J Shoulder Elbow Surg (2018) ■■, ■■–■■

ELSEVIER

Journal of Shoulder and Elbow Surgery

www.elsevier.com/locate/ymse

ORIGINAL ARTICLE

A matched quantitative computed tomography analysis of 3 surgical approaches for osteochondral reconstruction of the capitellum

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Background: The location of capitellar osteochondritis dissecans (OCD) lesions in the sagittal plane guides the surgical approach used for autologous osteochondral transplantation. We sought to compare the capitellar region accessible for orthogonal graft placement through 3 approaches: (1) posterior anconeus-split approach; (2) lateral approach with lateral collateral ligament (LCL) preservation (LCL-preserving lateral approach); and (3) lateral approach with LCL release (LCL-sacrificing lateral approach).

Methods: The 3 approaches were sequentially performed on 9 cadaveric elbows: posterior anconeus-split approach, LCL-preserving lateral approach, and LCL-releasing lateral approach. The extent of perpendicular access was delineated with Kirschner wires. Each specimen underwent computed tomography. The accessible region was quantified as degrees on the capitellum and converted into time on a clock, where 0° corresponds to the 12-o'clock position. Generalized estimating equation modeling was used to investigate for significant within-specimen, between-approach differences.

Results: The LCL-preserving and LCL-sacrificing lateral approaches provided more anterior perpendicular access than the posterior anconeus-split approach (mean, 0° vs 83°; $P < .001$). The posterior anconeus-split approach provided more posterior perpendicular access (mean, 215.0°; $P < .001$) than the LCL-preserving (mean, 117°; $P < .001$) and LCL-sacrificing (mean, 145°; $P < .001$) lateral approaches. The LCL-sacrificing lateral approach provided more posterior exposure than the LCL-preserving lateral approach (mean, 145° vs 117°; $P < .001$). The mean arc of visualization was greater for the LCL-sacrificing lateral approach than for the LCL-preserving lateral approach (145° vs 117°, $P < .001$).

Conclusions: A capitellar OCD lesion can be perpendicularly accessed from a posterior anconeus-split approach if it is posterior to 83° (2:46 clock-face position). A laterally based approach may be required for lesions anterior to this threshold. These data inform clinical decisions regarding the appropriate surgical approach for any OCD lesion.

Level of evidence: Anatomy Study; Cadaveric Dissection with Imaging

Keywords: Capitellum; exposure; OATS; OCD; osteochondral transplantation; osteochondritis dissecans; surgical approach

Institutional review board approval for this study was obtained through the Hospital for Special Surgery Institutional Review Board (study No. 2016-0709).

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1058-2746/$ - see front matter © 2018 Published by Elsevier Inc. on behalf of Journal of Shoulder and Elbow Surgery Board of Trustees.
https://doi.org/10.1016/j.jse.2018.03.029

Osteochondritis dissecans (OCD) of the capitellum is a leading cause of elbow disability in adolescent athletes, and the condition is increasing in prevalence.[5,16,33] OCD refers to a chronic alteration of subchondral bone because of repetitive load, which leads to disruption of the overlying cartilage.[23,31]

Management of capitellar OCD lesions is based largely on the integrity of the articular cartilage and the stability of the lesion.[24] For stable OCD lesions, as well as some unstable lesions that do not involve the lateral wall, a period of immobilization and cessation of sports activities is often sufficient to heal most lesions, particularly if the patient is skeletally immature.[36] For unstable OCD lesions, in which the osteochondral fragment has separated from the adjacent healthy bone, nonsurgical treatment is less likely to achieve healing.[14,28,36] For lesions treated surgically, capitellar microfracture, open reduction and internal fixation, and osteochondral autograft transplantation (OATS) are treatment options, and good clinical outcomes have been reported at medium-term follow-up.[4,9,17,18,21,30] However, these procedures are technically demanding, as they require sufficient exposure of the capitellum to allow for perpendicular access to the lesion in the narrow radiocapitellar joint.[22] Notably, selection of the surgical approach is one of the few variables within the surgeon's control to achieve adequate exposure for each treatment method.

