High resolution ultrasound: the first imaging technique in the diagnosis of carpal boss.

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Purpose

The carpal boss or "carpe bossu" is a relatively common clinical condition, a lump on the dorsal aspect of the hand, present in the 3% of the population. It is a bony protuberance localized in the dorsal carpometacarpal region, at the base of the index and middle fingers, and it is frequently confused, clinically, with a ganglion cyst.

This entity was first described by Filloe in 1931 (Filloe 1931), and nowadays its etiology is still not clearly understood. Different causes have been proposed: osteophytes in degenerative disease, childhood fracture, rupture of the dorsal ligament, post-traumatic periostitis secondary to the pull of the extensor carpi radialis brevis tendon insertion or an abnormality of the embryogenesis, which may or not be associated with an os styloideum. The os styloideum is originated from an accessory ossification center at the area of the quadrangular trapezoid-capitate-metacarpal joint. In most cases the os styloideum disappears during fetal development. If it persists isolated, it may interfere in the normal biomechanics leading to degenerative osteoarthritis. This entity has been also associated with tarsal coalitions (Alemohammad 2009). Repetitive micro traumatisms may contribute to the development of this bony protuberance, and some authors believe that this is a physiologic osseous proliferation due to stress overloading.

The carpal boss is, generally, asymptomatic. It presents as a lump on the dorsum of the wrist, being more evident with wrist flexion. Most of the symptoms are thought to be caused by degenerative changes of the joint; the development of a ganglion cyst/bursitis over the joint or pathology at the extensor tendons enthesis or tendon fraying when sliding over the osseous protuberance which may facilitate its rupture (Alemohammad 2009, Vermulen 2009, Williams 2008). Clinically the lesion can be described as a painful lump on the dorsum of the wrist, being more common in the right wrist although it may be also bilateral.

The treatment of this entity depends on the patient´s symptoms. The conservative treatment is effective in most cases, with standard non-steroidal anti-inflammatory drugs, corticosteroid injections, splint immobilization and hand therapy. Surgical treatment is reserved for those cases refractory to conservative treatment; and usually consists in a wide excision of the osseous protuberance to prevent recurrence, being arthrodesis under discussion (Lorea 2008, Vermuleun 2009 and Park 2008).

Imaging techniques are focused on demonstration the presence of an osseous deformity and associated pathology. Plain films are the first diagnostic tool. The standard views in AP and lateral positions of the wrist are commonly insufficient and do not allow an adequate visualization. The carpal boss view is the most specific radiography: it is a...
modified lateral view of the wrist with the hand flexed and supinated 30° to 40° with ulnar deviation of 20 to 30° (Cuono 1979, Conway 1985, Wong 2007). The visualization of the osseous deformity is characteristic of a carpal boss, although evaluation of accessory bones is usually difficult due to bone superposition.

Other imaging techniques such as MSCT and MR imaging can easily visualize the osseous abnormality, and specifically MR imaging has an exquisite contrast resolution when evaluating secondary findings of adjacent structures (Zanetti 2007). Bone scintigraphy has been also used to identify associated inflammatory changes (Apple 1984).

Most of the medical literature refers to the radiographic diagnosis and different surgical options. However, there are very few articles evaluating other imaging techniques and especially ultrasound. The purpose of this work is to demonstrate the utility of High resolution ultrasound (HRUS) in the diagnosis of this entity and its first position in the diagnosis algorithm.
Methods and Materials

28 patients referred to our department during the last three years because of a lump on the dorsum of the hand were studied and diagnosed as carpal boss by ultrasound.

The ultrasound examination was performed with a multi-frequency linear array probe (10-18 MHz), with the patient sitting in front of the examiner and the hands over the table. The study was performed in both planes. For the dynamic examination the wrist is placed on a gel tube with the fingers hanging over its edge to make fingers movement easier.

The following parameters were evaluated:

a- Correspondence of the dorsal lump with the bony protuberance

b- Presence of os styloideum.

c- Inflammatory changes in the carpometacarpal joint.

d- Ganglion cysts or bursitis over the joint

e- Involvement of the extensor tendons: second and third finger extensor tendons and/or extensor carpi radialis tendons.

f- Abnormal saltatory movement of the index extensor tendons over the bony protuberance (transitory dislocation of the tendons).
Results

All the 28 patients were referred to our department because of a lump on the dorsum of the hand. Only 4 of the patients had a clinical suspicion of carpal boss; a ganglion cyst was suspected in the rest of the patients. There were 5 males and 23 females, with an average age of 33 years (range age 22- 59 years). 50% of the patients had associated local pain.

