The Fourth Extensor Compartment Artery Vascularized Bone Graft of the Distal Radius for CMC Fusion in the Treatment of Carpal Boss: A Case Report

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Jorge G. Boretto¹, David Fernandez-Fernandez²,
Gerardo Gallucci¹, and Pablo De Carli¹

Abstract

Background: Carpometacarpal joints can be affected by traumatic or degenerative pathology. Although different techniques have been described to treat these conditions, most authors agree that arthrodesis is an effective treatment modality. Vascularized bone grafts of the distal radius have been used to treat carpal conditions, such as scaphoid nonunion or Kienbock disease, and they have been shown to have several advantages over nonvascularized bone grafts. **Methods:** We report a case of a carpal boss in a female patient treated with an arthrodesis of the second and third carpometacarpal joints by using the fourth extensor compartment artery vascularized bone graft. **Results:** At 6 weeks postoperative bone union was achieved. At 2 years follow-up the patient was able to perform daily life activities without pain. **Conclusions:** The fourth ECA VBG with reverse blood flow from the dorsal intercarpal arch allowed the graft to reach the CMC. A solid fusion was obtained at 6 weeks due to the biological advantage of the VBG.

Keywords: vascularized bone graft, carpal boss, carpometacarpal arthrodesis, bone

Introduction

Traumatic, congenital, and degenerative processes can affect the second through the fifth carpometacarpal (CMC) joints. Although traumatic injuries, such as CMC dislocation, are the most often diagnosed, chronic conditions are sometimes not recognized.^{2,11}

When chronic conditions, such as instability or arthritis, yield painful second and third CMC joints, arthrodesis has been proposed as the preferred treatment.^{2,9} However, arthrodesis of the fourth and fifth CMC is more debatable because the biomechanics of the ulnar joints differ from those of the radial side.¹¹

Vascularized bone grafts (VBG) are shown to have several advantages over non-VBG, both in basic science and in clinical research.^{1,5,6} The use of VBG for carpal pathology has increased since the vascular supply of the distal radius was defined.¹⁸ Most of the time, VBG has been used to treat scaphoid nonunion or Kienbock disease.^{8,12,13,15,20} However, based on the length and the arc of rotation of the pedicle, a VBG of the distal radius can be used to treat pathology of the CMC joints.

We present a case of a patient with a carpal boss in whom a CMC arthrodesis was performed with a fourth extensor compartment artery (ECA) VBG of the distal radius.

Case Report

A right-handed 61-year-old woman presented with a 12-month history of right dorsal wrist pain. The pain was located at the right second and third CMC joints. The patient rated the pain 8/10 on the visual analog scale (VAS). The woman had been treated for osteoarthritis of the trapezio-metacarpal joint with a trapeziectomy and intermetacarpal ligament reconstruction 5 years earlier. She had neither a previous trauma nor a traumatic wound in the involved hand.

On physical examination, a bony protrusion with a hard consistency adhered to the depth planes was palpated. Passive second and third CMC joint motion increased the pain.

Plain radiographs showed a bony prominence on the CMC joints. A wrist computed tomography (CT) scan showed no

¹Hospital Italiano de Buenos Aires, Argentina

²Complejo Hospitalario de Cáceres, Extremadura, España

Corresponding Author:

Jorge G. Boretto, Hand and Upper Extremity Surgery Department, Prof. Dr. Carlos Ottolenghi Institute, Orthopaedic and Traumatology Service, Hospital Italiano de Buenos Aires, Potosí 4247, Ciudad Autónoma de Buenos Aires C1199ACK, Argentina.
Email: jorge.boretto@hospitalitaliano.org.ar

Figure 1. a, Coronal computed tomography (CT) scan of the second carpometacarpal (CMC) joint showing a narrowed joint on the dorsal aspect. b, Coronal CT scan of the third CMC joint showing a narrowed joint and a dorsal boss.

accessory bones. However, it confirmed the presence of degenerative changes with a narrowed joint space and subchondral sclerosis in the second and third CMC joints (Figure 1).

Conservative treatment consisted of nonsteroidal anti-inflammatory drugs (NSAIDs), kinesiology, and rest from activities, which were not effective in relieving the pain. Because of persistent pain, surgical treatment was then indicated.

Surgical Technique

A dorsal longitudinal incision centered over the lunate and the distal radius was performed. The second and third CMC were identified and en bloc resection was performed. The resection of the CMC joints, including the boss, produced a bony defect of $1 \times 1 \times 1.5$ cm.

