

Systematic Review

Evidence-Based Indications for Elbow Arthroscopy

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Purpose: The purpose was to review the literature on the outcomes of elbow arthroscopy and to make evidence-based recommendations for or against elbow arthroscopy for the treatment of various conditions. Our hypothesis was that the evidence would support the use of elbow arthroscopy in the management of common elbow conditions. **Methods:** A literature search was performed by use of the PubMed database in October 2010. All therapeutic studies investigating the results of treatment with elbow arthroscopy were analyzed for outcomes and complications. The literature specific to common elbow arthroscopy indications was summarized and was assigned a grade of recommendation based on the available evidence. **Results:** There is fair-quality evidence for elbow arthroscopy in the treatment of rheumatoid arthritis of the elbow and lateral epicondylitis (grade B recommendation). There is poor-quality evidence for, rather than against, the arthroscopic treatment of degenerative arthritis, osteochondritis dissecans, radial head resection, loose bodies, post-traumatic arthrofibrosis, posteromedial impingement, excision of a plica, and fractures of the capitellum, coronoid process, and radial head (grade C_r recommendation). There is insufficient evidence to give a recommendation for or against the arthroscopic treatment of posterolateral rotatory instability and septic arthritis (grade I recommendation). **Conclusions:** The available evidence supports the use of elbow arthroscopy in the management of the majority of conditions where it is currently used. The quality of the evidence, however, is generally fair to poor. **Level of Evidence:** Level IV, systematic review of Level II-IV studies.

Elbow arthroscopy was first reported in 1931 in a cadaveric study, where Burman¹ concluded that the joint was not suitable for arthroscopy. He published a subsequent article after successfully perform-

ing arthroscopy of the anterior compartment.² An improved understanding of arthroscopic anatomy and refinements in equipment and techniques in the 1970s and 1980s allowed elbow arthroscopy to become more prevalent. The peer-reviewed scientific evidence that supports the effectiveness of this procedure for most current indications remains sparse.

The current accepted indications for elbow arthroscopy include the treatment of degenerative arthritis, rheumatoid arthritis, synovitis, lateral epicondylitis, osteochondritis dissecans (OCD), radial head resection, posterolateral rotatory instability (PLRI), loose bodies, post-traumatic arthrofibrosis, posteromedial impingement, plica excision, septic arthritis, and fractures of the capitellum, coronoid, and radial head. The purposes of this study were to review the literature on the outcomes and complications of elbow arthroscopy

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TABLE 1. *Levels of Evidence for Therapeutic Studies**

Therapeutic Studies Investigating Results of Treatment	
Level I	Randomized controlled trial with significant or no significant difference but narrow confidence interval; systematic review of Level I randomized controlled trials (where study results were homogeneous)
Level II	Lesser-quality randomized controlled trial (e.g., <80% follow-up, no blinding, or improper randomization); prospective cohort study; systematic review of Level II studies or Level I studies with inconsistent results
Level III	Case-control study; retrospective cohort study; systematic review of Level III studies
Level IV	Case series
Level V	Expert opinion

*Based on data from Wright et al.⁵

for various common indications, to provide a summary of the quality of the evidence available, and to report evidence-based recommendations for or against arthroscopy. Our hypothesis was that the evidence would support the use of elbow arthroscopy in the management of common elbow conditions.

METHODS

The methodology of this study was modeled on that described in Glazebrook et al.,³ where the concepts introduced by Wright et al.^{4,5} were used to provide the evidence-based indications for ankle arthroscopy. A search of the PubMed database was performed in October 2010 for all published articles in the English language using the key words “elbow arthroscopy.” This returned 645 results. The abstracts of these articles were reviewed to identify those describing therapeutic studies reporting the results of treatment with elbow arthroscopy. Two hundred fifteen articles were identified. Further searches were performed for each condition commonly treated with elbow arthroscopy, by use of the condition as the search term, combined with the words “elbow arthroscopy.” This yielded 4 additional results.

A total of 219 articles were retrieved for analysis. The scientific articles that gave specific outcome measures for each condition were included. Review articles and case series with mixed diagnoses and pooled outcomes without separation of results for each individual condition were excluded. Ninety-eight articles met the aforementioned inclusion criteria.

