



## MIPO Helical Plate in Metadiaphyseal Complex Humeral Fractures with Proximal Extension

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Multifragmentary diaphyseal humeral fractures with proximal extension are rare injury patterns caused primarily by high-energy trauma. These injuries require personalized surgical treatment, both in a surgical approach and as a stabilization implant.

The anatomical shape of the humerus, the presence of the deltoid tuberosity and the proximity of the radial nerve to the radial sulcus present challenges for the treatment, therefore, minimally invasive plate osteosynthesis (mipo) incisions and stabilization of the fracture with a helical philos (proximal humeral internal locking system) plate are recommended.

The mipo technique with helical philos plate of the fractures multifragmentary shaft humeral implants with proximal extension have gained popularity due to an emphasis on biologic respect for fracture and the satisfactory clinical outcomes. Compared with the open reduction and internal fixation, it is based on a technique with minimal surgical dissection, little bleeding, very low neurovascular injury, reduced local infection and shorter operating time. However, it has not yet entered on the mainstream clinical practice despite being performed for almost two decades ago, possibly due to the presumed high risk of neurovascular injury.

Considering the anatomy of the humerus, the proximal lateral face is ideal for the screw fixation in the neck and head while the anterior or anteromedial surface is the perfect position for the plate application in the middle third and the distal part.

In the proximal humerus with the direct anterolateral transdeltoid approach and after the use of a helical implant the

following structures are in risk: the axillary nerve and the tendon of the long head of the biceps. The distal limit of the approach to be respected is the axillary nerve, located about 3.5 cm distally to the tip of the greater tuberosity.

Distally, the approach is anterior, external parabolic anterior transbrachial, dividing the longitudinal brachialis muscle in the middle, considering its double innervation (lateral half innervated by the radial nerve and the medial half innervated by the musculocutaneous nerve). In this phase, the structures most at risk of injury are the radial and lateral antebrachial cutaneous nerves. The musculocutaneous nerve is most at risk when using a helical plate owing to its previous location to the midshaft and distal humerus.

The helical plate design is mainly directed to minimizing the risk of the radial nerve injury because the plate is approximately parallel to the nerve from the proximal region to distal in the humerus.

The mipo technique with helical philos plate is an effective and safe surgical option for multi-fragmentary diaphyseal humeral fractures with proximal extension, as it preserves the deltoid muscle insertion, improves bone plate contact, with minimal risk of axillary and radial neurological injury, promotes bone healing with adequate functional and cosmetic outcome. The goal is to create the best scenario for healing and not absolute stability at a high biological cost.