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Carpal boss in chronic wrist pain and its association with partial osseous coalition and osteoarthritis - A case report with focus on MRI findings

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ABSTRACT

The carpal boss is a bony prominence at the dorsal aspect of the 2nd and/or 3rd carpometacarpal joint, which has been linked to various etiologies, including trauma, os styloideum, osteophyte formation, and partial osseous coalition. It may result in symptoms through secondary degeneration, ganglion formation, bursitis, or extensor tendon abnormalities by altered biomechanics of wrist motion. We present a case of symptomatic carpal boss with the finding of a partial osseous coalition at the 2nd carpometacarpal (metacarpal–trapezoid) joint and highlight the magnetic resonance imaging (MRI) findings of carpal boss impingement and secondary osteoarthritis. To the best of our knowledge, there is no report in the literature describing the imaging findings of partial osseous coalition and degenerative osteoarthritis in relation to carpal boss.

Key words: Carpal boss; carpal coalition; chronic wrist pain; os styloideum; osteoarthritis

Introduction

Carpal boss, also known as "carpe bossu," is a bony prominence at the dorsal aspect of the 2nd and/or 3rd carpometacarpal joint and was first described by Fiolle.[1] Its etiology has yet to be fully defined to date, but can be congenital in the form of an accessory ossicle (os styloideum) or acquired from trauma or degenerative osteophytosis.[2] It is likely multifactorial, with a persistent os styloideum at the area of the quadrangular trapezoid-capitate-metacarpal joint causing abnormal biomechanics of wrist joint motion and leading to secondary osteoarthritis with spur formation.[3]

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A persistent os styloideum is the widely accepted theory behind the carpal boss and has been described as the ninth carpal bone.[4,5] It represents an un-united ossicle over the dorsal aspect of the wrist at the base of the 2nd and 3rd metacarpals. The os styloideum may be fused to the adjacent metacarpal as a bony process or separated by a fibrous synchondrosis.[6]

Clinically, carpal boss is seen as a bony protuberance at the dorsal wrist and is often asymptomatic. Symptoms associated with carpal boss are attributed to secondary osteoarthritis, bursitis, ganglion formation, or extensor tendon slipping or impingement.

Various associations contributing to the symptomatic carpal boss have also been proposed, such as an accessory digitorum brevis manus muscle,[7] accessory capitate,[8] and intratendinous ganglion formation.[9] More recent cadaveric anatomical studies by Nakamura *et al*. and Alemohammad *et al*.[10,11] have suggested a link between congenital partial carpal coalition and carpal boss.

Case Report

A 33-year-old man presented with low-grade pain in the dorsal aspect of the right wrist for several months, without a history of trauma. This pain had been recurrent for the past 10 years, usually exacerbated by activities requiring wrist motion, such as racquet sports. Clinical examination demonstrated slight protuberance at the dorsal aspect of the wrist at the region of the dorsal 2nd and 3rd carpometacarpal joints without overlying skin changes. The normal range of motion was preserved. The provisional diagnosis was a dorsal wrist ganglion. Initial radiographs, however, suggested narrowing of the joint spaces at the 2nd and 3rd carpometacarpal joints and the trapezio-capitate joint with subtle sclerosis [Figure 1], raising the suspicion of arthritis.

An MRI (Philips Ingenia 3.0T, The Netherlands) was performed for further assessment, which revealed a dorsal bony process at the quadrangular joint representing an os styloideum variant fused to the base of the 3rd metacarpal [Figure 2]. No ganglion cyst, a common finding in dorsal wrist pain and swelling, was evident. The fused os styloideum shared a non-osseous synchondrosis with the adjacent trapezoid bone at its dorsalulnar aspect [Figure 3, left image]. It was also interesting to note that there was a partial osseous coalition at the dorsal aspect of the 2nd carpometacarpal joint between the 2nd metacarpal and the trapezoid [Figure 3, middle image].

Figure 1: Frontal radiograph of the right hand shows subtle narrowing of the 2nd and 3rd carpometacarpal joint spaces and subchondral sclerosis (black arrows)

Degenerative osteophytic spurs developing at the dorsal aspect of the base of the 3rd metacarpal were observed and, in conjunction with the os styloideum variant at the dorsal aspect of the quadrangular joint, constituted the "carpal boss." This was best appreciated on the sagittal scans [Figure 4A]. The dorsal ligaments between the 2nd metacarpal, 3rd metacarpal, the capitate, and the trapezoid were not identified and soft tissue edema was noted at the dorsal quadrangular joint [Figure 4B]. This may be related to deficient dorsal ligaments in association with the partial coalition as described by Alemohammad *et al*. or due to tears of the dorsal ligaments. There was also evidence of full-thickness cartilage loss at the quadrangular joint with subchondral marrow edema consistent with degenerative osteoarthritis [Figure 3, right image], and an associated effusion in the midcarpal compartment. This probably accounted for the patient's wrist pain and limitation of wrist motion. Our patient responded to a 2-week trial of conservative therapy, and a follow-up clinic visit in 6 months did not reveal significant complaints or limitation of wrist activities.