All articles were reviewed for complications and outcomes, such as pain, range of motion (ROM), and strength. Each article was assigned a Level of Evi-

dence (I to IV) using the criteria specified by Wright et al.⁵ (Table 1). We then performed an analysis of the reviewed literature by examining the risk versus benefit of elbow arthroscopy for a particular indication and the level of evidence on which this information is based. This analysis was summarized for each particular elbow arthroscopy indication by assigning a grade of recommendation (A, B, C_f, C_a, C_c, or I) (Table 2) as originally proposed by Wright⁴ and modified by Stevens et al.⁶ The grade of recommendation is based on the strength of the available evidence and the magnitude of net benefit (benefits minus harms).

RESULTS

There is fair-quality evidence for the recommendation for elbow arthroscopy in the treatment of rheumatoid arthritis and lateral epicondylitis (grade of recommendation, B). There is weak evidence for, rather than against, the use of elbow arthroscopy in the treatment of degenerative arthritis, OCD, radial head resection, loose bodies, post-traumatic arthrofibrosis, posteromedial impingement, excision of plica, and fractures (grade C_f). There is insufficient evidence to make a recommendation for the treatment of PLRI or septic arthritis (grade I). A summary of the grades of recommendation for or against the current generally accepted indications for elbow arthroscopy is presented in Table 3.

Degenerative Arthritis

Levels of Evidence I to III: Cohen et al.⁷ performed a prospective cohort study (Level II) compar-

TABLE 2. *Grades of Recommendation for Summaries or Reviews of Orthopaedic Studies**

Description	
A	Good evidence (Level I studies with consistent findings) for or against recommending intervention
B	Fair evidence (Level II or III studies with consistent findings) for or against recommending intervention
C _f	Poor-quality evidence (Level IV or V studies) recommending for intervention
C _a	Poor-quality evidence (Level IV or V studies) recommending against intervention
C _c	Conflicting evidence (Level IV or V studies) not allowing a recommendation for or against intervention
I	Insufficient evidence to make a recommendation

*Based on data from Wright et al.⁴ and Stevens et al.⁶

TABLE 3. Summary of Evidence-Based Recommendations and Grades for or Against Current Generally Accepted Indications for Elbow Arthroscopy

Procedure	Recommendation	Grade of Recommendation
Degenerative arthritis	For arthroscopy	C _f
Rheumatoid arthritis	For arthroscopy	B
Lateral epicondylitis	For arthroscopy	B
OCD	For arthroscopy	C _f
Radial head resection	For arthroscopy	C _f
PLRI	Insufficient evidence to make recommendation	I
Loose bodies	For arthroscopy	C _f
Posttraumatic arthrofibrosis	For arthroscopy	C _f
Posteromedial impingement	For arthroscopy	C _f
Excision of plica, meniscus, or annular ligament	For arthroscopy	C _f
Septic arthritis	Insufficient evidence to make recommendation	I
Fractures	For arthroscopy	C _f

ing open and arthroscopic elbow debridement, both with fenestration of the distal humerus. Of the patients, 18 underwent the open procedure and 26 underwent the arthroscopic procedure. Of the 44 procedures, 39 (88.6%) were performed for primary osteoarthritis, with the remainder being post-traumatic. Overall, the open procedure was better than the arthroscopic procedure for flexion ROM (mean improvement in flexion range of 15° v 4°, $P < .05$). There were no statistically significant differences in pain or ROM, although the data suggested that patients undergoing the arthroscopic procedure had greater pain relief and patients undergoing the open procedure had better overall ROM. There was no significant difference in patient satisfaction between the procedures. The only complication was a repeat operation in a patient who underwent an open debridement procedure 2 years earlier for a “poor result.”

McLaughlin et al.⁸ examined patients with primarily radiocapitellar degenerative arthritis and performed a retrospective cohort study (Level III) to compare debridement and arthroscopic radial head excision with (28 elbows) and without (8 elbows) fenestration of the distal humerus. Patients who had radial head excision alone had statistically greater improvement in ROM (mean arc improvement, 62°)

than those with excision and fenestration (mean arc improvement, 46°) ($P = .002$). The outcome scores improved in both groups; however, a statistical comparison of the scores was not performed by the authors. In the fenestration group, 2 patients (7.1%) were dissatisfied and required reoperation, 1 for contracture release and 1 for radial head replacement because of intractable pain.

