JSES Reviews, Reports, and Techniques 1 (2021) 242–245

Contents lists available at ScienceDirect

JSES Reviews, Reports, and Techniques

journal homepage: www.jsesreviewsreportstech.org

# Treatment of avascular necrosis in adult humeral capitellum with vascularized humeral bone graft

Clifton J. Daigle, BS, Shannon L. Ahmad, BS, Matthew R. Delarosa, MD *, Patrik Suwak, DO, William Kleinman, MD, Rasheed Ahmad, MD

*Department of Orthopaedics, Louisiana State University Health Sciences Center, New Orleans, LA, USA*

ARTICLE INFO

*Keywords:*
Avascular Necrosis
AVN
capitellum
vascularized bone graft
hand surgery

Avascular necrosis (AVN) of the adult elbow is a rare condition in which a localized region of bone dies as a result of diminished blood supply. Necrotic bone can progressively weaken and collapse, affecting the articular surface; however, even the presence of ischemic bone without collapse can cause pain. AVN about the elbow can cause pain with flexion, extension, pronosupination, and/or load-bearing. Pain usually increases over time.[3]

Historically, débridement of necrotic bone followed by bone grafting of the elbow defect have been reported as the most successful short-term treatments.[6,7,10] Pain often returns, however, possibly because osseous vascularity is not fully restored using these methods. We present a case of a 46-year-old women affected by avascular necrosis in her left humeral capitellum. The patient was treated with a vascularized humeral bone graft.

## Case report

A 46-year-old white female presented with a 4-month history of pain in her left elbow during activities of daily living. The pain also often awakened her from sleep. There was no known antecedent trauma. Of note, she had been diagnosed with AVN of her hip several months before the start of her elbow pain (she had received 3 large doses of steroids for intractable migraine headaches prior to the discovery of AVN in her hip, possibly precipitating osteonecrosis in that location). Her ingested steroids might also have precipitated the AVN of her capitellum.

On physical examination, she had sharp pain in her left elbow with either flexion, extension, or forearm supination. She had limited elbow range of motion: 20° to 140° flexion left; 5° to 150° flexion right. Magnetic resonance imaging (MRI) clearly demonstrated a large effusion in the left elbow and AVN of her humeral capitellum (Fig. 1).

The patient underwent arthroscopic débridement and microfracture chondroplasty of the avascular capitellum. She reported relief of pain and tenderness in the area of the capitellum postoperatively, with range of motion slightly improved to 10° to 140° flexion. Two months postop, the patient experienced recurrence of her left elbow pain with daily activities, especially at the end-arcs of flexion and extension. She related that her pain level was still better than preop, but that improvement had plateaued. Her left elbow range of motion had decreased to 20° to 130°. Nonsteroidal anti-inflammatories helped only with sharp pain.

In an attempt to provide further symptomatic relief, a second surgery was proposed, the goal being restoration of blood flow to the capitellum with a vascularized bone graft.

By 9 months postop, the patient's preoperative pain was gone. Elbow motion was 20-140 degrees of flexion. She remains asymptomatic with no tenderness on palpation. Patient consent was obtained before use in this publication.

## Technique

The elbow was approached through a lateral Kocher incision. Fat was elevated anteriorly from the fascia, exposing a triangle of fascia bordered by the mobile wad anteriorly and Triceps posteriorly. The Pankovich interval (between Anconeus and Triceps) was next opened, extending the Kocher interval. The proximal corner of the Anconeus could thus be identified and isolated. Fascia between

Institutional review board approval was not required for this case report.

* Corresponding author: Matthew R. Delarosa, MD, Colorado Orthopedic Consultants, 145 Inverness Drive East, Suite 300, Englewood, CO 80112, USA.
*E-mail address:* mattdelarosa@mac.com (M.R. Delarosa).

