Title:  Boxer’s Knuckle: A Single Case Study

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Abstract

Direct trauma to the dorsal aspect of the MCP joint of the fingers is a common occurrence in sports. Boxers and martial artists sustain repetitive forceful trauma to the clenched fist. The MCP joint may sustain contusions, synovitis, articular fractures, collateral ligament damage, or extensor mechanism disruption (Arai 2002, Hame 2000). Traumatic soft tissue injury to the extensor mechanism have been coined "boxer's knuckle" and can be a devastating injury to the elite athlete (Posner 1989). This case study examines the anatomy of the extensor mechanism and relates this to an injury seen in clinic in a patient who did not participate in any sport.

Introduction

Functional Anatomy

The anatomy and the function of the extensor mechanism is complex and consist of a linkage system created by the radial nerve innervated extrinsic system and the ulnar and median nerve innervated intrinsic system (Eaton 1969). The extrinsic extensors to the fingers arise in the forearm and comprise of extensor digitorum, extensor indicis and extensor digiti minimi.

They enter the hand through six compartments formed by the extensor retinaculum. The first compartment contains the abductor pollicis longus and extensor pollicis brevis, the second the extensor carpi radialis longus and brevis, the third extensor pollicis longus, the fourth extensor digitorum and extensor indicis, the fifth extensor digiti minimi and the sixth and most medial extensor carpi ulnaris. At the wrist the tendons are covered by a synovial sheath but not over the dorsal hand or fingers (Fig.1).
As the extensor tendon approaches the metacarpophalangeal joint, it spreads out to form the dorsal digital or extensor expansion, also described as the extensor hood. This is a fibrous expansion over the dorsum of the proximal phalanx of each digit. It can be regarded as an aponeurotic extension of the tendon of extensor digitorum.

Each expansion forms a moveable hood which moves distally when the metacarpophalangeal joint is flexed and proximally when it is extended, in which position it is most closely applied to the joint.

The expansion is triangular, and the base of the triangle, which is proximal, wraps around the dorsal and collateral aspects of the metacarpophalangeal joint. A tendon of extensor digitorum blends with the expansion along its central axis, and is separated from the metacarpophalangeal joint by a small bursa. The base of the expansion, which connects this tendon to the adjoining interosseous muscles on each side, is stabilized by numerous transverse fibres and by links that extend to the deep transverse metacarpal ligaments.

As the tendon of extensor digitorum approaches the proximal interphalangeal joint, it divides into a middle and two lateral slips. The middle slip passes across the joint and carries the main insertion of the extensor into the base of the middle phalanx. The two
lateral slips converge over the middle phalanx, and unite to be inserted into the base of the terminal phalanx. The lateral slips are joined by parts of the tendons of the interossei and, on the radial side, by the tendon of the lumbrical muscle. Thus both the interossei and lumbricals are inserted into the base of the terminal phalanx via the lateral slips.

At the MCP joint the extensor mechanism is comprised of the longitudinal extensor digitorum tendon and the transverse peripheral fibers, termed the sagittal bands. Intact sagittal bands prevent subluxation of the extensor digitorum tendon (Hame 2000, Ryan 1994). The extensor tendons are also stabilized by the juncturae tendinum, which are fibrous connections between the tendons proximal to the MCP joints (Fig.1). Beneath the extensor expansion is the thick dorsal capsule, which contributes to protection of the MCP joint (Posner 1989). These structures are maximally stretched over the metacarpal head as a fist is made, making them more susceptible to injury (Hame 2000). The index and small fingers each have two extensor tendons crossing the MCP joint each lying on the ulnar side of the common extensor tendon (Hame 2000). The index finger has the extensor indicis which shares the same synovial sheath as extensor digitorum in the 4th dorsal compartment. The small finger has the extensor digiti minimi whose tendon, after passing through the 5th dorsal compartment, splits into two parts. The medial part takes the main share in forming the expansion on the first phalanx. The lateral part, before it joins the expansion, is joined by the tendon from the extensor digitorum.

The intrinsic tendons are composed of four dorsal interossei (abductors), three palmar interossei (adductors), and four lumbricals. The interossei originate from the lateral sides of the metacarpals and run distally on both sides of the fingers except the ulnar side of the little finger. The interossei tendons enter the finger dorsal to the intermetacarpal ligament. The lumbricals arise from the radial side of the flexor digitorum profundus tendon and pass palmar to the intermetacarpal ligament. The tendons of these intrinsic muscles join to form the lateral bands, all passing palmar to the axis of the metacarpophalangeal joint (Fig.2).
Fig. 2
Extensor mechanism of the dorsum of the finger (MP – Metacarpophalangeal, PIP – Proximal interphalangeal, DIP – Distal interphalangeal joints).
Pathology

Traumatic soft tissue injuries to the metacarpophalangeal (MCP) joint may result from repetitive or isolated forceful blows with the clenched fist. The most commonly described injury is disruption of the sagittal fibers of the extensor tendon mechanism. This may be isolated or combined with a more serious and disabling extensor expansion disruption with dorsal capsular rupture. This pattern of injury has been termed "boxer's knuckle" (Arai 2002).

The term "boxer's knuckle" was first coined by Gladden (1957) who used the term to describe four types of injury each representing an increasing degree of pathology to the dorsal region of the metacarpophalangeal joint. In all instances there was swelling about the affected knuckle and thickening of the soft tissue,

- **Type I.** Thickening of the soft tissue, including the tendon and capsule over the distal end of the metacarpal bone, with no evidence of a tear.

- **Type II.** Thickening of soft tissue, tendon and capsule over the affected joint, with tear of the more superficial portion of the soft tissue.