Level of Evidence IV: Phillips and Strasburger⁹ published a case series on the arthroscopic removal of loose bodies in degenerative and post-traumatic conditions. This article is discussed in greater detail in the “Loose Bodies” section below. In short, the authors reported greater improvements in ROM in patients who had loose bodies removed and osteophytes debrided for post-traumatic stiffness as compared with degenerative arthritis.

We identified 11 case series that reported the results of patients undergoing arthroscopic treatment for degenerative arthritis.¹⁰⁻²⁰ Excluding the article by Jerosch et al.,¹⁴ which did not give specific numbers of patients, these encompassed 182 patients, of whom 140 (76.9%) had good to excellent results. Of the patients, 7 (3.8%) had complications, which included 3 patients with heterotopic ossification (HO), 2 with transient median nerve dysesthesias, and 2 with superficial portal-site infections.

Jerosch et al.¹⁴ evaluated the results of 103 elbow arthroscopies for mixed diagnoses. They analyzed patients with degenerative arthritis as a separate group, although they did not state how many patients this encompassed. They found that pain and function improved significantly in the degenerative arthritis group but strength and ROM did not. In their overall group, 9 patients (8.7%) had transient dysesthesias: 2 median, 2 ulnar, and 5 radial.

Summary: The results of arthroscopic treatment for osteoarthritis are encouraging. The single article comparing arthroscopic and open debridement reported improved ROM by a mean of 11° in the open group. Pain levels, though, suggested greater improvement in the arthroscopic group. The most common complications of arthroscopic treatment of degenerative arthritis were transient neurologic dysfunction and HO. In summary, there is poor-quality evidence for, rather than against, the arthroscopic treatment of degenerative arthritis.

Grade of Recommendation: C_f.

Rheumatoid Arthritis

Levels of Evidence I to III: Tanaka et al.²¹ conducted a prospective cohort study (Level II) compar-

ing arthroscopic (n = 29) and open (n = 29) synovectomy in patients with rheumatoid arthritis of Larsen grade 2 or less. Both groups had an improvement in ROM, pain, and function as a result of surgery. There were no statistically significant differences between the groups in any parameter, although it was observed that there were better pain scores in the arthroscopic group and better overall function and motion in the open group. In a subgroup of patients with a preoperative flexion arc of less than 90°, the authors found that patients treated arthroscopically had a significantly higher level of function than those treated with open surgery. Synovitis recurred in 6 patients (20.7%) in the arthroscopic group and in 3 patients (10.3%) in the open group; statistical analyses comparing these outcomes were not reported. There were 2 transient neurapraxias (6.9%) (1 ulnar and 1 radial) in the arthroscopic group and 1 (3.4%) superficial infection in the open group.

Nemoto et al.²² performed a retrospective cohort study (Level III) comparing arthroscopic synovectomy in patients with rheumatoid arthritis of Larsen grades 1 through 3 (group 1, n = 6) and Larsen grade 4 (group 2, n = 5). Patients were assessed with a visual analog scale for pain, a functional score, and evidence of radiographic deterioration. They found that patients in both groups had significant improvements in pain visual analog scale and function. The motion arc improved in group 1 but not in group 2, whereas the rotation arc did not change in either group. Group 2, but not group 1, showed substantial progression of joint destruction. No complications occurred in either group. The authors concluded that arthroscopic synovectomy is a beneficial procedure for rheumatoid arthritis, even in cases as advanced as Larsen grade 4.

Level of Evidence IV: Six case series met the inclusion criteria for this article, consisting of a total of 52 patients.²³⁻²⁸ Of these, 35 patients (67.3%) had a good to excellent result and 1 was said to have a “partial and satisfactory improvement.”²⁴ There were 3 transient ulnar nerve complications (5.8%)²⁵ and 1 transection of the anterior interosseous nerve portion of the median nerve (1.9%).²⁸ Kang et al.²⁶ reported continued pain and synovitis with progression of joint destruction in 4 of 26 patients (15.4%) treated with arthroscopic synovectomy. Two of these patients required a repeat synovectomy, the third patient underwent a total elbow arthroplasty, and the fourth patient declined further operative intervention.

