

Arthroscopic Treatment of Lateral Epicondylitis

Clinical and Cadaveric Studies

H. Mullett, FRCS (Tr & Orth)†; M. Sprague, MD†; G. Brown, MD†; and
M. Hausman, MD†*

Clinical and cadaveric studies were done to investigate the role of a degenerative fringe of the radiocapitellar complex subluxating in the radiocapitellar joint in patients with lateral epicondylitis. In the clinical study, arthroscopic resection of this capsular complex was done. Thirty patients with recalcitrant symptoms of lateral epicondylitis for a minimum of 9 months had surgery. In all patients at arthroscopy, a collar-like band of radiocapitellar capsular complex was found to impinge on the radial head and subluxate into the radiocapitellar joint with manipulation under direct vision. Histologic analyses of the resected tissue showed hyaline degeneration and fibrosis. There were no complications in this series. Twenty-eight patients had complete relief of symptoms by this procedure within 2 weeks of surgery. The average time until return to work was 7 days. Elbow arthroscopy was done in 34 cadaveric elbows to examine the relationship of the annular ligament, the lateral joint capsule, and the radial head. A degenerative capsular fold impinging on the radial head was seen in 15 elbows. A classification system, based on the relationship of the capsular fold to the radial head is described. In Type 1 (19 elbows), the radial head is completely exposed. In Type 2 (six elbows), there is partial coverage of the radial head by the capsuloligamentous complex without interposition into the joint in any position. In Type 3 elbows (six elbows), there is subluxation of the capsular edge into the joint, whereas in Type 4 elbows

(three elbows), the radial head is completely obscured throughout the range of motion. The lesion was equally prevalent in men and women. The arthroscopic findings at the time of surgery in the clinical group were the same as the Grade 2 and Grade 3 changes that were seen in cadaveric specimens.

Level of Evidence: Therapeutic study, Level IV (case series—no, or historical control group). See the Guidelines for Authors for a complete description of levels of evidence.

Since the early description of tennis elbow, there has been controversy regarding the pathogenesis and treatment of lateral epicondylitis.^{5,16,20} Nonoperative measures such as physiotherapy or steroid injection usually are successful, although the recovery period may be prolonged.^{10,19,21} Operative treatment generally releases, repairs, or denervates the common extensor origin. However, it is not uncommon that these procedures fail to alleviate symptoms with success outcomes seen in 65%–95% of patients treated operatively.⁵

We assessed the clinical outcome of patients having a novel arthroscopic procedure for lateral epicondylitis. We observed a degenerative capsulovenous fringe of the leading edge of the annular ligament. Presuming there was impingement of this tissue on or in the radiocapitellar joint, we divided and debrided this tissue. The common extensor origin was normal and left undisturbed. In a related cadaveric anatomic study, we arthroscopically assessed the variability of this capsuloligamentous tissue and its relationship to the radial head throughout range of motion (ROM).

MATERIALS AND METHODS

Clinical Study

We retrospectively reviewed 30 consecutive patients in whom arthroscopic lateral epicondylitis procedures were done by the senior author (MRH) from 1999–2003. There were 16 men and

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From *Department of Orthopaedic Surgery, Beaumont Hospital, Dublin, Ireland; and the †Department of Orthopaedic Surgery, Mount Sinai Hospital, New York, NY.

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Each author certifies that his or her institution has approved the human protocol for this investigation and that all investigations were conducted in conformity with ethical principles of research, and that informed consent was obtained.

Correspondence to: Michael Hausman, MD, Department of Orthopaedic Surgery, Mount Sinai Hospital, 5 East 98th Street, New York, NY 10029. Fax: 212-534-6202; Phone: 212-241-1658; E-mail: michael.hausman@mssm.edu. DOI: 10.1097/01.blo.0000176143.08886.fe

