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Open vs Percutaneous vs Arthroscopic Surgical Treatment of Lateral Epicondylitis: An Updated Systematic Review

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Take-Home Points

- While favorable results have been reported for open, arthroscopic, and percutaneous surgical techniques, there is no current consensus regarding the optimal technique for lateral epicondylitis.
- There is no difference between open, arthroscopic, and percutaneous surgical treatment for lateral epicondylitis regarding return to work and subjective satisfaction.
- Open treatment led to a greater percentage of patients being pain free at final follow-up.
- While arthroscopic treatment led to better pain and functional scores at final follow-up, the absolute differences were quite small and likely not clinically significant.
- We recommend open débridement as the best means of minimizing cost and achieving a pain-free outcome in the long-term.

Lateral epicondylitis affects 1% to 3% of adults each year. Although common, symptoms of lateral epicondylitis resolve spontaneously within a year of symptom onset in 80% of cases, and only 3% of patients who seek medical

treatment ultimately require surgical intervention within 2 years of symptom onset.¹ Despite a relatively low percentage of patients who require surgery, Sanders and colleagues¹ noted a significant increase in the rate of surgical intervention from 1.1% to 3.2% of cases in the last 15 years. Surgical intervention is generally indicated when pain and functional disability persist after 6 to 12 months of nonsurgical treatment. Traditional surgical treatment involves open release/débridement of the extensor carpi radialis (ECRB) origin; however, with the increasing prevalence of surgical intervention, surgeons have demonstrated a rising interest in less invasive techniques like arthroscopic release/débridement and percutaneous tenotomy as alternatives to traditional open débridement. While favorable results have been reported for all 3 techniques, there is no current consensus regarding the optimal surgical technique. In 2007, Lo and Safran² reported no difference in the results of open, percutaneous, and arthroscopic techniques regarding any outcome measure in a systematic review of 33 papers. We conducted a repeat systematic review of the current literature to update Lo and Safran's² review and to ascertain if more recent literature demonstrates superiority of 1 technique regarding pain relief, subjective questionnaire data, subjective satisfaction, restoration of strength, and return to work. We hypothesized that return to work would be accelerated, pain decreased, and function improved in the early postoperative period in the arthroscopic and percutaneous groups, but there would be no difference in ultimate pain, functional outcome, or subjective satisfaction.

Methods

Search Strategy and Study Selection

We conducted a systematic review of the literature to update the topic of surgical intervention with lateral epicondylitis since the publication of the most recent review by Lo and Safran² in 2007, which included all relevant studies published up to 2004. To include all relevant studies published since that time, we searched PubMed (MEDLINE) for all literature published from January 1, 2004 to May 23, 2015 using the following key words: *lateral epicondylitis* AND (*surgery* OR *operative* OR *surgical* OR *open* OR *arthroscopic* OR *percutaneous*). General search terms were utilized to avoid unintentional exclusion of relevant studies. Two authors reviewed the abstracts of all resultant citations. **Table 1** outlines the inclusion and exclusion criteria for the search. References from all included studies were reviewed for applicable articles that were not captured by the initial broad search strategy. A Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) trial flow chart shows the study selection algorithm (**Figure 1**).

Data Extraction and Analysis

Data were extracted from the included studies by 2 reviewers using data abstraction forms. All study, subject, and surgery parameters were collected. The study and subject demographic parameters analyzed included year of publication, level of evidence, presence of study financial conflict of interest, number of subjects and elbows, gender, age, proportion in whom the dominant extremity was involved, proportion who were laborers, proportion who had a workman's compensation claim, duration of symptoms prior to surgical intervention, and surgical technique employed (open, arthroscopic, or percutaneous). We recorded the following clinical outcomes: proportion of patients with complete pain relief, proportion who were partially or completely satisfied, proportion who were improved, duration to return to work, grip strength, Disabilities of the Arm, Shoulder, and Hand (DASH) score, visual analog scale (VAS) pain score, and complication rate.