In addition to the previously mentioned case series, Lee and Morrey²⁹ reported on the outcome of ar-

throscopic synovectomy in 14 patients aged under 65 years with rheumatoid arthritis or juvenile idiopathic arthritis, with a mean follow-up of 42 months. Although the authors reported that 14 patients (100%) had mild or no pain at early postoperative follow-up, pain increased over time; at final follow-up, just 9 patients (64.3%) had mild or no pain. Likewise, 13 patients (92.9%) had good to excellent functional outcome at early follow-up, compared with 8 patients (57.1%) at final follow-up.

Summary: There are consistent findings across multiple studies with Levels of Evidence from II to IV that arthroscopic synovectomy for rheumatoid arthritis is beneficial. We do note, however, that the results overall are not as positive for arthroscopic treatment of rheumatoid arthritis as for other conditions of the elbow. Therefore there is fair-quality evidence to recommend for, rather than against, the arthroscopic treatment of rheumatoid arthritis of the elbow.

Grade of Recommendation: B.

Lateral Epicondylitis

Levels of Evidence I to III: Peart et al.³⁰ performed a cohort study (Level III) comparing open extensor carpi radialis brevis (ECRB) release and debridement with extensor mechanism repair (n = 46) versus arthroscopic ECRB release with limited synovectomy (n = 29). The groups were compared with regard to pain, weakness, satisfaction, return to work, and duration of postoperative therapy. There was no statistically significant difference in results between the groups, although it was observed that there was an earlier return to work in the arthroscopic group (1.7 weeks v 2.5 weeks for the open procedure). Good to excellent results were found in 72% of arthroscopic cases and 69% of open cases, with no complications in either group.

Rubenthaler et al.³¹ published a cohort study (Level III) comparing arthroscopic (n = 20) and open (n = 10) ECRB tendon release. There was no significant difference between the groups in terms of good to excellent results (75% and 60%, respectively), pain scores, elbow function rating, surgical time, return to work, functional outcome scores, ROM, and tenderness. The arthroscopic group had 1 postoperative hematoma and 1 superficial portal infection.

Level of Evidence IV: There are 8 published case series describing the outcomes of arthroscopic management of lateral epicondylitis.³²⁻³⁹ These encompass 189 patients, of whom 174 (92.1%) achieved a good to excellent result. Only 1 complication (0.5%) was reported, transient “forearm paresthesias.”³⁶ Baker and

Baker³² published an article in 2008 reporting on the long-term outcomes (mean, 130 months) of a series of patients who had undergone arthroscopic ECRB release. This was a subset of the patients previously reported on in 2000.³³ Of the 39 patients originally reported on, 30 were available for longer-term follow-up for the second article. Patient satisfaction remained high, with 26 patients (86.7%) reporting that they were satisfied and 28 patients (93.3%) stating that they would undergo the surgery again. In addition, 29 patients (96.7%) reported that they were better or much better, as compared with 37 (94.9%) in the original publication. This case series showed a lasting effect after arthroscopic ECRB release.

Summary: The published data on arthroscopic procedures for ECRB tendon release show similar results when compared with open operations. Case series data consistently report high levels of good to excellent outcomes. However, there are no reports comparing arthroscopic management versus nonoperative management. Therefore there is fair-quality evidence to recommend for, rather than against, the arthroscopic treatment of lateral epicondylitis. We have assigned a grade B recommendation for arthroscopic treatment of lateral epicondylitis on the basis that it appears to result in similar outcomes to open surgery.

Grade of Recommendation: B.

OCD of Capitellum

Levels of Evidence I to III: Takahara et al.⁴⁰ published a retrospective cohort study (Level III) comparing 2 groups. The first group (n = 70) was treated operatively by arthroscopic removal of loose bodies, as well as debridement and/or fixation of the OCD lesion. The second group (n = 36) was treated nonoperatively, including rest and activity modification. The decision to treat a patient operatively or nonoperatively was made based on the severity of symptoms and signs. For patients with a closed physis, operative management provided better pain relief and return to sports than nonoperative management. Among the operative patients, those who had fixation or reconstruction of the articular surface had significantly better results ($P < .05$) than those who had fragment removal alone. Patients treated nonoperatively who followed advice to rest the elbow were significantly better ($P < .05$) than those who did not follow these instructions with respect to pain, radiographic findings, and healing. Nonoperatively treated patients with an open physis fared significantly better than those with a closed physis with regard to healing ($P < .001$),

pain ($P < .01$), return to sports ($P < .05$), and radiographic findings ($P < .05$).