14 women with an average age of 46 years (range, 34–78 years). All patients had a trial of conservative treatment for at least 9 months (range, 9–48 months). This included rest, activity modification, counterforce bracing, nonsteroidal antiinflammatory medication, and an average of two cortisone injections (range, 1–5 injections). No patients had a history of fracture or other elbow disorders. No patients were receiving workers' compensation. Physical examination revealed tenderness on deep palpation of the radiocapitellar joint or over the lateral epicondyle that was exacerbated by resisted wrist extension, especially with the elbow extended. Elbow ROM was full in all patients. Surgery was done on an outpatient basis. The technique used for the elbow arthroscopies was described by Baker and Jones.² The patient was in the supine position, and a tourniquet was used. A complete arthroscopic examination of the elbow was done. The radiocapitellar area was observed from either a proximal posterolateral or transtriceps portal. The working portal was the posterior radiocapitellar portal. The posterior portion of the radiocapitellar capsular complex was detached from the proximal ulna. This portion was removed first as this released a band of tissue which was difficult to access from the anterior compartment. The radiocapitellar capsule complex was resected distally to native annular ligament. It then was examined in flexion and extension to ensure that there was no impingement in the radiocapitellar joint. A radiocapitellar portal and an anteromedial viewing portal were used to complete débridement to the equator of the radial head. The lateral ulnar collateral ligament was protected in all cases. The capsule was resected using a combination of a banana knife, an arthroscopic radiofrequency ablator, and 4.5-mm and 3.5-mm arthroscopic shavers. Images of the degenerative radiocapitellar collar were taken using a digital camera. A schematic of the radiocapitellar capsular complex is shown in Figure 1. In five patients, a sample of the tissue was taken for histologic analysis. The operative time in this series was approximately 40 minutes. The portals were sutured with interrupted nylon sutures. The patients wore a splint for 2–3 days, and sutures were removed at 2 weeks. It was important to ensure meticulous wound closure to prevent sinus formation, particularly with the posterolateral portal.

The clinical outcome was assessed by clinical examination by an independent board-certified orthopaedic surgeon and a detailed questionnaire. Our aim was to ascertain resolution of symptoms and return to work and sporting activities. The examination included ROM, presence of focal tenderness, and evidence of posterolateral instability. Thirty patients completed the questionnaire, and 21 patients had a clinical examination. The patients who did not have a clinical examination had, at their last office visit, recovered full ROM, were asymptomatic, and completed the detailed questionnaire. Four of these patients traveled from overseas specifically for the surgery. The average length of followup was 2 years (range, 6–50 months).

Cadaveric Study

Thirty-four paired cadaveric elbows were used for this study (22 females, 12 males). The average age of the specimens was 67 years (range, 53–86 years). None of the specimens had any apparent deformity or scars indicative of previous trauma or sur-

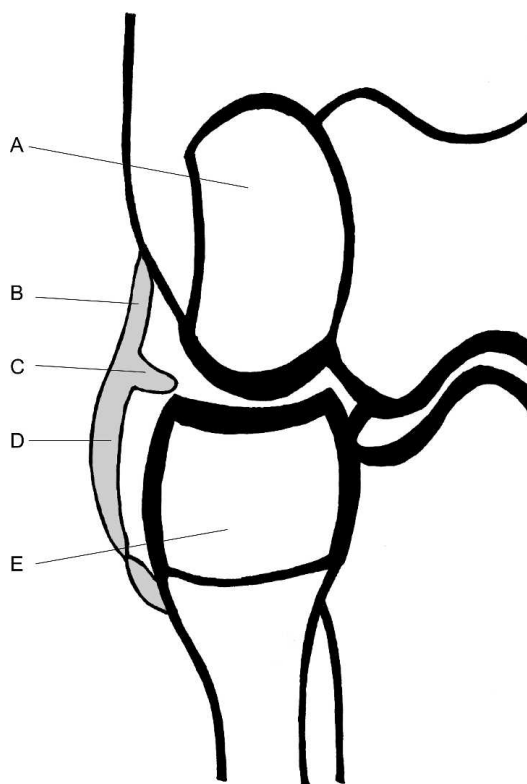


Fig 1. This schematic diagram of the radiocapitellar capsular complex shows the (A) capitellum, (B) the capsule of the radiocapitellar portion of the elbow, (C) the radiocapitellar capsular complex with meniscal-like thickening or fold, (D) the capsule of the proximal radioulnar joint, and (E) the radial head.

gery. A standard arthroscopic technique was used establishing the proximomedial portal for the 4.0-mm scope with a 30°-camera (Dyonics, Smith & Nephew Inc., Oklahoma City, OK). Saline (0.9%) was injected to maintain joint distension. The procedure was done by two board-certified orthopaedic surgeons who were experienced in elbow arthroscopy and the arthroscopic lateral epicondylitis technique. The radiocapitellar joint was examined in flexion and extension with particular attention to the annular ligament. The state of the articular surface of the radial head was recorded. The annular ligament and radial head were probed carefully using a direct lateral portal. The examination was recorded digitally to allow for evaluation by three orthopaedic surgeons. The position of the annular ligament was classified according to degree. The radiocapitellar joint was deemed normal (Type 1) if the radial head was uncovered in flexion and extension, and in full pronation and supination (Fig 2A) Type 2 variant was present if the radial head was partially covered by a loose fold that was not interposed in the radiocapitellar joint in flexion and extension (Fig 2B). Type 3 was present when the radial head was obscured by the radiocapitellar capsular complex, which became interposed in the radiocapitellar joint in flexion or extension (Fig 2C). A Type 4 arrangement was present