https://doi.org/10.1016/j.xrrt.2021.03.004

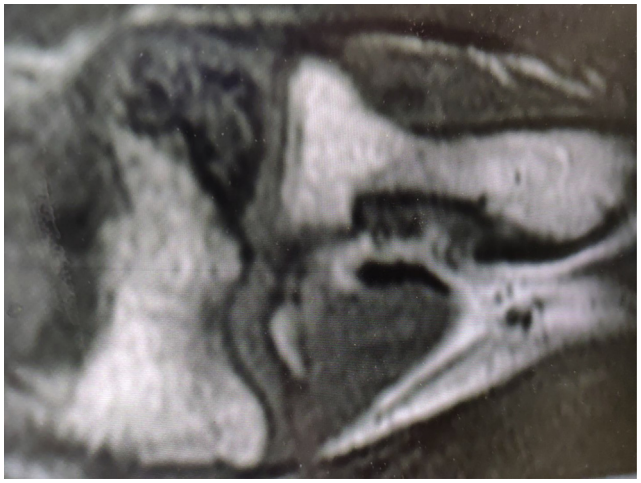

**Figure 1** MRI demonstrating avascular necrosis of the humeral capitellum.

Triceps and mobile wad was then opened with two longitudinal parallel incisions approximately 7 mm apart. The radial recurrent artery with its venae commitantes lies on the bone contained within this fascial sleeve (Fig. 2). Fascial incisions were then extended proximally until the metaphysis-diaphysis junction of the lateral humerus.

A cortico-cancellous graft was next raised using osteotomes. Longitudinal and proximal transverse cuts were made in the bone. The pedicle was divided as the proximal transverse corticotomy was made. The pedicle was then elevated from the bone in the area of the distal transverse cut, and a distal transverse corticotomy made, deep to the artery. A rectangular cortico-cancellous graft was thus created. Subperiosteal dissection distally mobilized the vascularized graft on its pedicle (Figs. 3 and 4). The tourniquet was deflated to confirm vascularity of the graft, then reinflated (Fig. 5).

The extensor/supinator origin was next elevated off the anterior aspect of the lateral epicondyle, exposing the target for graft placement. A guide wire was introduced into the lateral epicondyle, angled toward the capitellum (entry point anterior to the lateral ridge of the epicondyle, staying anterior to the lateral collateral ligament origin). Fluoroscopy confirmed the tip of the wire in the center of AVN (which had been identified preoperatively on MRI and computed tomography [CT] scan). Cannulated hand-driven reamer was then used to create a tunnel in the area of the capitellar AVN. The reamer was 8 mm in diameter, large enough to avoid damaging the pedicle as the graft was inserted directly into the capitellum. Graft and vascular pedicle were introduced (proximal end first) into the tunnel—pedicle adjacent to the cephalad wall of the tunnel, and cancellous bone undersurface orientated distal within the tunnel. Only gentle manual pressure was necessary to insert the graft (Figs. 6 and 7). Four millimeter of the graft was left protruding from the lateral cortex, protecting the passage of the pedicle.

The periosteum of the graft was then sutured to the extensor/supinator origin. Fluoroscopy confirmed graft position within the capitellar tunnel. The proximal fascia was closed, avoiding compression of the pedicle. The skin was closed, and a bulky long-arm compression dressing applied.

## Discussion

AVN of the adult elbow is rare. There are no reports of a successful long-term treatment in cases of large regions of necrotic