Statistical Analysis

Data from all studies were pooled and descriptive statistics were reported as weighted mean \pm weighted standard deviation for continuous variables and frequency with percentage for categorical variables. A meta-analysis was performed for all outcome measures that were reported in 3 or more studies within a specific treatment cohort. Data were analyzed using 2-sample and 2-proportion Z-tests. Results were considered statistically significant at $P < .05$.

Results

Literature Search

Using the aforementioned search strategy, 154 studies were identified. Following application of the inclusion and exclusion criteria, 35 studies were included in the analysis (Figure 1). One study compared open and percutaneous techniques, and another compared arthroscopic and percutaneous techniques, rendering a total of 19 studies examining open surgical techniques for treatment of lateral epicondylitis,³⁻²¹ 12 studies examining arthroscopic techniques,^{14,22-32} and 6 studies reporting percutaneous surgical treatment of lateral epicondylitis^{29,33-37} (Table 2). There was 1 level I study (3%), 6 level III studies (17%), and 28 level IV studies (80%).

Subject Demographics

The 35 included studies comprised 1579 patients and 1640 elbows. Among these, 1055 (64%) elbows underwent open (O), 401 (25%) underwent arthroscopic (A), and 184 (11%) underwent percutaneous (P) treatment. The average age was 45.7 years, 47% of the patients were male, 43% were laborers, 31% had worker's compensation claims, and the dominant extremity was involved in 62% of patients. The percutaneous cohort was older than the open cohort ($P = 46.9$, $O = 45.4$, $A = 45.8$; $P = .036$). The duration of symptoms was shorter in the percutaneous cohort than in the other 2 groups and shorter in the arthroscopic cohort than in the open cohort ($P = 8$ months, $O = 23$ months, $A = 18$ months; $P < .001$). There were no significant differences between groups regarding gender, occupation, worker's compensation status, or involvement of the dominant extremity (Table 3).

Meta-Analysis of Clinical Outcomes

Clinical outcome results were pooled for all studies reporting the same outcome measure for the same technique (open, arthroscopic, or percutaneous). A meta-analysis was performed for all outcome measures that were reported in a minimum of 3 studies utilizing the same surgical technique (Table 4).

Pain Relief

Thirteen open studies,^{3,5,7,8,11-16,18,19,21} 7 arthroscopic studies^{14,22-24,26,27,31} and 0 percutaneous studies reported the proportion of patients who were pain free at final follow-up. The proportion of patients who were pain free following open débridement was greater than that in the arthroscopic cohort ($O = 70\%$, $A = 60\%$; $P = .009$) (Table 4).

Subjective Improvement and Satisfaction

Nine open studies, 6 arthroscopic studies, and 1 percutaneous study reported the proportion of patients who felt that their condition had been improved as a result of surgery. There was no difference in the proportion of patients who experienced improvement between the open and arthroscopic cohorts. Four open studies,^{3,11,12} 5 arthroscopic studies,^{22,26,28,29,32} and 2 percutaneous studies^{29,36} reported the proportion of patients who were satisfied or partially satisfied with the results of the procedure. There was no difference between the open and arthroscopic groups in the proportion of patients who were satisfied or partially satisfied (Table 4).

Return to Work

The duration to return to work following surgery was reported in 5 open studies,^{4,5,10,13,14} 9 arthroscopic studies,^{14,23-29,32} and 2 percutaneous studies.^{29,36} There was no statistically significant difference between the open and arthroscopic groups with regard to duration to return to work (O = 6.5 weeks, A = 6 weeks; $P = .601$). The percutaneous technique could not be included in the meta-analysis due to the presence of only 2 studies, but the pooled mean duration to return to work in these 2 studies was 5.5 weeks (Table 4).