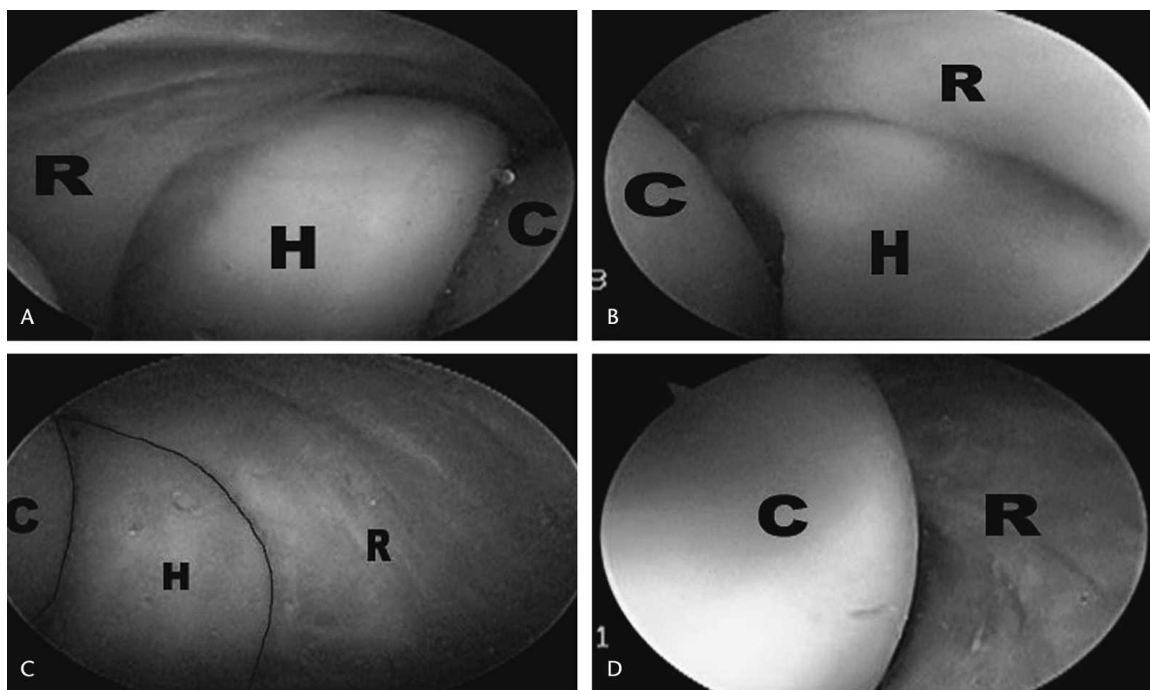


Fig 2A–D. Arthroscopic images of cadaveric elbows show the spectrum of morphologic features of the capsular ligament seen in the elbow. (A) In this image, the fully exposed radial head is seen in an elbow with Type 1 arrangement with no capsular impingement or coverage throughout ROM. (B) In an elbow with Type 2 arrangement, there is partial coverage of the radial head when the elbow is extended. (C) This arthroscopic view shows shrouding of the radial head in an elbow with Type 3 arrangement. There is subluxation of the capsular edge into the radiocapitellar joint characteristic of morphologic features of Type 3. (D) In this elbow with Type 4 arrangement, the radial head is completely obscured by the capsule in all positions of flexion and extension. The radial head is not exposed until the capsular edge is retracted or resected. R = radiocapitellar capsule complex; H = radial head; C = capitellum

when there was a fully developed thickened band that completely obscured the radial head and required extensive débridement to expose the bone (Fig 2D).

RESULTS

Clinical Study

The average time for return to work was 7 days (range, 1–21 days). No patients were receiving workers' compensation. Patients were asked to rate the outcome of the surgery as much better, better, same, or worse. Twenty-four patients reported that they were much better, four reported that they were better, and two reported that they were the same. No patient was worse than before surgery. Twenty-eight patients reported that they would have the same procedure again. Twenty-four patients who played sports before surgery found lateral epicondylitis affected their playing ability. Postoperatively, 20 patients were able to return to playing sports at the same level as before they had lateral epicondylitis, and four patients returned to playing sports at a lesser level. Twenty-four patients re-

ported they had no pain during rest or during physical activity. Four patients had no pain at rest but had occasional mild ache after physical activity. The remaining two patients had occasional pain at rest and during physical activity. One of these patients thought there was little benefit from the surgery and had an additional procedure done elsewhere. All patients regained full ROM by 3 weeks postoperatively. No patients had evidence of posterolateral instability.