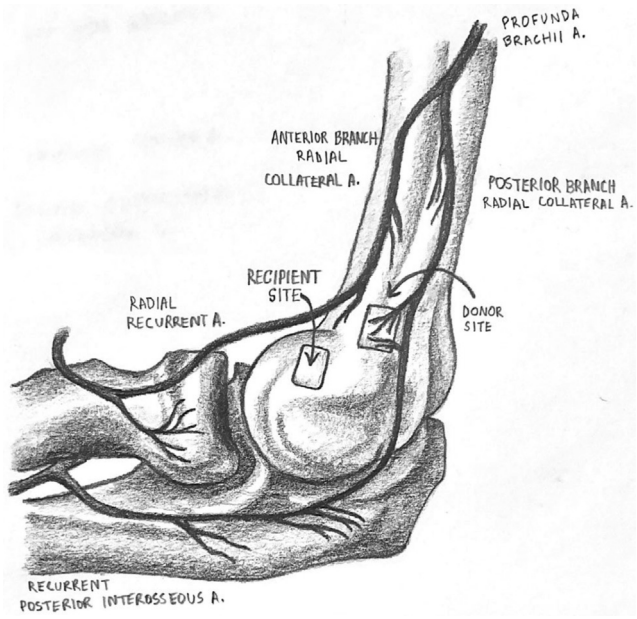


**Figure 2** Illustration of vascular anatomy.

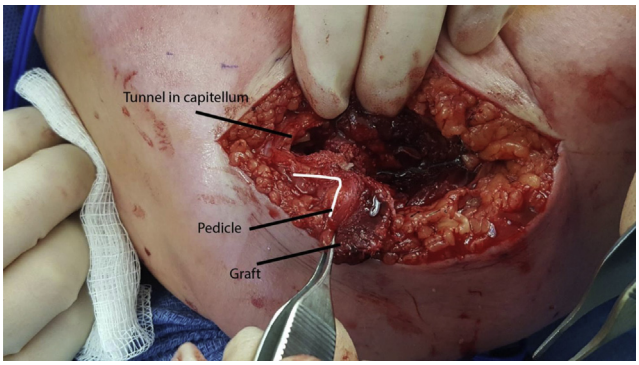


**Figure 3** The graft and its pedicle.

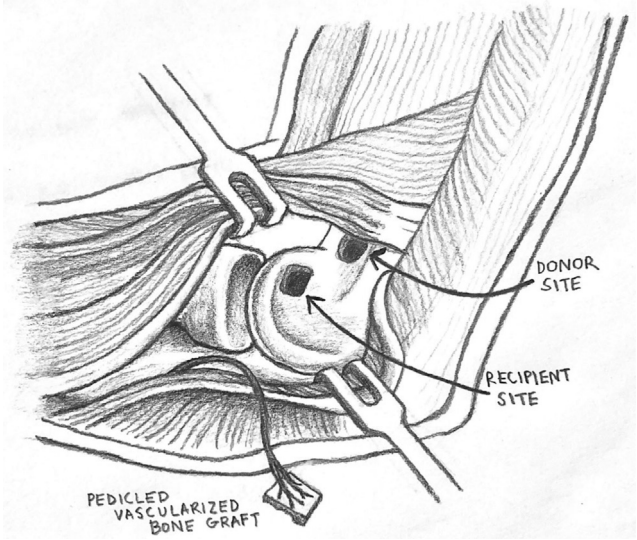


**Figure 4** Illustration of graft harvest on pedicle.

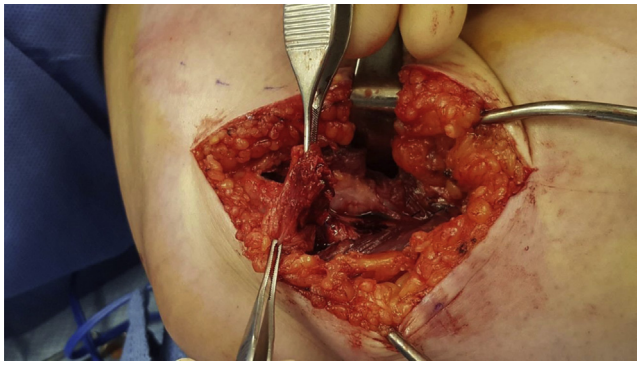

**Figure 5** Bleeding from the graft.

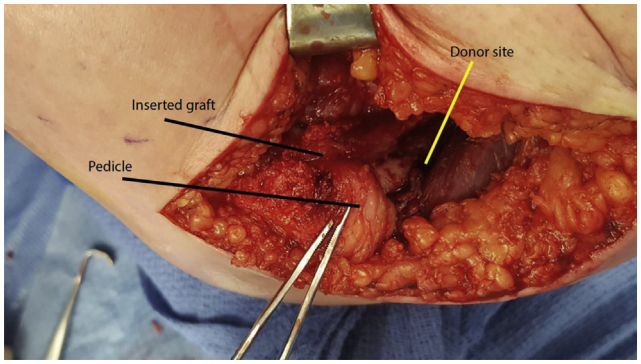


**Figure 6** Inserted graft.

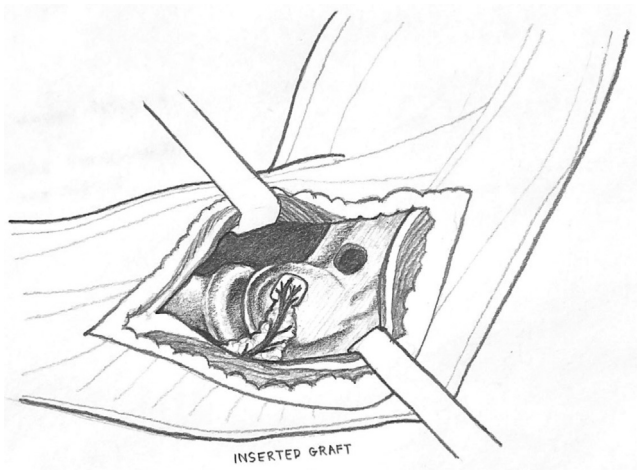


**Figure 7** Illustration of inset of the graft.

bone. Past attempts include arthroscopic débridement and autologous bone grafting from the rib[10] or the pelvis.[6] These efforts have been successful in restoring bone, but pain and tenderness return due to persistent poor revascularization.[1,3] In 2014, Marsell and Hailer presented a case combining autologous bone graft with bone morphogenetic protein.[6] Again, this method was successful in the short term for bone regeneration, but vascularity was not fully restored. Successful long-term pain relief was not achieved.

The mere presence of ischemic bone can cause pain. In both the Lichtman[5] and Ficat[2] classification systems, grade 1 AVN is defined as changes detectable only on MRI, not X-ray nor CT scan.

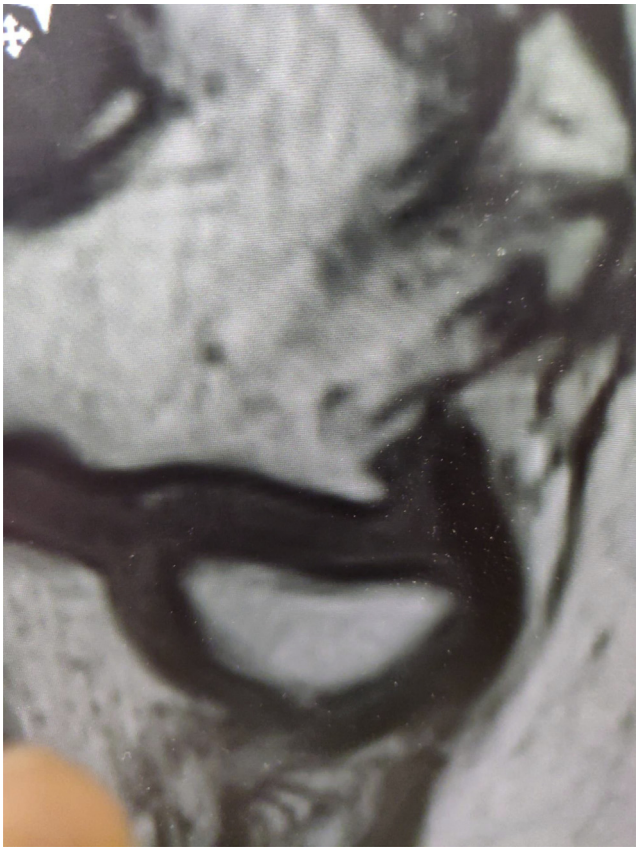