Grip Strength

Postoperative grip strength was reported in 2 open studies,^{10,19} 4 arthroscopic studies,^{28,30,32} and 2 percutaneous studies.³⁵⁻³⁶ A meta-analysis could not be performed on all the groups due to the presence of only 2 open and 2 percutaneous studies reporting grip strength. The pooled averages were O = 38.3 kg, A = 34.8 kg, and P = 27.1 kg (Table 4).

DASH Score

The postoperative DASH score was reported in 4 open studies,^{4,15,17,19,20} 5 arthroscopic studies,²⁸⁻³¹ and 3 percutaneous studies.^{29,33,36} At final follow-up, the mean DASH score was higher in the arthroscopic group than in the open and percutaneous groups (A = 12.8, O = 19.5, P = 25.3; $P < .001$ for both comparisons), and the mean DASH score was significantly higher in the open group than in the percutaneous group ($P = .029$). The reporting of DASH scores in the early postoperative period was not sufficiently consistent to allow us to test our hypothesis that there would be early differences in function between groups (Table 4).

VAS Pain Score

Postoperative VAS pain scores were reported in 11 open studies,^{6,8-10,12,15,19-21} 8 arthroscopic studies,^{24-26,29-32} and 5 percutaneous studies.^{29,33,35-37} At final follow-up, there was a lower mean VAS score in the arthroscopic group than in the open and percutaneous groups (A = 1.1, O = 1.9, and P = 2.5; $P < .001$ for both comparisons) and a lower mean VAS score in the open group than in the percutaneous group ($P = .002$) (Table 4). Reporting of VAS scores in the early postoperative period in the included studies was not sufficiently consistent to allow us to test our hypothesis that there would be early differences in pain between groups.

Complications

The complication rate was reported in 15 open studies, 10 arthroscopic studies, and 3 percutaneous studies. There was no difference in the complication rate between the open and arthroscopic techniques ($O = 2.4\%$, $A = 1.9\%$; $P = .629$) (Table 4). Complications noted in the open cohort included superficial wound infection (6), hematoma (5), synovial fistula (2), seroma (2), and posterior interosseous nerve palsy (1). Complications noted in the arthroscopic cohort included superficial infection (3), hematoma (1), and transient paresthesia (1). Of note, there were no complications in the percutaneous group.

Discussion

The primary purpose of this review was to determine if definitive evidence suggests that any 1 of open, percutaneous, or arthroscopic surgical treatment is superior to the other 2 for relieving pain, improving functionality, restoring strength, or accelerating return to work. The most striking finding of this study was a significantly higher proportion of patients who were pain free at final follow-up in the open group than in the arthroscopic group (70% vs 60%, $P = .009$) (Table 4). At final follow-up, there were no significant differences between groups regarding duration to return to work, proportion who were improved, proportion who were satisfied or partially satisfied, and complication rate. Average VAS and DASH scores at final follow-up were lower in the arthroscopic group than in the open and percutaneous groups (Figure 2). However, although the difference between mean DASH scores in the arthroscopic and open groups (6.7 points) was statistically significant, it is likely not clinically significant, as the minimal clinically important difference (MCID) for the DASH score is 10 points, as demonstrated by Sorensen and colleagues.³⁸ Although it has not been specifically defined for lateral epicondylitis, the MCID for VAS pain has been reported in the literature to range from 1.0 to 1.4.³⁹⁻⁴⁰ Therefore, as for the DASH score, the difference witnessed between the open and arthroscopic groups (0.8) is likely not clinically significant. Of note, the differences between values for arthroscopic and percutaneous techniques are greater than the MCID.

