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Hertel 7 fracture of the humeral head. Can two different fixation systems (Diphos/PHP) lead to different outcomes? A retrospective study

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ABSTRACT

Objective: To compare clinical outcomes and complication rates in the medium-to-long-term follow-up of Hertel 7 humeral head fractures treated with two different locking plates.
Materials and Methods: A total of 52 patients with type 7 humeral head fracture (in accordance with Hertel classification) were enrolled retrospectively: 24 patients [4 male, 20 female; mean age (standard deviation [SD]): 68.9 (5.8) years] were treated with Diphos H plate (Group A) and 28 patients [6 male, 22 female; mean age (SD): 61.0 (7.5) years] with Proximal Humeral Plate (PHP; Group B). The mean follow-up periods were 25.6 and 18.9 months, respectively. Functional outcomes were assessed using the Constant score and Disabilities of the Arm, Shoulder and Hand (DASH) score; X-ray evaluation was also performed and complications were recorded.
Results: The mean Constant score in the Diphos and PHP groups at follow-up were 75.6 (SD 13.4) and 78.9 (SD 12.8), respectively ($p > 0.05$). The DASH score was similar in both groups (Diphos: 18.6, range 0-51.5; PHP: 16.8, range 0-47.8) ($p > 0.05$). In our series, 9.6% of patients had complications; these included a case of aseptic non-union and a case of avascular necrosis of the humeral head in each group, and a secondary screw perforation in a patient treated with Diphos.
Conclusions: In patients with Hertel 7 proximal humeral fractures, Diphos and PHP lead to similar satisfactory functional outcomes and are associated with low complication rates; this confirms that both are useful implants for the treatment of this pattern of fracture.

Introduction

Many fixation systems, if correctly applied, can facilitate humeral head fracture healing and guarantee satisfactory outcomes; however, locking plates are currently the most widely used device implanted for this type of fracture [1–4]. Plates can act as a guide for fracture reduction as they have a dedicated pre-contoured design that reflects the anatomy of the proximal humerus and also supports the greater tuberosity. Locking plates guarantee a more stable fracture fixation than other fixation devices thereby enabling better outcomes, particularly in osteoporotic bone [5,6].

Conversely, many studies focus on the high complication rates associated with locking plates, which have been reported to be up to 20–30% (primarily loss of reduction, screw loosening and osteonecrosis of the humeral head), and on the significantly higher costs compared with other fixation systems [7–12].

In this study, the efficiency of two different locking plates was compared: the Diphos H plate (Lima corporate, San Daniele del Friuli, Italy) and the Contours Proximal Humeral Plate (PHP, Orthofix, Bussolengo, Italy) were used for the internal fixation of Hertel 7 humeral head fracture (fracture of the surgical neck and greater tuberosity) with the aim of evaluating if the different physical and biomechanical features of these two devices lead to different clinical outcomes and complication rates in the medium-to-long-term follow-up [13].

Methods

A total of 56 patients with Hertel 7 humeral head fracture who met the indications for operative treatment, as outlined by Neer, were surgically treated in two dedicated centres for the treatment of shoulder and elbow pathologies (Sapienza, University of Rome

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Table 1
Baseline characteristics of the studied group.

		Diphos		PHP	
		no.	Mean (SD) or%	no.	Mean (SD) or%
Age		24	68.9 (5.8)	28	63.0 (7.5)
Sex	*Male*	4	17%	6	21%
	Female	20	83%	22	79%
Follow-up (months)			25.6		18.9
Diaphysis screws			3 in 24 patients (100%)		3 in 28 patients (100%)
Epiphysis screws			5 in 5 patients (21%) 6 in 7 patients (29%) 7 in 12 patients (50%)		4 in 28 patients (100%)

and University of Modena, Italy) between October 2011 and December 2014 [14]. All patients were enrolled retrospectively.