Level of Evidence IV: Twenty case series have reported the results of arthroscopic treatment of OCD as a distinct group.^{18,23,24,41-57} These studies described the outcomes for a total of 163 patients, of whom 129 (79.1%) had good to excellent results. Of the patients, 6 (3.7%) required a repeat operation for arthrofibrosis, repeat debridement, or excision of the radial head. In addition, 2 nerve complications (1.2%) were reported, including 1 posterior interosseous nerve neurapraxia and 1 ulnar nerve neurapraxia.

Summary: The literature generally reports good results of arthroscopic management of OCD; however, the quality of evidence is predominantly low, with mainly Level IV studies. The single Level III study reported better results for patients with closed physes treated arthroscopically as compared with those treated nonoperatively. Therefore, on the basis of the available literature, we recommend for, rather than against, the arthroscopic treatment of capitellar OCD.

Grade of Recommendation: C_r.

Radial Head Resection

Level of Evidence III: A study by McLaughlin et al.⁸ involving patients with radiocapitellar arthritis was previously discussed in the "Degenerative Arthritis" section earlier. This retrospective cohort study showed improved ROM in patients who underwent arthroscopic radial head excision without fenestration of the distal humerus.

Level of Evidence IV: There are 2 published articles describing the results of radial head resection in 13 elbows.^{58,59} Lo and King⁵⁸ described the first case report of arthroscopic radial head resection, with the patient gaining approximately 60% pain relief and being able to return to work. Menth-Chiari et al.⁵⁹ described 11 patients with complete arthroscopic resection and 1 with partial radial head resection for post-fracture pain or for rheumatoid arthritis. The 11 patients with complete resection had therapeutic benefit and were satisfied with their result. The patient with an incomplete resection did not improve clinically and was dissatisfied.

Summary: Although studies are limited to date, there is evidence of effectiveness for the arthroscopic excision of the entire radial head. Therefore, on the basis of the available literature, we recommend for, rather than against, arthroscopic radial head excision. Unfortunately, the quality of the evidence is poor or weak.

Grade of Recommendation: C_r.

Posterolateral Rotatory Instability

Levels of Evidence I to III: Savoie et al.⁶⁰ reported on a cohort study (Level III) comparing arthroscopic repair or plication of the lateral ulnar collateral ligament (LUCL) in 24 patients versus open repair, plication, or reconstruction in 30 patients. They reported significant improvements in the Andrews-Carson scores in each group, with no statistically significant difference between groups.

Level of Evidence IV: We identified just 1 case series reporting arthroscopic management of PLRI. Spahn et al.⁶¹ performed electrothermal shrinkage of the LUCL in 21 patients and followed up with clinical outcome scores and radiographic evaluation. They reported that the clinical outcome score increased from 40 preoperatively to 77 postoperatively, with 11 patient outcomes (52.4%) classified as “good” and 10 (47.6%) as “moderate.” They found that the mean distance between the capitellum and radial head on standardized varus stress radiographs decreased significantly from 13 mm preoperatively to 2 mm postoperatively.

Summary: Given the publication of only 1 article studying repair, plication, or reconstruction of the LUCL and 1 article reporting electrothermal shrinkage with only moderate success, there is insufficient evidence for anything other than a grade I recommendation for arthroscopic treatment of PLRI.

Grade of Recommendation: I.

Loose Bodies

Elbow arthroscopy is uncommonly performed for removal of loose bodies in isolation. Typically, loose body removal is done in conjunction with other arthroscopic procedures. Several articles did not report outcomes specifically for patients who underwent isolated loose body removal and were therefore excluded from our analysis. There were no published articles that compared arthroscopic versus open removal of loose bodies.