In light of a recent increase in the prevalence of surgical intervention for lateral epicondylitis, many authors have promoted arthroscopic and percutaneous techniques as alternatives to traditional open débridement with the goal of achieving the same results with decreased morbidity and accelerated return to work. Given the increased proportion of patients who were pain free at final follow-up in the open cohort, it is our contention that open release/débridement of the common extensor/ECRB origin allows the surgeon to fully appreciate the extent of tendinotic tissue that is contributing to the patient's symptoms and to address the pathology in its entirety. Other authors have also questioned whether the full extent of extra-articular tendinosis can be accurately identified arthroscopically. Cummins⁴¹ demonstrated, in a series of 18 patients who underwent arthroscopic ECRB débridement, that 6 patients had residual tendinosis upon open evaluation and 10 had residual tendinosis on histologic assessment. Additionally, in the same series, residual tendinopathy was associated with poorer clinical outcomes.

The improved visualization associated with an open technique comes at minimal expense, as the incision was only 1.5 cm to 5 cm in 13 of 15 papers reporting incision length.^{3,4,6,8-11,13,15,18-20} This increased exposure may not translate into increased morbidity, as there was no increase in the duration to return to work nor the complication rate. As a result of the extensive instrumentation necessary for arthroscopic techniques, open techniques also appear to be less expensive. Analyses in the literature have suggested increased expenditures associated with arthroscopic treatment ranging from 23%⁴² to 100%⁴³ greater than those of open treatment.

Although obvious, it should be noted that a percutaneous tenotomy does not permit assessment of the extent of

pathologic tendinosis. As a result of an inability to visualize and débride pathologic tissue, percutaneous tenotomy rendered inferior outcomes to open and arthroscopic techniques in terms of both postoperative VAS pain score and DASH score. Nonetheless, it is a relatively rapid and simple technique and resulted in zero complications in 184 elbows. Overall, percutaneous tenotomy appears to be an inferior technique to open and arthroscopic techniques in terms of achieving complete pain relief and optimal functional recovery; however, it may be useful in those who wish to avoid a more invasive intervention.

Limitations

The most significant limitation of this study was the heterogeneity in the techniques utilized in each group. Among the 19 papers in the open cohort, 11 used techniques aimed at lengthening or release of the extensor origin, 7 performed débridement of tendinotic tissue at the ECRB origin, and 1 compared these approaches. Exposures ranged from 1.5 cm to 8 cm in length, 3 techniques added tendon repair following débridement, and 2 utilized a radiofrequency device.

Among the 12 papers in the arthroscopic cohort, 8 performed arthroscopic (inside-out) débridement of the tendinotic tissue at the ECRB origin, 3 performed arthroscopic release of the ECRB tendon, and 1 performed endoscopic ECRB release in an outside-in fashion. Four techniques added posterior synovial plica excision and 4 added decortication of the lateral epicondyle débridement or release. Some authors advocate for arthroscopic intervention on the grounds that it permits evaluation and correction of other intra-articular pathology. With this in mind, some authors have suggested that a synovial fold (plica) adjacent to the radiocapitellar joint may contribute to lateral elbow pain.^{27,44} Nevertheless, in the only comparative trial in the literature, Rhyou and Kim³⁰ demonstrated that excision of posterior synovial fold failed to enhance pain relief or function in a retrospective cohort study comparing arthroscopic débridement with and without plica excision.

Some authors advocate decorticating the non-articular, lateral epicondyle with a shaver to stimulate bleeding and promote a healing response. However, 1 study in our review compared arthroscopic ECRB release with and without decortication and found that decortication significantly increased pain up to 4 weeks postoperatively, increased duration to return to work, and did not improve the ultimate clinical result.²⁵ Of note, others have used a similar rationale to advocate drilling the lateral epicondyle when utilizing an open technique. However, Dunn and colleagues⁸ note that they have modified the Nirschl technique to eliminate drilling because they feel it increases postoperative pain and may damage the extensor digitorum communis origin.

Among the 6 papers in the percutaneous tenotomy cohort, 2 performed tenotomy with a hypodermic needle, 2 with a scalpel through a limited incision (0.5 cm-1 cm), 1 using a TX1 tissue removal system (Tenex Health), and 1 with a percutaneous radiofrequency probe. In 3 techniques, ultrasound was used to direct the tenotomy.