Inclusion criteria were: type 7 humeral head fracture in accordance with Hertel classification diagnosed by X-Ray and CT; closed fracture; aged at least 18 years, and treatment within 7 days of admittance [13]. Patients were excluded if they had pathological or open fractures; brachial plexus/nerves injuries; concomitant ipsilateral fractures of the distal humerus and/or elbow joint; or previous non-unions. The final study groups comprised 24 patients treated with Diphos H plate (carbon fibre-reinforced-poly-ether-ether-ketone [CFR-PEEK]) (Group A) and 28 patients treated with PHP (titanium) (Group B). The CFR-PEEK confers to the plate an elastic modulus similar to the cortical bone, although the torque strength is similar to that of steel. The radiolucency of this material facilitates reduction manoeuvres, optimises the fluoroscopic and radiographic visualisation of the fracture rim and reduces the starburst effect and artefacts, thereby also simplifying CT and MRI reading. Titanium is associated with better biocompatibility and osteointegration. The Diphos stabilises the humeral head with polyaxial locked self-tapping screws, which enable secure intraoperative reconstruction. The PHP mainly stabilises with a cannulated main locking screw that is inserted just above the calcar area and has been engineered to reduce the invasiveness of the system in terms of metallic content in the humeral head. This larger-holed screw works as a cantilever, blocking the humeral head in the frontal plane and transferring the main load to the diaphysis of the humerus. To complete the stabilisation and fix fracture fragments, polyaxial fine-threaded screws are inserted and locked in the appropriate holes. These thinner-holed screws work through traction and stabilise the humeral head in the sagittal and transverse planes.

The baseline characteristics of the patients in the study are shown in Table 1.

All operations were performed by three expert shoulder surgeons (SG, PB, GC) in the two centres using a delto-pectoral approach with the patient in beach-chair position on a radiolucent Table Skin incision avoided the cephalic vein, which was identified and laterally displaced. The subscapular bursa was removed to improve access to the underlying structures. The fracture was then visualised and reduced with indirect manoeuvres and, if necessary, sutures were placed to drive the tuberosity fragments into the correct position, preserving the soft tissue links to the bone and ensuring the calcar. Correct reduction sometimes needed autologous or homologous bone grafts to fill the bone loss. Once a satisfactory alignment of the fracture was achieved, Diphos was placed 5–8 mm or PHP 12–16 mm distal to the top of the great tuberosity; both plates were placed 3–4 mm lateral to the bicipital groove (Figs. 1 and 2).

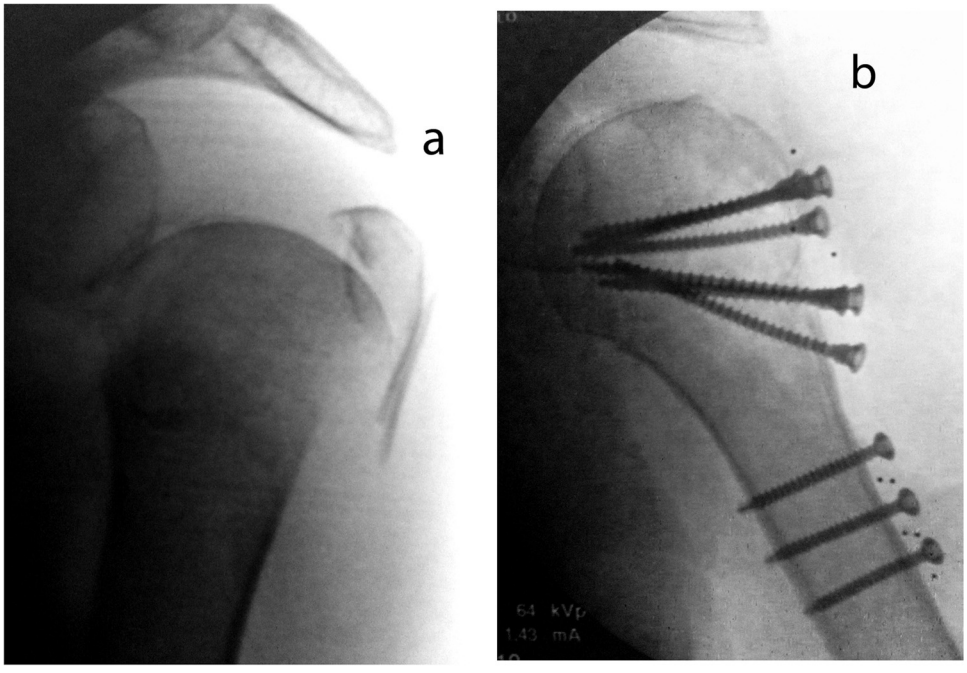

Fig. 1. Hertel 7 proximal humeral fracture in a 59-year-old female treated with Diphos. a) Preoperative and b) Postoperative X-Rays.

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