A Cadaver Model That Investigates Irreducible Metacarpophalangeal Joint Dislocation

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Purpose Controversy exists over the pathologic anatomy of irreducible dorsal metacarpophalangeal (MCP) dislocation. The aim of this work is to develop a cadaveric model of MCP joint dislocation that closely simulates the clinical situation and to study the structures around the MCP joint and their contribution to irreducibility of the dislocation.

Methods Nine fresh-frozen cadaveric specimens were amputated at the radiocarpal joint and stabilized in a specially formulated fixture. The dislocation was created by an impact load delivered by a servohydraulic testing machine, at a displacement rate of 1000 mm/s and with a maximum displacement of 60 mm. An irreducible dislocation was successfully created in 6 index fingers. An attempt at closed reduction was followed by a dissection of the dislocated joint.

Results In the 6 examined specimens, the flexor tendons were ulnar to the joint in all cases, the radial digital nerve was superficial (5 cases) or radial (5 cases) to the metacarpal head, and the lumbrical was usually radial (5 of 6 cases) to the joint. Division of the superficial transverse metacarpal ligaments, natatory ligaments, flexor tendons, or lumbricals does not aid reduction of the dislocation. Division of the volar plate was necessary for reduction of the dislocation in all 6 cases, whereas division of the deep transverse metacarpal ligaments does not allow reduction of the dislocation.

Conclusions We present a model for creating an irreducible MCP joint dislocation using an impact load that simulates the clinical situation. The volar plate is the primary structure preventing reduction of the dislocation. Division of the deep transverse metacarpal ligament is not effective in reducing the dislocation. The flexor tendons, lumbricals, superficial transverse metacarpal ligament and natatory ligaments do not contribute to irreducibility. The anatomy of the structures surrounding the MCP joint is variable, and careful dissection to prevent iatrogenic injuries is mandatory. *(J Hand Surg 2009;34A:1506–1511. Copyright © 2009 by the American Society for Surgery of the Hand. All rights reserved.)*

Key words Metacarpophalangeal joint, dislocation, volar plate, deep transverse metacarpal ligament.

Among Kaplan's many contributions to hand surgery is his description of the pathologic anatomy of complex (irreducible) metacarpophalangeal (MCP) joint dislocation in a classic article in 1957.[1] This article, based on a single case, is still widely quoted in the literature. Kaplan believed that a noose that formed around the joint (by the natatory ligament, superficial transverse metacarpal ligament [STML],

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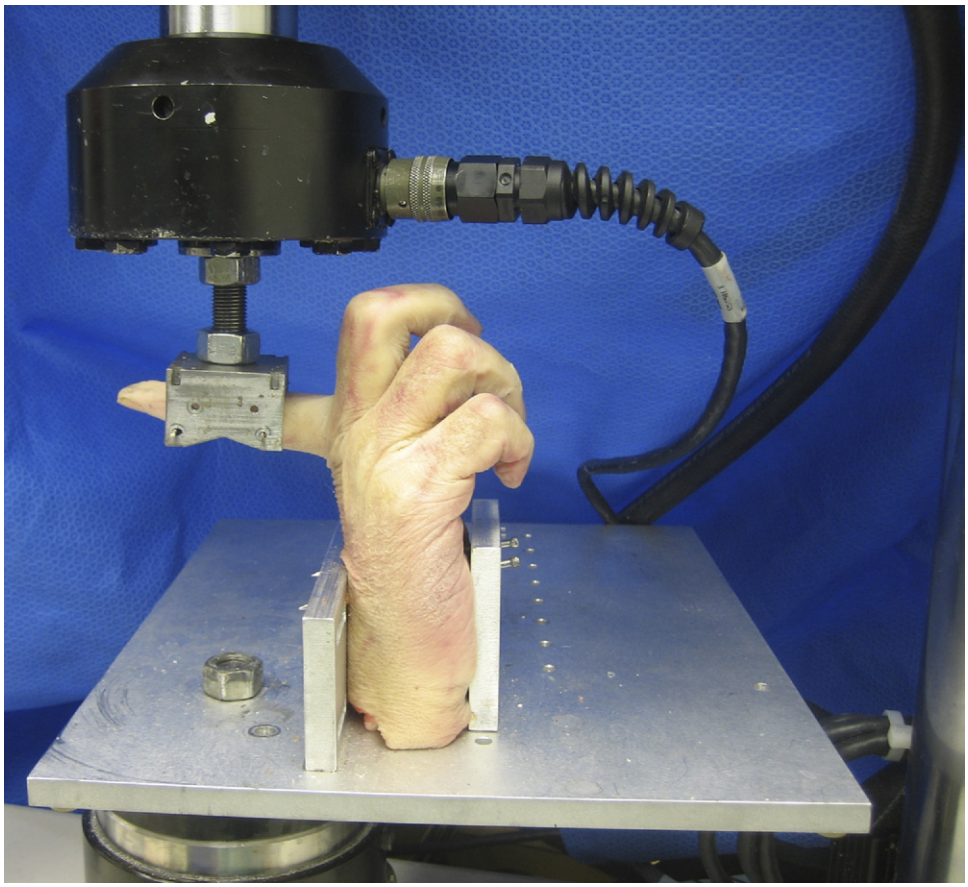

FIGURE 1: The hand stabilized in the servohydraulic testing apparatus before creation of the dislocation.

flexor tendons, and lumbricals) contributed to the irreducibility of the dislocation. However, many surgeons believe that Kaplan's description is not entirely accurate.[2–4] An alternative theory suggested that the deep transverse metacarpal ligament (DTML) and the volar plates form a continuous band volar to the MCP joint, that this band remains intact but is displaced dorsal to the metacarpal head at the site of the dislocated joint, and that interruption of this band by dividing either the DTML or the volar plate will allow reduction of the dislocation.[2,3] Previous cadaveric models of MCP dislocation involved an open surgical dissection of the joint, release of the volar plate proximally, and manually dislocating the joint, thereby re-creating the anatomy as usually observed during surgery as opposed to re-creating the usual traumatic force that caused the dislocation. The aim of this work is to (1) develop a cadaveric model of MCP dislocation in the index finger that closely simulates the clinical situation; (2) define the location of the STML, natatory ligaments, DTML, flexor tendons, lumbrical, index finger radial neurovascular bundle, and volar plate in an irreducible MCP dislocation; and (3) evaluate their contribution to the irreducibility of the dislocation.

MATERIALS AND METHODS

Nine fresh-frozen cadaveric specimens (6 male and 3 female) were used in this study, ranging in age from 38 to 59 years. The specimens were thawed at room temperature for approximately 12–24 hours before the study. The specimens were examined to exclude the presence of previous pathology or scars in the hand or fingers.

The specimens were amputated at the level of the wrist (radiocarpal joint). The flexor tendons were sutured to the extensor tendons at the amputation level to maintain their tension. The hand was then stabilized between 2 metal plates on a specially fabricated test jig and fixed in place using 2 Steinmann pins passed in a volar–dorsal direction at the level of the distal carpal row and proximal metacarpals (Fig. 1). The index finger was extended at the MCP joint to approximately 90°. It was then fixed to the actuator test jig with 2 transverse 1.5-mm (0.059-in) K-wires, first at the level of the head