The quality of this review is also limited by the studies included for analysis, as with any systematic review. Because 28 of the 35 included studies were classified as evidence level IV, the likelihood of methodological bias is increased. The majority of studies contained ≥ 1 demonstrable biases, including selection, detection, attrition biases, or a combination. Selection bias is prevalent among predominantly level IV studies, in which the authors have selected their preferred surgical technique. There was heterogeneity in the reporting of preoperative variables and the outcome measures that were utilized. Scoring systems, such as the Nirschl Tennis Elbow Score and the Mayo Elbow Performance Index, would have been valuable in comparing the groups had they been more consistently reported. The heterogeneity in clinical outcome tools and the lack of reported outcome variance or standard deviations prevented a formal meta-analysis of some of these outcome measures. Due to inconsistent reporting, we were also unable to test our hypothesis that there would be less pain and improved function in the arthroscopic and/or percutaneous cohorts in the early postoperative period compared to the open cohort due to

the less invasive techniques used. Although the differences in DASH and VAS scores at final follow-up likely did not meet the MCID threshold, these differences may have been greater and more clinically relevant in the early postoperative period.

Conclusion

We hypothesized that the arthroscopic and percutaneous groups would experience accelerated return to work and reduced pain in the early postoperative period but no difference in ultimate pain, functional outcome, or subjective satisfaction. There is no difference between open, arthroscopic, and percutaneous surgical treatment for lateral epicondylitis regarding return to work and subjective satisfaction; however, open treatment led to a greater percentage of patients being pain free at final follow-up. While arthroscopic treatment led to better pain and functional scores at final follow-up, the absolute differences were quite small and likely not clinically significant. In light of the available evidence, we recommend open débridement as the best means of minimizing cost and achieving a pain-free outcome in the long term. For future investigators, it would be useful to perform a randomized clinical study directly comparing open, arthroscopic, and percutaneous techniques, including assessment of pain and functional scores in the early postoperative period, and to further evaluate differences in cost among the various techniques.

This paper will be judged for the Resident Writer's Award.

Key Info

Figures/Tables

Figures / Tables:

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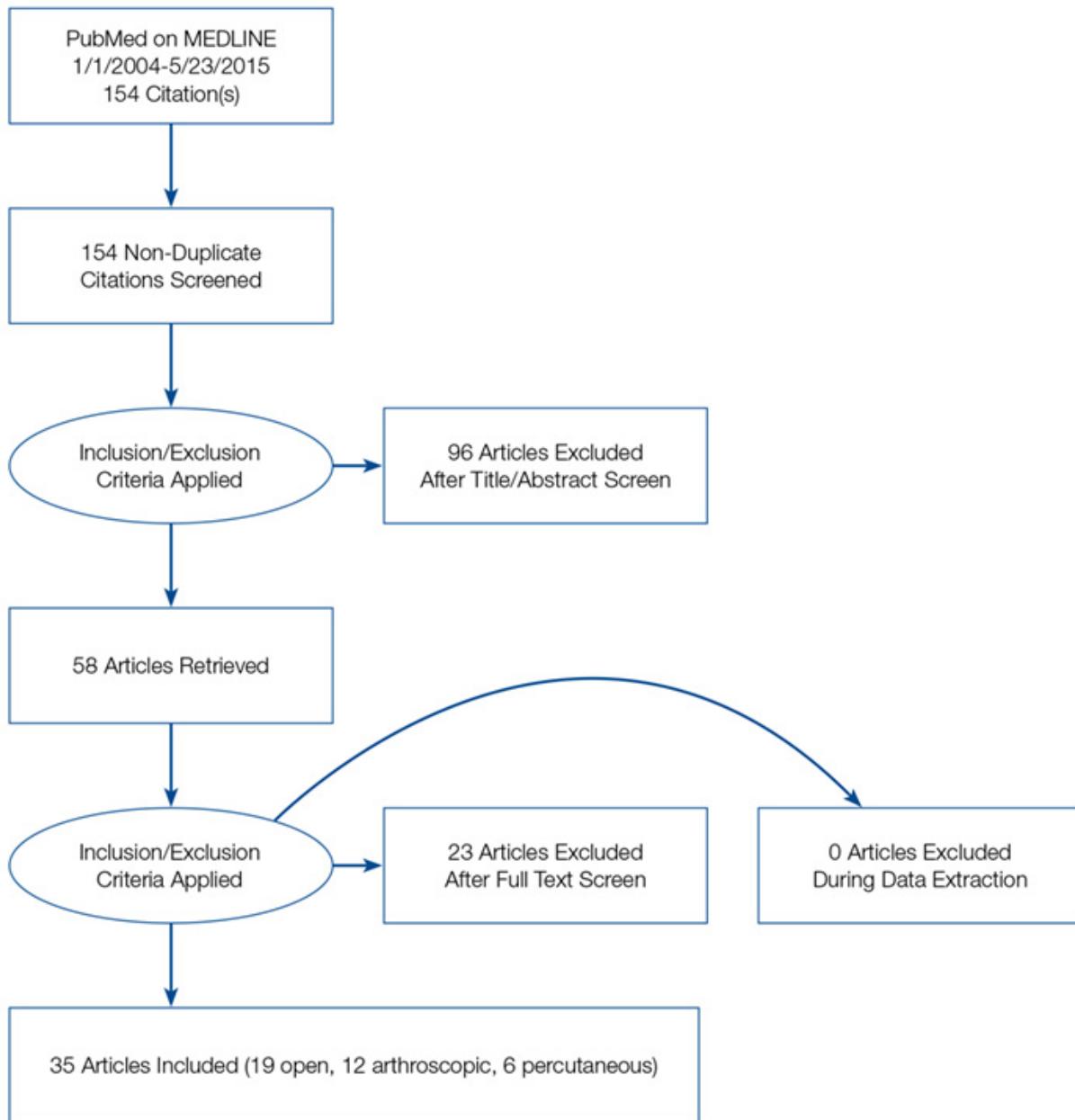


Figure 1. Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) trial flow chart describing the inclusion process for the studies in the systematic review.