Level of Evidence IV: Flury et al.⁶² compared arthroscopic removal of loose bodies for synovial chondromatosis with a historical control group that underwent open loose body removal. They found a significant reduction in the mean duration of postoperative pain in the arthroscopic group of 2.4 months compared with 4.6 months in the open group ($P = .014$). The data also suggested that there was higher patient satisfaction in the arthroscopic group. There

were no significant differences in ROM, pain relief, patient outcome measures, or complications.

Phillips and Strasburger⁹ reported on the arthroscopic removal of loose bodies and debridement of osteophytes in patients with post-traumatic stiffness and degenerative arthritis. All patients had improved pain and motion postoperatively. However, patients with post-traumatic stiffness started with a poorer ROM (mean, 38° to 117°; arc, 79°) than patients with degenerative arthritis (mean, 22° to 120°; arc, 98°) but improved to a greater degree, yielding similar final ROM values for post-traumatic stiffness patients (mean, 7° to 135°; arc, 128°) and degenerative arthritis patients (mean, 8° to 133°; arc, 125°, respectively).

There were 12 case series reporting the outcomes of loose body removal alone^{12,24,51,56,63-70} and 9 case series reporting the outcomes of loose body removal along with other associated procedures, such as debridement of osteophytes or chondroplasty.^{11,15,18,19,28,43,50,54,71} The articles reporting removal of loose bodies alone totaled 109 patients, of whom 98 (89.9%) had good to excellent results or improved significantly. The articles reporting loose body removal in association with other procedures totaled 150 patients, of whom 110 (73.3%) had good to excellent results or improved significantly.

Although Andrews et al.⁷² did not report the outcomes of loose body removal separate from the remainder of the patients in their case series, they noted that patients who underwent loose body removal had the highest rate of good to excellent outcomes, along with patients who had removal of olecranon osteophytes, when compared with patients operated on for other diagnoses. O’Driscoll and Morrey¹⁸ reported that patients who had loose bodies as their primary diagnosis or in conjunction with OCD fared better than those who had loose bodies in conjunction with post-traumatic arthritis, degenerative arthritis, idiopathic joint contracture, or synovial chondromatosis.

The complications of arthroscopic loose body removal reported in the literature include 1 patient with a postoperative infection requiring irrigation and debridement, with a final outcome reported as worse than preoperative.⁶⁵ Other complications reported include transection of the anterior interosseous nerve,²⁸ 2 transient median nerve¹⁵ and 4 transient radial nerve^{18,54} palsies, 2 cases of transient forearm numbness (1 median nerve and 1 lateral antebrachial cutaneous nerve),⁶⁸ persistent wound drainage with negative cultures,¹⁸ HO requiring open removal,¹¹ and a

postoperative ROM worse than the preoperative range.¹⁸

Summary: The available literature reports generally good outcomes with the arthroscopic removal of loose bodies; however, a few studies do show significant complications. Therefore, on the basis of the literature, we recommend for, rather than against, arthroscopic loose body removal. Unfortunately, the quality of the evidence is poor or weak.

Grade of Recommendation: C_f.

Post-traumatic Arthrofibrosis

Level of Evidence IV: The study of Phillips and Strasburger⁹ was discussed in greater detail in the previous section. Patients who had removal of loose bodies and debridement of osteophytes for post-traumatic stiffness had a greater degree of improvement in ROM than did patients with degenerative arthritis.

Ten case series were identified, reporting on 463 patients, of whom 424 (91.6%) had good to excellent results.^{12,18,63,73-80} Geib and Savoie⁷⁶ reported a case series of 388 patients, of whom 93% reported satisfactory results. This series, however, was mentioned in passing as part of an instructional course article, and details of the patients were not given. Two publications were single case reports of nerve transections due to elbow arthroscopy for post-traumatic arthrofibrosis.^{75,77} Gay et al.⁷⁵ reported a case of ulnar nerve transection in a patient who had an arthroscopic elbow release after a previously failed open release without ulnar nerve transposition with postoperative radiation therapy for HO prophylaxis. Haapaniemi et al.⁷⁷ reported a case of arthroscopic median and ulnar nerve transections in a patient with recalcitrant stiffness after open reduction and internal fixation of a proximal ulnar fracture who had also undergone previous hardware removal. The only other reported complication was a single case of superficial infection, which required drainage and antibiotics.⁷³

Summary: The available literature reports good outcomes in the majority of patients managed with arthroscopic techniques. We do, however, recommend extreme caution because elbow anatomy may be distorted in post-traumatic conditions, increasing the risk of complications. Therefore, on the basis of the available literature, which is classified as poor, we weakly recommend for, rather than against, the arthroscopic treatment of post-traumatic arthrofibrosis.

