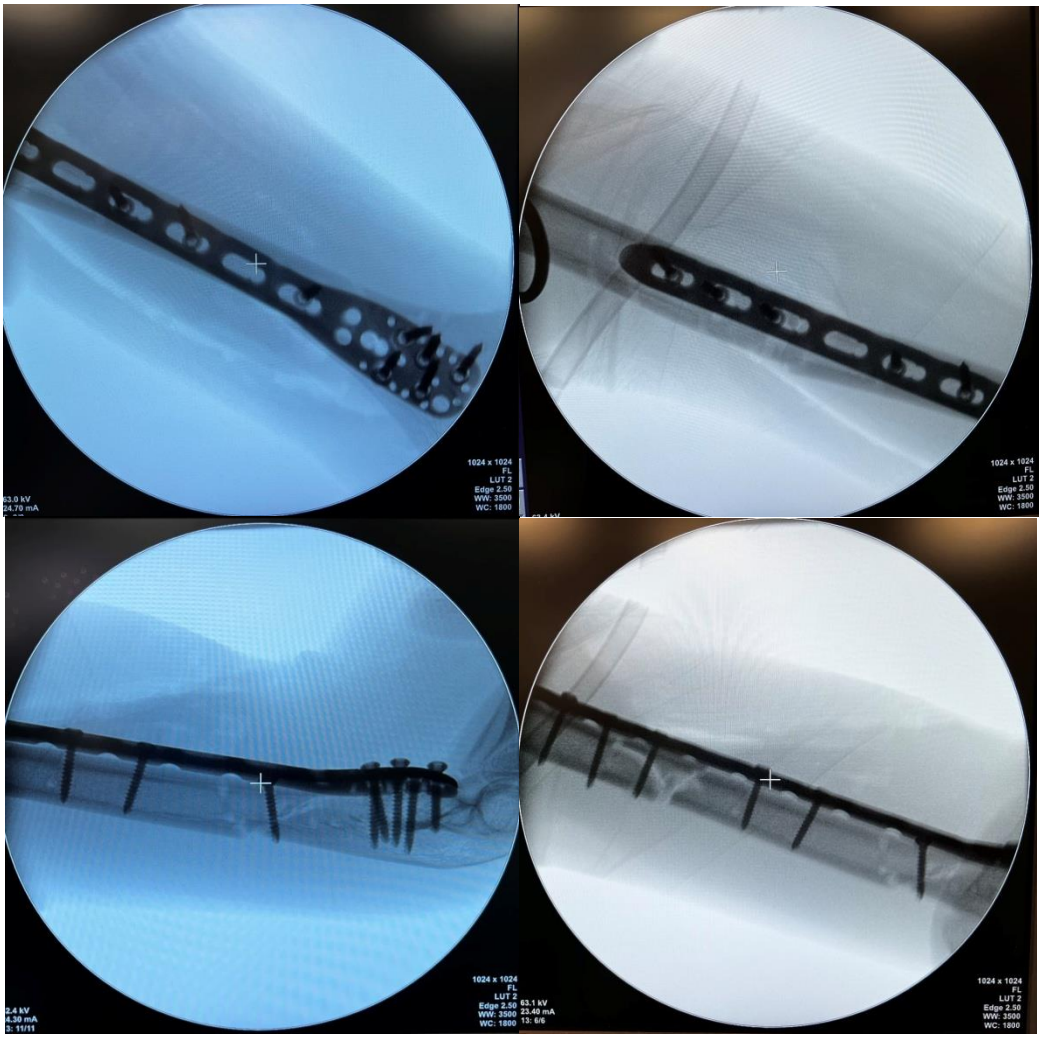

Fig. 3. Intraoperative fluoroscopic conformation of satisfactory fracture reduction with screws and reverse (upside-down) PHILOS plate placement

Discussion

The most commonly used approaches for addressing distal extra-articular humerus fractures are the posterior and anterolateral approach, with posterior being the approach of choice in most of the LCP (Locking Compression Plate) or alternatively LC-DCP (Low-Contoured Dynamic Compression Plate) and DCP (Dynamic Compression Plate) cases because of the distal humerus flat surface anatomy suitable for plating as well as the possibility of more distal extension of the plate with additional screw placement and dual plating if necessary. When using posterior triceps split or triceps sparing approach, the reduced elbow ROM and triceps extension strength should be noted compared with the anterolateral approach[8].