The current gold standard for capitellar resurfacing is through 1 of 3 open approaches: a posterior anconeus-split approach, a lateral approach with preservation of the lateral collateral ligament (LCL), or a lateral approach with release of the LCL.[8,10] A posterior anconeus-split approach provides excellent exposure of posterior lesions, and anterior lesions can usually be visualized with extreme flexion of the elbow. In patients with restricted elbow motion or lesions that are poorly visualized despite maximum elbow flexion, a lateral approach is recommended.[10] While some surgeons perform a lateral approach without release of the LCL,[11,24,26,32] others advocate release of the LCL to facilitate exposure and, when indicated, perpendicular graft placement.[2,19,22,32]

Aside from surgeon preference, the optimal surgical approach depends largely on lesion location. Historically, the majority of clinically significant OCD lesions were thought to involve a narrow region in the anterior-distal capitellum between 120° and 135° anterior to the humeral shaft.[20] However, many capitellar OCD lesions have recently been shown to involve a broader region of the capitellum than previously recognized.[3,12] The surgical implications of this finding are unknown, as it is possible that these anterior lesions may not be accessible through a posterior anconeus-split approach. Similarly, it is unknown which posterior lesions are visualized through the lateral approach without detaching the LCL.

While previous investigations analyzed the proportion of the capitellum visualized arthroscopically, it was unknown what portion of this visible surface would be accessible for open interventions, such as microfracture or OATS.[6,29] Therefore, the objective of this study was to define the extent of the capitellum accessible for perpendicular graft placement via the 3 aforementioned open surgical approaches. By focusing on orthogonal access to the capitellum, we sought to use the most restrictive criteria and, thus, determine the minimum exposed region with each approach. We hypothesized that there would be significant differences in the region of the capitellum accessible for orthogonal graft placement when comparing each of the following 3 approaches: (1) posterior anconeus-split approach, (2) lateral approach with preservation of the LCL (LCL-preserving lateral approach), and (3) lateral approach with release of the LCL (LCL-sacrificing lateral approach).

Materials and methods

Nine fresh-frozen cadaveric upper extremities without previous surgical incisions at the elbow, forearm, or wrist were obtained (average age, 71 years; range, 61 to 88 years; 3 female and 6 male specimens) and were thawed to room temperature. Each approach was sequentially performed: posterior anconeus-split approach, LCL-preserving lateral approach, and LCL-releasing lateral approach. Dissections were performed by a senior orthopedic resident (C.C.J.) under the supervision of a fellow (S.M.R.) and/or attending (A.D.). No gross elbow pathology was identified during any of the dissections.

The posterior anconeus-split approach was performed as described by Iwasaki et al.[11,28] A longitudinal skin incision was made just ulnar to the proximal radioulnar joint. After the anconeus muscle was split, the capsule was incised (Fig. 1, *A-D*). A 10-mm osteochondral transplantation autograft-donor harvester (Arthrex, Naples, FL, USA) was used to demarcate the most anterior-proximal aspect of the capitellum accessible for perpendicular graft placement (Fig. 1, *E* and *F*). A 1.4-mm Kirschner wire was inserted at the anteriormost aspect of the circle created by the OATS harvester (Fig. 1, *G*). The process was repeated to demarcate the posterior-distal capitellum accessible through this approach (Fig. 1, *H* and *I*). Each specimen then underwent computed tomography (CT) using a GE Discovery CT750HD scanner (GE Healthcare, Milwaukee, WI, USA) at 120 kV and 200 mA with a slice thickness of 0.625 mm. Three-dimensional (3D) reformats were created using GE Advanced Workstation post-processing software.

Following this, an LCL-preserving lateral approach was performed on the same specimens. To ensure that dissection stayed at the level of the mid axis of the radiocapitellar joint, the interval between the extensor digitorum communis (EDC) and extensor digiti quinti was used, as described by Schrumpf et al[26] (Fig. 2, *A-C*). The common extensor origin anterior to the mid axis of the radiocapitellar joint was elevated subperiosteally to expose the capitellum (Fig. 2, *D*). The 10-mm OATS harvester was used to identify the most anterior-proximal and posterior-distal aspects of the capitellum accessible for perpendicular graft harvest. K-wires were inserted at the limits of visualization, and the specimens underwent CT scanning with 3D reconstruction.

In the final stage of dissection, the LCL, which had been exposed and protected in the LCL-preserving lateral approach, was released off its origin proximally and a varus stress was applied to the elbow. The additional capitellar surface area visualized was then marked with K-wires, and the specimens underwent a final CT scan with 3D reconstruction.