Discussion

The carpal boss is seen as a bony protuberance at the region of the quadrangular (trapezoid–capitate–metacarpal) joint, often at the base of the 2nd and/or 3rd carpometacarpal joint, representing a persistent os styloideum or its variant. This may be confused clinically with the much more common ganglion cyst in patients presenting with chronic wrist pain.

Although radiographs are useful as an initial imaging modality, optimal demonstration of the carpal boss may be difficult due to superimposed bony structures. When routine radiographs are non-diagnostic, a specific carpal boss view may be performed with a lateral projection,

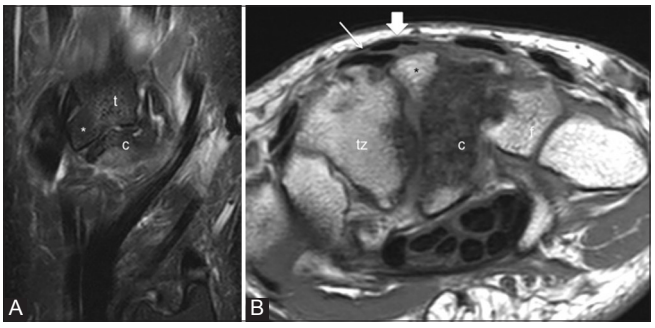

Figure 2: (A) Coronal T2-weighted fat-saturated image shows a bony process representing an osstyloideum variant (*) that has fused to the base of the 3rd metacarpal (t). (B) Axial T1-weighted image shows the distal aspect of the osstyloideum process (*) over the dorsal aspect of the quadrangular joint. The extensor carpi radialis brevis (ECRB) tendon (thin arrow) courses near the styloidal process before inserting at the lateral dorsal surface of the 3rd metacarpal base. A few fibers of the ECRB also insert at the medial dorsal surface of the 2nd metacarpal (not shown). The extensor digitorum tendon overlying the osstyloideum is also shown (thick arrow) [tz: Trapezoid bone, c: Capitate bone]

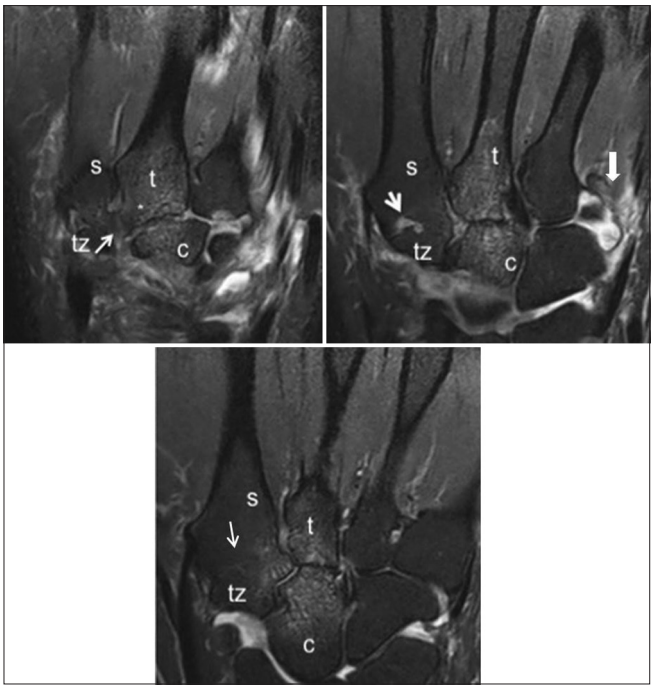

Figure 3: Sequential T2-weighted fat-saturated coronal images of the wrist from dorsal to volar (left to right). The fused os styloideum (*) shares a non-osseous synchondrosis with the adjacent trapezoid bone at its dorsalulnar aspect (arrow, left image). A partial osseous coalition at the dorsal part of the 2nd carpometacarpal joint is observed between the 2nd metacarpal and the trapezoid (arrow, middle image). More volar image on the right shows complete osseous fusion between the two bones (arrow, right image). Note marrow edema at the region of the quadrangular joint with full-thickness cartilage loss and presence of a midcarpal joint effusion with synovitis (middle image, thick arrow) [s: Second metacarpal, t: 3rd metacarpal, c: Capitate, tz: Trapezoid]

positioning the affected wrist in 30° of supination and ulnar deviation. This view compensates for the obliquity of the longitudinal axis of the metacarpal-capitate joint and optimizes the profiling of the os styloideum, which projects 30°-40° dorso-radially.[2]

MRI is invaluable in the evaluation of chronic wrist pain when radiographic evaluation is inconclusive and allows characterization of the carpal boss, assessment of possible associations, and identifying complications.