a- Ultrasound demonstrated in all cases the correspondence of the dorsal lump with the bony protuberance .(Fig.1)

b- An os styloideum was identified in five patients.(Fig. 2)

c- 12 patients had supra-adjacent ganglion cyst or bursitis. All these patients were symptomatic. (Figs. 3 and 4).

d- In 11 patients, 50% of the cases, inflammatory changes of the carpometacarpal joint were shown, with synovial proliferation and increased Power Doppler signal.(Fig. 5)

e- 6 patients had abnormalities of the extensor carpi radialis brevis tendon: decreased ecogenicity, increased volume and loss of the characteristic fibrillar pattern of the tendon (Fig. 6).In one patient tenosynovitis of the extensor tendons of the index was demonstrated.

f- The dynamic exploration assessed a transitory dislocation of the extensor tendons only in one patient.

We also reviewed other imaging techniques. 7 patients had previous plain radiographs in orthogonal views, and an osseous abnormality was retrospectively identified in 4 patients (Fig. 7). Only one patient had specific carpal boss view.

8 patients had MSCT scans and multiplanar reconstruction, 3D and VR images were also obtained (Fig. 8), allowing a better depiction of the osseous abnormality and associated changes in the joint (Fig. 9), but no additional information was provided and the soft tissue involvement was not visualized.
Fig. 1: Fig. 1: Dorsal lump, superficial VR image (red rectangle indicates probe position). Sagittal 10-18 US image demonstrating the bony protuberance (red arrowheads)

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Fig. 2: Os Styloideum: a) lateral radiography, red rectangle; b) sagittal sonogram of the same patient, callipers

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Fig. 3: Fig. 3 Bursitis: a) lateral radiography that shows a bony protuberance and a supra-adjacent soft-tissue mass; b) sagittal view of the same patient demonstrating the correspondence of the soft tissue mass with a bursitis at the carpometacarpal joint.

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Fig. 4: Ganglion cysts in two different cases, axial sonograms.

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Fig. 5: Fig. 5 Synovitis of the carpo-metacarpal joint: synovial hypertrophy and increased Power Doppler signal in a symptomatic patient with local pain.

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Fig. 6: Extensor carpi radialis brevis tenosynovitis: a) longitudinal sonogram, decreased echogenicity, synovial hypertrophy (*); b) axial sonogram of the same patient showing the same features and the hypervascular pattern.
Fig. 7: Fig. 7 Lateral radiographs in two different patients with carpal boss (red ellipses).

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Fig. 8: Fig. 8 3D image in a patient with a bony protuberance in the third metacarpal-capitate joint. VRI in same patient demonstrating the extensor tendons, in purple the most frequent affected tendons in this pathology: tendon for the index finger of the extensor digitorum and extensor carpi radialis brevis.

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Fig. 9: Fig. 9 Symptomatic patient with carpal boss: Sagittal reformation and axial CT image in patient with osteoarthritic changes at the carpometacarpal joint (ellipses).
Conclusion

The carpal boss is, a relatively frequent entity, defined as a bone protuberance on the dorsum of the wrist, between the base of the second and third metacarpals, the capitate and the trapezoid. Radiologists must be aware of this entity, not only because it is usually misdiagnosed with a ganglion, but also because it is a relatively frequent cause of pain in this anatomical region.

The standard radiographic views of the wrist may not contribute to the diagnosis and the specific views are rarely obtained because there is not a clinical suspicion.

Multiplanar techniques, such as MSCT and MR Imaging, diagnose easily this lesion. MSCT is exquisite assessing the bone protuberance, the degenerative changes of the joint, and presence of an os styloideum; even more the possibility to obtain 3D reconstructions facilitates the visualization for clinicians. MR imaging also evaluates inflammatory changes of the surrounding soft tissue, the presence of tendonitis, bursitis, synovitis and ganglion cyst formation.

However, due to the fact that the main clinical symptom is a lump on the dorsum of the hand, the first diagnosis tool should be the ultrasound. This technique can demonstrate the osseous nature of this lump, localize the affected joint and assess the presence or absence of an accessory ossicle. Besides, HRUS can easily visualize a supra-adjacent bursitis, ganglion cysts and signs of synovitis or tendinosis. Moreover, it allows the examiner to perform a dynamic examination to assess an abnormal movement of the tendons over the osseous protuberance.

We believe, therefore, that ultrasound is the technique of choice for the diagnosis of this entity. The other imaging techniques, mainly MSCT and MR imaging, should be reserved for patients with an unfavorable outcome with conservative management, when surgical treatment is considered.
References