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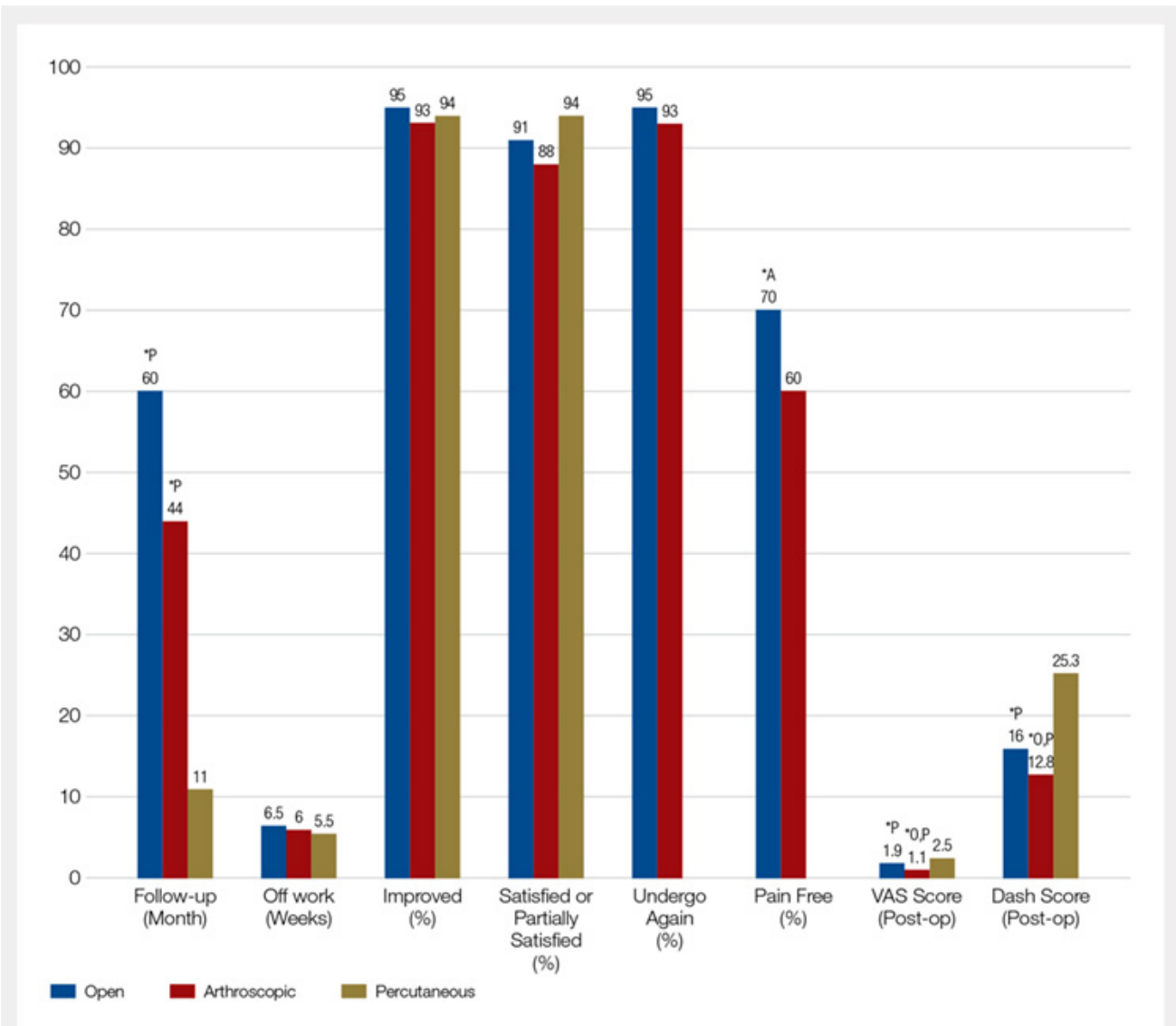


Figure 2. Postoperative clinical outcomes following surgery for lateral epicondylitis.

Table 1. Inclusion and Exclusion Criteria for the Analyzed Studies

Inclusion Criteria	Exclusion Criteria
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<ul style="list-style-type: none"> • Case series/cohort studies reporting the results of isolated arthroscopic, percutaneous, or open surgical treatment for lateral epicondylitis. • Comparison studies reporting the results of any combination of arthroscopic vs percutaneous versus open surgical treatment for lateral epicondylitis. 	<ul style="list-style-type: none"> • Anatomic studies: 11 • Systematic reviews: 1 • Review articles: 45 • Case series/cohort studies reporting the results of isolated arthroscopic, percutaneous, or open surgical treatment for lateral epicondylitis. • Comparison studies reporting the results of any combination of arthroscopic vs percutaneous versus open surgical treatment for lateral epicondylitis. Technique articles: 3 • Imaging studies: 6 • Case reports: 7 • Basic science articles: 2 • Erratum to previous studies: 1 • Studies in non-English languages: 7 • Letters to Editor/Author replies: 2 • Surveys to surgeons: 1 • Studies assessing other etiologies of elbow pain different from lateral epicondylitis: 7 • Studies about available online information on the term lateral epicondylitis: 2 • Therapeutic studies on lateral ulnar collateral ligament reconstruction: 2 • Therapeutic studies on injection treatments for lateral epicondylitis: 10 • Therapeutic studies on radial shock wave therapy for lateral epicondylitis: 6 • Therapeutic studies for radial tunnel syndrome: 1 • Technique not addressing extensor origin: 1 • Studies evaluating rehabilitation/exercises for musculoskeletal injuries: 3 • Studies that were included in the Lo and Safran² systematic review of the literature: 2
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Table 2. Study Demographic Data for Open, Arthroscopic, and Percutaneous Lateral Epicondylectomy