**Figure 8** MRI showing resolution of capitellar changes.

Presumably, pain is due to ischemia of the bone, rather than intra-articular fracture or collapse of the articular surface. To address the pain of AVN, reversing ischemia should be beneficial for long-term relief. Core decompression relieves the pressure in the ischemic bone, restoring some blood supply by creeping substitution; however, free-fibula transfer has been shown to increase vascularity on SPECT/CT scanning at both six months and 36 months.[1]

A successful surgical technique utilizing vascularized local bone graft was reported by Zaidemburg et al, in 1991, to treat scaphoid nonunion with AVN of the proximal pole.[10,11] Since then, the use of vascularized bone graft techniques have been reported in many scaphoid nonunion cases and has showed consistent rates of success.[4,8] Pedicled, vascularized grafting based on the ascending branch of the lateral femoral circumflex artery has also been used in femoral head AVN, successfully preventing pain and progressive collapse of the femoral head.[12] More recently, a pedicled vascularized graft has been utilized to treat moderate sized capitellar OCD lesions in aldolescents.[9]

In our case report, a pedicled distal humerus vascularized bone graft was used, keeping the posterior radial collateral artery and its perforators attached to a piece of lateral distal humerus cortico-cancellous bone. The patient reported complete resolution of pre-operative pain. Range of motion was maintained. Repeat MRI 6 months later demonstrated resolution of the AVN within the humeral capitellum (Fig. 8). CT scan performed at 7 months showed remodeling of the graft (Fig. 9).