Grade of Recommendation: C_f.

Posteromedial Impingement

Level of Evidence IV: There is overlap of the diagnosis of posteromedial impingement with that of

degenerative arthritis and loose bodies. We identified 6 studies describing case series where a total of 46 patients underwent arthroscopy for posteromedial impingement and were reported as a distinct group.^{19,81-85} At variable follow-up, 41 patients (89.1%) were reported as having good to excellent outcomes.

Two of the articles were case reports on patients who had significant complications. Hahn and Grossman⁸² described a patient who sustained a 5-cm-long ulnar nerve transection that was reconstructed with sural nerve cable grafts. Sodha et al.⁸⁴ described a 17-year-old boy in whom HO developed after an arthroscopic debridement.

Summary: The described case series overall report good outcomes, but there is the possibility of devastating complications because of the proximity of the ulnar nerve. A thorough knowledge of the anatomy of the region is required when performing this procedure arthroscopically. There is low-level evidence to recommend for, rather than against, the arthroscopic management of posteromedial impingement.

Grade of Recommendation: C_f.

Excision of Plica

Level of Evidence IV: Nine studies evaluated outcomes after excision of plicae.⁸⁶⁻⁹⁴ Seven case series evaluated outcomes after arthroscopic excision of plicae, with 39 (88.6%) of the 44 patients having a good to excellent result.^{86,88-90,92-94}

Aoki et al.⁸⁷ reported on 2 brothers who had painful snapping plicae. Each underwent an in situ ulnar nerve release and arthroscopy, which identified the plica. However, the plica was excised in only 1 patient, and he returned to baseball pitching without any further snapping. The patient who did not have the plica excised returned to baseball pitching with persistent symptoms of snapping. Kang and Kim⁹¹ compared 2 patients with a painful snapping meniscus at the radiocapitellar joint. One was treated by open excision and the other by arthroscopic excision, both with complete resolution of symptoms.

Summary: On the basis of the available literature, with good outcomes and no reported complications in the Level IV studies, we recommend for, rather than against, the arthroscopic treatment of elbow plicae.

Grade of Recommendation: C_f.

Septic Arthritis

Level of Evidence IV: There are only 2 articles describing the outcomes of 3 patients who underwent arthroscopic management of septic elbow arthri-

tis.^{95,96} Jerosch et al.⁹⁵ described 2 patients aged 4 and 28 years who had septic arthritis of the elbow due to hematogenous spread of *Staphylococcus aureus*. After a single arthroscopic irrigation and debridement and with postoperative antibiotics, both patients improved and regained full ROM. Mastrokalos et al.⁹⁶ described a patient with a postoperative deep infection 2 months after a total elbow arthroplasty. This resolved after a single arthroscopic irrigation and debridement in combination with intravenous and oral antibiotics, with the patient achieving ROM of 10° to 120° with a stable implant.

Summary: Although arthroscopic management of septic arthritis in other joints has been shown to be of benefit, there is insufficient published information on the use of arthroscopy in septic arthritis of the elbow to justify a recommendation.

Grade of Recommendation: I.

Fractures

The published literature on the arthroscopic management of elbow fractures is limited to case reports and small case series. There are no articles comparing open versus arthroscopic techniques. In each of these fractures, there is insufficient evidence to recommend arthroscopic treatment over open management.

Capitellar Fractures: The literature reports 2 patients with arthroscopic excision of capitellar fracture fragments⁹⁷ and 1 with arthroscopic reduction and internal fixation (ARIF).⁹⁸ Both patients with excision attained stable elbows with near-full ROM and only mild pain. The patient who underwent ARIF went on to achieve healing and had final ROM from 15° to 140°.