	Open	Arthroscopic	Percutaneous	Total
Number of studies	19	12	6	35
Level of evidence				
I	1 (5%)	0	0	1 (3%)
II	0	0	0	0
III	3 (16%)	4 (33%)	1 (17%)	6 (17%)
IV	15 (79%)	8 (67%)	5 (83%)	28 (80%)
US: International	8:12	3:9	1:5	12:24
Journals of publication				
AJSM	3	1	1	5
JSES	2	2	1	5
Arthroscopy	2	2	0	3
KSSTA	1	2	0	3
CORR	0	2	0	2
JHS	0	1	0	1
JOS	1	1	0	2
AJO	2	0	0	2

Other 8 1 4 12

Abbreviations: AJO, *The American Journal of Orthopedics*; AJSM, *American Journal of Sports Medicine*; Arthroscopy, *The Journal of Arthroscopy and Related Surgery*; CORR, *Clinical Orthopaedics & Related Research*; JHS, *Journal of Hand Surgery*; JOS, *Journal of Orthopaedic Surgery*; JSES, *Journal of Shoulder and Elbow Surgery*; KSSTA, *Knee Surgery, Sports Traumatology, and Arthroscopy*.

Table 3. Subject Demographics for Open, Arthroscopic, and Percutaneous Groups

	Open	Arthroscopic	Percutaneous
Subjects (N)	999	397	183
Elbows (N)	1055	401	184
Elbows with follow-up (%)	915 (87%)	350 (87%)	181 (98%)
Males (%)	427 (47%)	173 (49%)	78 (43%)
Females (%)	488 (53%)	177 (51%)	103 (57%)
Mean age (years)	45.4	45.8	46.9
Dominant elbow (%)	70%	69%	53%
Laborer (%)	56%	53%	48%
Work comp (%)	36%	30%	NR
Symptoms to operation (months)	23	18	8
Min. symptoms to operation (months)	6	6	3
Mean follow-up (months)	60	44	11

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Table 4. Postoperative Clinical Outcomes Following Surgery for Lateral Epicondylitis

	Open (O)			Arthroscopic (A)			Percutaneous (P)			P-value (O vs A)	P-value (A vs P)	P-value (O vs P)
	Value	Studies	n	Value	Studies	n	Value	Studies	n			
Return to work (weeks)	6.5	5	142	6	9	237	5.5	2	54	0.601	0.651	0.28
Improved (%)	95%	9	450	93%	6	175	97%	1	34	0.327	0.719	0.849
Satisfied or partially satisfied (%)	91%	4	148	88%	5	125	94%	2	54	0.418	0.223	0.492
Pain free (%)	70%	13	704	60%	7	188	NR	0	n/a	0.009	N/A	N/A
DASH (preoperative)	57.8	2	93	51.2	4	75	55.7	3	73	0.001	0.025	0.359
DASH (postoperative)	19.5	4	142	12.8	5	95	25.3	3	73	<0.001	<0.001	0.029
VAS (preoperative)	7.9	10	340	7.8	8	211	7.9	5	155	0.331	0.644	0.929
VAS (postoperative)	1.9	11	416	1.1	8	211	2.5	5	155	<0.001	<0.001	0.002
Grip strength-kg (preoperative)	25.7	2	67	22.6	3	61	18.9	2	41	N/A	N/A	N/A
Grip strength-kg (postoperative)	38.3	2	67	34.8	4	106	27.1	2	41	N/A	N/A	N/A
Complication Rate (%)	2.4%	15	747	1.9%	10	286	0%	3	130	0.629	N/A	N/A

Abbreviations: DASH, Disabilities of the Arm, Shoulder and Hand; N/A, not available; VAS, visual analog scale.

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