In our patient, the os styloideum was seen as a bony process fused to the 3rd metacarpal base, which is the most common variant described by Thompson[6] [Figure 2]. Less commonly, it can originate from the capitate or trapezoid, or can remain as a separate ossicle at the base of the 2nd metacarpal or the trapezoid.

In our case, the interesting finding of a partial osseous coalition involving the dorsal aspect of the 2nd metacarpal and trapezoid bone [Figure 3] supports the findings by Alemohammad *et al*., which demonstrated a high percentage of partial osseous coalitions between two or more of the capitate, trapezoid, 2nd metacarpal, and

Figure 4 (A and B): (A) Sagittal T1-weighted image shows the carpal boss in profile, with osteophytic spurs developing at the dorsal aspect of the base of the 3rd metacarpal (t) and at the capitate (C) Full-thickness cartilage loss is seen. (B) Sagittal T2-weighted fat-saturated image shows marrow edema in the capitate and 3rd metacarpal base. The dorsal ligament between the capitate and the osstyloid is not identified and prominent soft tissue edema is noted at the dorsal aspect of the joint (dotted arrow). The extensor digitorum tendon (white arrows) is closely related to the carpal boss [l: Lunate]

3rd metacarpal bones with an associated bony prominence in the general cadaver population and proposed an association between congenital fusion and carpal boss. In particular, the most common location for the osseous partial coalition is between the 2nd metacarpal and the trapezoid bones, and when an osseous coalition is present, it is incomplete and located at the dorsal aspect of the wrist.[10] These findings were present in our patient. In addition, the dorsal ligaments between the 2nd metacarpal, the 3rd metacarpal, the capitate and the trapezoid bones were not identified on MRI and may be congenitally deficient, further corroborating with the cadaveric findings by Alemohammad *et al*.

In assessing complications, MRI is useful in evaluating the features of osteoarthritis, including cartilage defects and chondromalacia, as well as marrow edema-like signal changes. Osteoarthritis with spur formation often develops in long-standing cases of carpal boss and can lead to painful symptoms. In our patient, there was extensive full-thickness cartilage loss at the quadrangular joint with marrow edema, compatible with osteoarthritis [Figure 4A].

Notably, the extensor carpi radialis brevis courses close to the carpal boss and may be prone to impingement or traction injury. Slipping of an extensor tendon over the carpal boss may also occur.[3] Other possible complications include intratendinous ganglion formation with predisposition to tendon rupture, as well as inflammatory bursitis.[9] Possible associations which may contribute to the symptomatic carpal boss, such as an accessory extensor digitorum brevis manus muscle or accessory capitate, can also be identified on MRI.

The patient's symptoms are deemed a result of carpal boss impingement and osteoarthritis with full-thickness cartilage

loss related to long-standing carpal boss. In particular, the presence of a partial osseous coalition may have contributed to the altered biomechanics of wrist motion and represents part of the patho mechanical etiology behind symptomatic carpal boss.

Treatment of the symptomatic carpal boss may be conservative or surgical. Conservative management includes pain relief with nonsteroidal anti-inflammatory drugs (NSAIDS), immobilization, corticosteroid injections, and physiotherapy. Surgical treatment encompasses wide wedge excision of the carpal boss and the associated degenerative arthritic changes to the level of normal articular surfaces and normal adjacent cancellous bone.[3,12] Evidences of symptomatic recurrences and 3rd carpometacarpal instability after wedge resection have been reported in the literature, and carpometacarpal arthrodesis has been proposed as an alternative primary treatment or after failure of simple resection.[13]

At present, there is no consensus regarding the optimal treatment of carpal boss and surgery is usually considered after failed conservative treatment. It is of interest to note that the association of deficient dorsal ligaments with partial osseous coalition at the quadrangular joint may contribute to or compound the instability of the 3rd carpometacarpal joint after a wedge resection, on the basis that the dorsal ligament between the capitate and the base of the metacarpal is typically disrupted during a surgical wedge resection.[3] This may affect the surgical management in this group of patients, who may require carpometacarpal arthrodesis as a primary or secondary treatment following wedge resection.

Conclusion

In conclusion, MRI is useful in the evaluation of the symptomatic carpal boss and can identify known associations and complications that have an impact on management. Also, the associated finding of a partial osseous coalition between the 2nd metacarpal and the trapezoid bone that lends support to the hypothesis based on anatomical studies that congenital carpal coalition is related to the development of carpal boss.

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