Cadaveric Study

Observation of the radiocapitellar joint was successful in all 34 elbows. The radial head was completely uncovered in 19 specimens (56%), and a collar-like band was present in 15 specimens (44%). The collar was present in 10 of 22 elbows of female specimens and seven of 12 elbows of male specimens. The collar was present bilaterally in five pairs of elbows. The radial head was completely uncovered (Type I) in seven pairs of elbows. Type 2 arrangement was present in seven specimens (21%), Type 3 arrangement was present in five specimens (15%), and Type

4 arrangement was present in three specimens (9%). The articular surface of the radial head was normal in 12 specimens (35%). There were mild articular changes seen particularly on the lateral aspect of the radial head in 22 specimens (65%). These changes were in elbows with and without the radiocapitellar collar.

DISCUSSION

Investigators have suggested lateral epicondylitis occurs primarily in the common extensor origin.^{5,19,20} Numerous surgical procedures detach, debride, denervate, and alter the anatomic origin of these tendons.^{5,6,8,9,12,13,15,17-19,23} A reasonable outcome is usual after any of these procedures, although approximately 10% of patients have refractory symptoms.^{5,6} In addition, postoperative recovery is prolonged. After open procedures, patients typically have prolonged postoperative discomfort with a slow return to work and sporting activities. In all of our patients, a radiocapitellar collar was present and impinged at the radiocapitellar articulation. Histologic analyses of the resected tissue in a sample of patients showed evidence of hyaline degeneration and subsynovial fibrosis. This agreed with the arthroscopic findings of a leathery noncompliant tissue rather than an active inflammatory condition.

Results of the clinical study were encouraging. Patients had rapid return of motion and early return to work and sporting activities. It was our impression that the pathologic lesion was a degenerative capsular fold that impinged on the radial head and could be interposed in the anterior or posterior portions of the radiocapitellar joint. Compression of this tissue in or against the radiocapitellar articulation caused typical symptoms that were exacerbated by contraction of the strong wrist extensors. Presumably, forceful contraction of the overlying extensors compresses the underlying capsule against the bone, as postulated by Bosworth.⁴ Unlike other arthroscopic procedures for lateral epicondylitis, the common extensor origin was not altered or released because the tendon was observed to be grossly normal once the deeper, capsular layer was debrided.^{3,11,22}

In 1955, Bosworth described the evolution of his treatment of lateral epicondylitis from complete division of the common aponeurotic origin of the extensor muscles to simple resection of the anterolateral capsule.⁴ His change in practice was based on his experience of patients who had residual symptoms after division of the common extensor origin. He noticed that the annular ligament pinched a synovial fringe that extended into the radiocapitellar joint and speculated that the limited success of division of the common extensor origin was by reducing the tension acting on the synovial fringe rather than addressing the

primary disorder. The histologic slides of hyaline degeneration of the annular ligament in Bosworth's study⁴ were identical to those seen in our study (Fig 3).

Baker et al, using an arthroscopic technique of releasing the common extensor origin, suggested accelerated rehabilitation and return to work and other activities (average, 2.2 weeks) as the chief advantages to the procedure.³ However, as in the standard open procedure, the capsular lesion is not specifically addressed. However, release of the tendon and capsule from the lateral epicondyle and supracondylar ridge may partially decompress the underlying joint because of distal migration of the capsulotendinous complex. Ten percent of patients had pain with everyday activities, which was consistent with results of another study of open tennis elbow release.⁵

Antuna and O'Driscoll described a snapping plica caused by a hypertrophic synovial fold associated with radiocapitellar chondromalacia.¹ They reported good results from arthroscopic resection of this tissue in 14 patients. All patients had painful snapping preoperatively, and nine patients had a history of trauma. We hypothesized that this snapping plica was a variant of the spectrum of morphologic features of the radiocapitellar capsule observed in our cadaveric study. This tissue can cause symptoms of lateral epicondylitis if it impinges on the radial head or interposes in the radiocapitellar joint even in the absence of the classic snapping sensation associated with plica syndrome.