Coronoid Fractures: There are 4 articles reporting on arthroscopic excision^{12,99,100} or ARIF^{99,101} of coronoid fractures. All patients who underwent excision (n = 5) or ARIF (n = 8) had satisfactory outcomes with acceptable ranges of motion. Additional procedures were required for lateral collateral ligament imbrication (n = 1) or ulnar nerve transposition (n = 1), although it was not specified whether these were patients who had been initially treated with excision or ARIF.⁹⁹

Radial Head Fractures: There is one article reporting a case series of 3 patients who had arthroscopic excision of radial head fragments.¹² There are 3 articles reporting 21 patients who underwent ARIF procedures.¹⁰²⁻¹⁰⁴ Each article reported a 100% rate of good to excellent outcomes.

Summary: Although the evidence is weak, we did not find any evidence of poorer outcomes as a result of arthroscopic treatment. Therefore, on the basis of the available literature, we can recommend for, rather than against, the arthroscopic treatment of elbow fractures. However, the arthroscopic management of elbow fractures is a technically challenging procedure and should be reserved for experienced arthroscopists.

Grade of Recommendation: C_f.

DISCUSSION

Like arthroscopy of other joints, elbow arthroscopy is an attractive way to access the joint without a larger incision and the perceived morbidity of an arthrotomy.¹⁸ The proximity of neurovascular structures makes elbow arthroscopy potentially more risky than arthroscopy of other joints.¹⁸ The literature is littered with reports of severe neurologic injuries as a result of elbow arthroscopy.^{46,57,75,77,82}

It is only in the past few decades that elbow arthroscopy has become more commonly used, because of improvements in instrumentation and techniques. The literature regarding the arthroscopic treatment of conditions of the elbow is still limited, and comparative studies have emerged only during the past 10 years.^{7,8,21,22,30,31,40,60,62,91} Only some of these studies directly compare the outcomes of arthroscopic and open procedures.^{7,21,30,31,60,62,91}

The strength of this study lies in its comprehensive review of the elbow arthroscopy literature. All of the identified articles were reviewed for indications, outcomes, and complications. Synthesis of these data, including the assigned level of evidence, allowed an evidence-based recommendation for or against arthroscopy for each commonly recognized indication.

A limitation of this study may be the use of the modified grade-of-recommendation scale.⁶ We believe the original scale described by Wright⁴ is overly stringent. In the original scale, a C grade of recommendation was described as conflicting or poor-quality evidence not allowing a recommendation for or against surgery. Because the majority of orthopaedic literature is classified as having a Level of Evidence of IV, a recommendation for or against cannot be made based on Wright's original scale. Therefore the modified scale of Stevens et al.⁶ appears to be more relevant to the orthopaedic literature. The modified scale divides Wright's grade C recommendation into 3 subgrades (Table 2): C_f, poor-quality evidence recommending for intervention; C_a, poor-quality evidence recommending against intervention; and C_e,

conflicting evidence not allowing a recommendation for or against the intervention. We agree with Stevens et al. that early research into novel procedures can still guide readers as to the direction in which Level IV evidence is trending before the publication of higher-quality Level I to III evidence. An additional limitation is that we restricted our queries to articles in the English language, and therefore good-quality studies in other languages may have been missed.

This article presents the current state of evidence supporting the use of elbow arthroscopy. A comprehensive review of the English-language literature has produced 92 Level IV studies, 5 Level III studies, and 1 Level II study on the outcomes of elbow arthroscopy for various conditions. Our analysis gives a grade B recommendation for, rather than against, elbow arthroscopy in the treatment of rheumatoid arthritis and lateral epicondylitis. The analysis concluded a grade C_f recommendation for, rather than against, elbow arthroscopy for the treatment of degenerative arthritis, OCD, radial head resection, loose bodies, post-traumatic arthrofibrosis, posteromedial impingement, fractures, and plicae. Insufficient evidence (grade I) to make a recommendation for or against elbow arthroscopy was found for PLRI and septic arthritis. Unfortunately, this article also draws attention to the deficiency of high-level studies on elbow arthroscopy. Therefore we encourage clinicians and researchers to conduct studies of arthroscopy with higher levels of evidence.

CONCLUSIONS

The available evidence supports the use of elbow arthroscopy in the management of the majority of conditions where it is currently used. The quality of the evidence, however, is generally fair to poor.

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