## Conclusion

This technique is attractive for several reasons: 1) it is simple; most surgeons have the technical skills required to raise this graft. In addition, the posterior radial collateral artery is much larger than

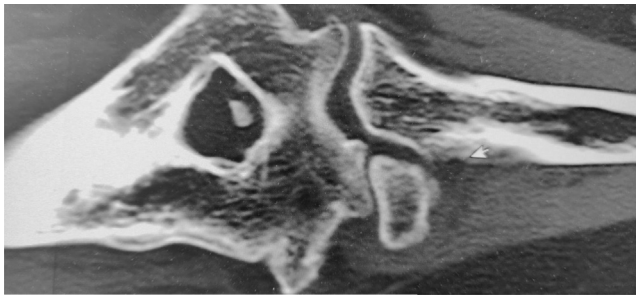

**Figure 9** CT scan reveals healing of the vascularized graft.

the 1-2 supra-retinacular artery of the wrist, recommended for scaphoid AVN by Zaldemberg; 2) it limits the morbidity to one extremity; 3) microvscular anastamosis is not required; 4) it appears to be successful, at least in the short term.

## Conflicts of interest

The authors, their immediate family, and any research foundation with which they are affiliated have not received any financial payments or other benefits from any commercial entity related to the subject of this article.

## Funding

No funding was disclosed by the authors.

## Patient consent

Obtained.

## References

1. Cao L, Guo C, Chen J, Chen Z, Yan Z. Free vascularized fibular grafting improves vascularity compared with core decompression in femoral head osteonecrosis: a randomized clinical trial. Clin Orthop Relat Res 2017;475:2230-40. https://doi.org/10.1007/s11999-017-5374-x.
2. Ficat RP. Idiopathic bone necrosis of the femoral head. Early diagnosis and treatment. J Bone Joint Surg Br 1985;67:3-9.
3. Fondi C, Franchi A. Definition of bone necrosis by the pathologist. Clin Cases Miner Bone Metab 2007;4:21-6. https://doi.org/10.1007/s11999-017-5374-x.
4. Kawamura K, Chung KC. Treatment of scaphoid fractures and nonunions. J Hand Surg 2008;33A:988-97. https://doi.org/10.1016/j.jhsa.2008.04.026.
5. Lichtman DM, Mack GR, MacDonald RI, Gunther SF, Wilson JN. Kienböck's disease: the role of silicone replacement arthroplasty. J Bone Joint Surg Am 1977;59:899-908.
6. Marsell R, Hailer NP. Successful treatment of a humeral capitellum osteonecrosis with bone morphogenetic protein-7 combined with autologous bone grafting. Upsala J Med Sci 2014;119:287-9. https://doi.org/10.3109/03009734.2014.931493.
7. Nicoletti S, Salama A, Stanley D. Idiopathic osteonecrosis of the humeral capitellum. Case Report. J Bone Joint Surg Br 2008;90-B:512-4. https://doi.org/10.1302/0301-620X.90B4.20060.
8. Ribak S, Medina CEG, Mattar R, Ulson HJR, de Resende MR, Etchebehere M. Treatment of scaphoid nonunion with vascularized and nonvascularized dorsal bone grafting from the distal radius. Int Orthop 2010;34:683-8. https://doi.org/10.1007/s00264-009-0862-6.
9. Shimada K, Temporin K, Oura K, Tanaka H, Noguchi R. Anconeus muscle-pedicle bone graft with periosteal coverage for osteochondritis dissecans of the humeral capitellum. Orthop J Sports Med 2017;5:2325967117727531. https://doi.org/10.1177/2325967117727531.
10. Watanabe R, Sato K, Nakamura T, Obara Y, Toyama Y, Ikegami H. Steroid-induced osteonecrosis of bilateral distal humerus treated by arthroplasty using costal osteochondral graft: case report. J Hand Surg 2011;36A:816-9. https://doi.org/10.1016/j.jhsa.2011.02.003.
11. Zaidemberg C, Siebert JW, Angrigiani C. A new vascularized bone graft for scaphoid nonunion. J Hand Surg 1991;16A:474-8.
12. Zhao D, Xu D, Wang W, Cui X. Ilaic crest vascularization for femoral head osteonecrosis. Clin Orthopaedics Relat Res 2006;442:171-9. https://doi.org/10.1097/01.blo.0000181490.31424.96.