In one cadaveric study, the annular ligament was described as a complex structure lying in three strata.¹⁴ The innermost stratum is formed by the capsule of the joint,

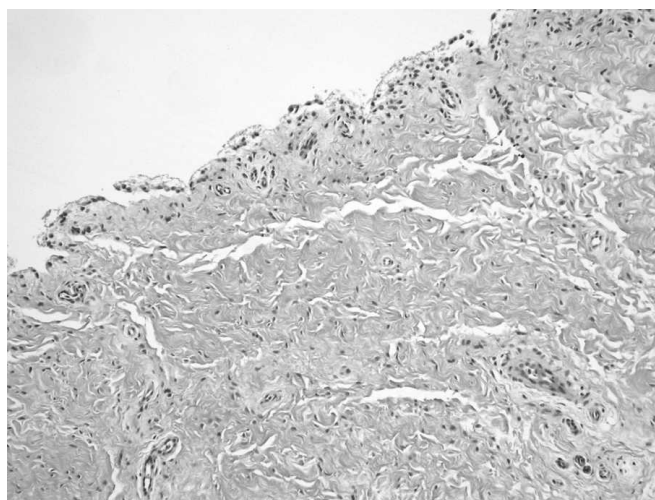


Fig 3. A section of resected radiocapitellar capsular complex shows evidence of hyaline degeneration (large arrow) and subsynovial fibrosis (small arrow) (Stain, hematoxylin and eosin; original magnification, $\times 150$).

which is continuous superiorly with the capsule of the elbow. The intermediate stratum is the annular band (annular ligament). It is attached anteriorly to the anterior margin of the radial notch of the ulna as one band, but posteriorly it frequently is subdivided into two or more bands that are attached to the posterior margin of the radial notch. The outermost stratum is derived from the lateral ligament of the elbow. Its posterior fibers form a definite bundle that usually crosses the annular band and gains attachment to the supinator crest, frequently to a special tubercle on the crest.

A synovial fold of the humeroradial joint has been described as being responsible for lateral epicondylgia of the elbow.⁷ Anatomic and histologic examinations were done in 50 cadaveric elbows. The synovial fold was found in 43 specimens and was classified according to its relationship to the radial head. The position along the superior edge of the annular ligament was circular in four specimens, dorsal in 11 specimens, laterodorsal and dorsal in six specimens, lateral to dorsal in five specimens, lateral in five specimens, ventral in four specimens, and circular in four specimens. The mean length was 21.4 mm, the mean width was 2.9 mm, and the mean maximum thickness was 1.7 mm. Boyer and Hastings also reported several interesting histologic features, and there were two distinct types of folds.⁵ In 30 specimens, the synovial fold was a rigid structure with a thick fibrous axis with fatty tissue along the attachment on the capsule and a thickened synovial layer. In 13 specimens, the fold was a pliable structure with a thin fibrous axis and a thin double-layered synovium. No specimens had fibrochondroid tissue, which dismissed the hypothesis that the tissue is analogous to a meniscus. Nerve fibers were observed in the deep part of the synovial fold above the annular ligament in close proximity to the collagen-oriented fibers of the capsule. The presence of these deep nerve fibers may explain why pain at rest may occur in patients with lateral epicondylitis although an inflammatory response is not seen histologically.

We observed the variation in the anatomy of the structures around the anterior radial head via arthroscopy. The presence of a dense radiocapitellar capsular complex impinging on or in the radiocapitellar joint was found in a minority of specimens. The lesion correlated with that resected in our arthroscopic treatment of patients with lateral epicondylitis with good results.

There are several limitations to our study. There was no knowledge of previous elbow symptoms in the cadaveric specimens, nor was there arthroscopic evidence of previous surgery or injury. In the clinical study, some patients were reluctant to return for clinical assessment, although all completed the detailed questionnaire. The study was

done in an urban center that had a highly mobile population, and four of the patients traveled from overseas specifically for treatment.

There are multiple advantages of arthroscopic division of the radiocapitellar collar. The diagnosis may be confirmed by a thorough arthroscopic examination at which time other abnormalities can be addressed. The technique causes little postoperative pain and wound healing is rapid. Range of motion is restored quickly (postoperative stiffness was not seen). The technique allows precise dissection and complete access to the entire proximal radioulnar joint and radiocapitellar joint which could be done only by an extensile open lateral approach. Although elbow arthroscopy is not done frequently, the technique may be mastered quickly by surgeons with established arthroscopic skills. The clinical results in our series compared favorably with results of standard open techniques, with a faster return to work, sporting, and leisure activities.

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