Technical Brief

Metacarpal Fracture Intramedullary Fixation with BioPro HBS Headless Cannulated Screws

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Background:
Metacarpals serve as the muscular attachment site for intrinsic muscles of the hand. They form the arch of the hand and serve as the bridge between the digits and the distal carpal row. Metacarpal fractures account for 18% of all below-elbow fractures in the United States.[1] Angulated or mal-rotated fractures of the hand can alter the function of the hand, making grasp difficult. In addition, shortening of the metacarpal as little as 2 mm, can lead to tendon imbalance, weakness and decreased motion.[2] Treatment of metacarpal fractures is based on the type of fracture, degree of displacement or rotation and the inherent stability of the fracture.

Treatment Options:
A variety of treatment options exist in the treatment of metacarpal fractures. Stable, well aligned fractures are amenable to splint or cast treatment. All other fractures are candidates for surgical fixation. Methods of internal fixation used in metacarpals include external fixators, screws alone, plates and screws, K-wires, intramedullary K-wires or intramedullary screws. There are potential issues with each of these methods. K-wires do not provide rigid fixation limiting early motion and often require subsequent removal. Plate and screw fixation can require extensive dissection, potentially leading to adhesions and also frequently require a subsequent procedure for hardware removal.

Intramedullary Screw Fixation:
The rationale for intramedullary (IM) fixation is based on minimal trauma at the insertion site, preservation of fracture site biology and a high tolerance for sustained cyclic loading.[3] Compared to Kirschner Wire Fixation, headless compression screws for metacarpal neck and shaft fractures are biomechanically superior in load to failure, 3 -point bending, and axial loading.[4] The dorsal entry point for screw fixation has been shown by quantitative 3-dimensional computed tomographic analysis to be only minimally violated during the clinically relevant arc of motion.[5] In addition, in metacarpal fractures, IM fixation has the advantage of minimizing extensor tendon trauma and the subsequent adhesions commonly associated with traditional plating techniques. Since the hardware is located in the medullary canal, there is no prominence and removal is rarely necessary.

Operative Technique for Intramedullary Screw Fixation:
A single 1 cm incision is made over the metacarpophalangeal joint and the extensor tendon is split in line with its fibers. Then, a limited arthrotomy is made exposing the metacarpal head articular surface. A closed reduction is performed and the 0.9 mm guidewire for the BioPro HBS® Headless Screw System is advanced through the dorsal 1/3rd of the metacarpal head in line with the medullary canal and across the fracture site (alternatively, the guidewire can be used as a joystick to assist in fracture reduction). For complex fractures, a small dorsal incision can be made to facilitate direct reduction. The guidewire is over-drilled and the length of the screw is measured. Fluoroscopy is used to determine optimal depth of the wire. A 2.5 or 3.0 mm cannulated self-drilling and self-tapping (SDST) screw is selected based on pre-operative templating and advanced across the fracture site (Fig 1a and 1b). The arthrotomy, extensor tendon, and skin are repaired in the usual fashion. Post-operatively, sutures are removed after 7-10 days and active motion is started at the first post-operative visit. This is followed by passive motion at week 3 and light strengthening at week 4. Union is typically achieved by week 6[6] (Fig 2a and 2b).

Fig 1A.
AP radiograph demonstrating an unstable displaced and angulated 5th metacarpal shaft fracture.

Fig 1B.
Lateral radiograph demonstrating angulated and malrotated 5th metacarpal shaft fracture.

Fig 2A.
AP radiograph demonstrating anatomically reduced 5th metacarpal shaft fracture with intramedullary BioPro HBS screw for fixation.

Fig 2B.
Lateral radiograph demonstrating anatomic reduction of 5th metacarpal and fixation with intramedullary BioPro HBS screw. Note dorsal entry point of screw in metacarpal head.

References:

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