Antegrade intramedullary nailing as an alternative method of fracture fixation is not advised due to the specific distal humeral medullary canal anatomy and problematic fracture fragment manipulation and control, especially in comminuted fractures which can result in malunion or nonunion. When it comes to the retrograde technique complications, an entry site fracture and radial nerve damage have been published in the literature. Moreover, there is increasing evidence suggesting the superior biomechanical properties of distal humerus plating compared to intramedullary devices.

Another disadvantage of the other plating techniques is the fewer screw placement in the distal fracture fragment, which results in insufficient fracture fixation especially when addressing osteoporotic bone that can accentuate the problem. Therefore, the reverse (upside-down) PHILOS plate placement, which follows the anterior distal humeral contour and can provide additional number of fixation screws as well as multidirectional if needed, is a suitable alternative except for fractures extending distally more than 2-3 cm from the coronoid fossa. This leads to inability to place the PHILOS plate above the coronoid fossa and can result in reduced flexion of the elbow joint[1,9,10].

Conclusion

Open reduction and internal fixation using reversed PHILOS plate technique in the management of middle and distal humeral extra-articular diaphyseal fractures can be adequate alternative. Additional clinical studies on a large scale are necessary to further investigate this technique and its clinical applicability.

Conflict of interest statement. None declared.

References

1. Park J, Kim J, Oh Chi, Choi K, Hong J, Kim J. PHILOS Plate Osteosynthesis in Metaphyseal Fractures of the Distal Humerus through an Anterolateral Approach. *Clinics in Shoulder and Elbow* 2015; 18:(3) 128-132. doi:10.5397/cise.2015. 18.3.128.
2. Wali MG, Baba AN, Latoo IA, Bhat NA, Baba OK, Sharma S. Internal fixation of shaft humerus fractures by dynamic compression plate or interlocking intramedullary nail: a prospective, randomized study. *Strategies Trauma Limb Reconstr* 2014; 9(3): 133-140. doi: 10.1007/s11751-014-0204-0.
3. Kharbanda Y, Tanwar YS, Srivastava V, Birla V, Rajput A, Pandit R. Retrospective analysis of extra-articular distal humerus shaft fractures treated with the use of pre-contoured lateral column metaphyseal LCP by triceps-sparing posterolateral approach. *Strategies in Trauma and Limb Reconstruction* 2017; 12(1): 1-9. doi: 10.1007/s11751-016-0270-6.
4. Trikha V, Agrawal P, Das S, Gaba S, Kumar A. Functional outcome of extra-articular distal humerus fracture fixation using a single locking plate: A retrospective

study. *J Orthop Surg (Hong Kong)* 2017; 25(3): 2309499017727948. doi: 10.1177/23094990 17727948.

5. Scolaro JA, Hsu JE, Svach DJ, Mehta S. Plate selection for fixation of extra-articular distal humerus fractures: a biomechanical comparison of three different implants. *Injury* 2014; 45(12): 2040-2044. doi: 10.1016/j.injury.2014.08.036.
6. Yang Q, Wang F, Wang Q, Gao W, Huang J, Wu X, *et al*. Surgical treatment of adult extra-articular distal humeral diaphyseal fractures using an oblique metaphyseal locking compression plate via a posterior approach. *Med Princ Pract* 2012; 21(1): 40-45. doi: 10.1159/000331791.
7. Ali N, Ahmad Mir N, Ahmad Dar T, Nawaz Rather M, Ahmad Mir W, Shah S, *et al*. Outcome of Extra-Articular Distal Humerus Fractures Fixed by Single Column Extra-Articular Distal Humerus Locking Compression Plate Using Triceps Sparing Postero-Lateral Approach. *Bull Emerg Trauma* 2018; 6(4): 306-312. doi: 10.29252/beat-060406.
8. Illical EM, Farrell DJ, Siska PA, Evans AR, Gruen GS, Tarkin IS. Comparison of outcomes after triceps split versus sparing surgery for extra-articular distal humerus fractures. *Injury* 2014; 45(10): 1545-1548. doi: 10.1016/j.injury.2014.04.015.
9. Lim JR, Yoon TH, Choi YR, Lee HM, Chun YM. Biomechanical evaluation of a modified proximal humeral locking plate application for distal extra-articular diaphyseal humeral fractures. *J Orthop Res* 2021; 39(9): 1877-1883. doi: 10.1002/ jor.24925.
10. Lee JS, Kim KG, Yoon YC. Biomechanical performance evaluation of a modified proximal humerus locking plate for distal humerus shaft fracture using finite element analysis. *Sci Rep* 2023; 13(1): 16250. doi: 10.1038/s41598-023-43183-x.