- **Type III.** Thickening of soft tissue, tendon and capsule, over the affected joint, with tear of soft tissue and tendon.

- **Type IV.** Thickening of soft tissue, tendon and capsule, with tear of these structures, the defect extending into the joint space.

In this study only one of the four athletes studied had sustained a tear of the dorsal capsule. The injuries in the other three involved the extensor expansion, the central tendon or the sagittal band.

The example described in the case report will demonstrate an example of a boxer’s knuckle in a non-athlete and discuss the possible injury in terms of the anatomy and pathology previously outlined.
Case Report

History

A 74 year old gentleman was referred by his GP with a diagnosis of pain and swelling of the metacarpophalangeal joint of the index finger of the left hand due to ‘tendon contracture’. He was right hand dominant. Onset had been quite sudden 3-4 months previously since he struck the area with a hammer while doing carpentry.

Although retired he reported being very active. His pain was initiated with any gripping movement. Otherwise he reported being hypertensive, and had had a coronary artery bypass graft a number of years previously. He took Atenolol, Frusemide and Aspirin regularly as well as analgesics when the knuckle pain was bothering him.

Physical Examination

Examination revealed a mild swelling and tenderness over the dorsal aspect of his right index-finger MCP joint. The involved joint had full active range of motion. Grip strength was full although reproduced the subject’s pain over the MCP joint. With active MCP flexion, the extensor tendons, extensor digitorum and extensor indicis, appeared to subluxate to the ulnar aspect of the MCP joint. All other joints demonstrated a full pain free range of movement.

Investigations

An x-ray of the hand was requested at initial consultation (Fig.3). This demonstrated some generalised degenerative changes particularly in the metacarpophalangeal joint of the middle finger. To a lesser degree the metacarpophalangeal joint of the index finger also demonstrated degenerative change (Fig.4).
Fig. 3  X-Ray of the Hand
Diagnosis and Treatment

A diagnosis was made of radial sagittal band disruption. The subject was offered a local corticosteroid injection with the aim of reducing his pain on active gripping. After gaining his informed consent an injection was carried out.

25mg of hydrocortisone (1ml volume) with 0.5 ml 1% lignocaine was injected using a peppering technique into the radial aspect of the extensor mechanism of the metacarpophalangeal joint of the left index finger.

The subject was left for 10min and grip re-examined. Post injection he had a full pain free grip although there was still evidence of subluxation of the extensor tendons.
At review 1-month post injection the subject reported that there had been some increase in pain around the metacarpophalangeal joint for approximately 3-days post injection. However, since this time he had noted no pain in the joint and was able to grip without experiencing discomfort. Examination still revealed subluxation of the extensor tendons.

**Discussion**

The term "boxer's knuckle" as first described by Gladden (1957) is classified into four degrees of injury the most severe resulting in a tear through the soft tissue, tendon and dorsal capsule of the MCP joint and extending into the joint space itself.

In this study the injury was most likely confined to the radial sagittal band of the index finger and most probably represented a Type II or a Type III injury. That is thickening of the soft tissue, tendon and capsule with tear of either the superficial portion of the soft tissue only (Type II) or including a tear of the deeper soft tissue and tendon (Type III).

Disruption to the radial sagittal band of the extensor mechanism would allow the ulnar subluxation of both the tendons of extensor digitorum and extensor indicis. Radial subluxation of the extensor tendon resulting from disruption of the ulnar sagittal band is much rarer and may suggest that there is an additional and more severe injury to the underlying dorsal capsule (Stracher 2002).

Injuries to the dorsal capsule usually involve the MCP joint of the middle finger, followed in frequency by injuries to the MCP joint of the index finger. The knuckle of the middle finger is more prone to injury as it extends beyond the other knuckles when the hand forms a fist. Injuries occurring to the third metacarpal head may be due to poor technique when a boxer fails to make contact with the effective punching area of the broad surface over the proximal segments of the index and middle fingers. Instead, contact is made over the more localized area of the dorsal edge of the third metacarpal head which sustains injury.

Little is described in the literature of injuries to the extensor mechanism sustained in pursuits other than boxing. However, Posner (1989) described a compressive injury over a metacarpal head in a professional American football player who, while running with the ball had his hand struck by the helmet of an opposing player making a tackle. The blow resulted in a complete tear of the sagittal band and underlying dorsal capsule of the second metacarpal. It would seem plausible that the subject in this study sustained a similar injury. Being left handed he was using a hammer in the right hand when he struck the radial aspect of the metacarpophalangeal joint of the index finger, resulting in injury to the radial sagittal band.

Review of the literature reveals that some authors have recommended nonoperative treatment for sagittal band rupture (Hame 2000, Inoue 1996). This may not be a viable
option in athletes who require repetitive hand use as the tendon will continue to subluxate and the capsule will remain inflamed resulting in a chronic problem and inability to participate fully in their sport. Certainly training technique needs to be addressed; in the case of the boxer they should be knowledgeable of the correct application of hand wraps and gloves. Repetitive use of awkward blows and poor technique should be avoided particularly after an injury has been sustained. Such blows that may carry higher risk include those punches that are delivered so that the impact is not against the effective punching surface of the index and middle finger but rather against the dorsal edge of the metacarpal heads.

In the case of the subject in this study symptoms were controlled sufficiently with local injection and further treatment to correct the subluxing tendons was not indicated as the subject was not concerned regarding this subluxation. Should symptoms not have resolved or should they have returned after a period of improvement an MRI scan may have been useful to assess the degree of injury if surgical intervention was then deemed an appropriate further management option.

References