Next, the interval between the fourth and fifth extensor compartments was identified. Careful dissection of the floor of the fourth extensor compartment was performed to identify the fourth ECA (Figure 2). Once the fourth ECA was isolated, it was ligated proximally and divided. The appropriately sized graft was harvested from the distal radius 1.5 cm proximal to the radiocarpal joint. The retrograde flow pedicle of the graft was then dissected until the dorsal intercarpal arch where the pivot point was located, allowing the graft to arrive at the second and third CMC joints (Figure 3).

The fourth ECA VBG was placed at the excised CMC joints. A 1.6-mm Kirschner wire (K-wire) was introduced to fix the graft.

Careful hemostasis was performed and an intradermal suture was performed.

Postoperative

The postoperative period was uneventful. Wrist immobilization was held for 4 weeks. A CT scan at 6 weeks postoperative showed a solid fusion (Figure 4).

Figure 2. a, Dorsal approach of the wrist with the floor of the fourth extensor compartment dissected. b, On magnification, the long arrow marks the fourth extensor compartment artery and the short arrow marks the dorsal intercarpal artery.

Figure 3. a, The fourth extensor compartment artery vascularized bone grafts (VBG) harvested from the dorsal radius and the retrograde flow pedicle dissected till the dorsal intercarpal artery where it makes the pivot point. b, The VBG inserted at the carpometacarpal joint with the vascular pedicle passing under the extensor tendons.

At 2-year follow-up, the patient reported no pain (VAS 0/10) at rest or during activity. She was able to perform daily life activities. She was very satisfied with both the functional and the cosmetic results (Figure 5).

Discussion

Traumatic, degenerative, or congenital processes can affect CMC joints. Excluding traumatic dislocation, literature about CMC pathology is scarce except for the first CMC

Figure 4. a and b, Coronal computed tomography scans of the second and third carpometacarpal joints showing bone union at 6 weeks postoperatively.

Figure 5. a to d, Cosmetic and radiographic results at 2-year follow-up.

joint. Joseph et al as well as Carroll and Carlson were the first to highlight that pathologic CMC conditions are not recognized mainly in the second and third CMC joints.^{2,11} Most of the information came from case reports or case series about carpal boss.

Carpal boss is a palpable bony protrusion on the dorsal side of the hand that usually affects the joint between the trapezoid, capitate, and bases of the second and third metacarpal bones. The etiology of this entity is unclear; it may represent a degenerative process, the presence of an accessory carpal bone, or both.

There is agreement between most hand surgeons that symptomatic patients may eventually need surgical treatment when a course of nonoperative treatment has failed. However, there is no such consensus on what surgical technique should be used.

The techniques that have been described to treat this condition can be summarized as those that excise the hump and others that perform an arthrodesis of the CMC joint.^{10,14} While excision could lead to joint instability, arthrodesis sometimes fails to achieve bony fusion.^{3,4,19}

Although Loréa et al¹⁴ have reported no complications, others have reported nonunion following CMC arthrodesis in carpal boss as well as in traumatic instability.^{4,16}

VBG have the biological advantage of facilitating bone healing without creeping substitution and thus, accelerating bone union.¹ Regarding mechanical and biological properties, the superiority of VBG over nonvascular grafts has been established.¹⁷ VBG of the dorsal aspect of the distal radius have been used mainly to treat pathologic conditions that affect the scaphoid, the lunatum, or the capitate.^{7,8,12,15,20} However, because of the variety of VBG that can be harvested from the distal radius, various other conditions could be treated, such as those affecting the CMC joints.

Plates, staples, or K-wires can be used to fix the VBG. In our case, the VBG was fixed with a K-wire to avoid not only vascular pedicle injury but also hardware-related complication with extensor tendons.

Conclusion

We present a case of an arthrodesis of the second and third CMC joints affected by a carpal boss treated with a VBG. The fourth ECA VBG with reverse blood flow from the dorsal intercarpal arch allowed the graft to reach the CMC. A solid fusion was obtained at 6 weeks due to the biological advantage of the VBG.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

This article does not contain any experimental studies with human or animal subjects.

Statement of Informed Consent

All patients gave sign the informed consent before the treatment and the institutional review board approved the retrospective review of the medical charts.

Declaration of Conflicting Interests

The author(s) declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: Pablo De Carli reports personal fees from ACUMED, personal fees from AO Foundation, outside the submitted work. Jorge G. Boretto reports personal fees from AO Foundation, outside the submitted work. Gerardo Gallucci reports personal fees from ZIMMER, outside the submitted work. David Fernandez-Fernandez has no commercial interests to disclose.

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