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Percutaneous microtenotomy using a microdebrider coblation wand for the treatment of lateral epicondylitis

A systematic review

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Abstract

Background: Lateral epicondylitis is one of the most common causes of elbow pain. Most patients recover with conservative treatments; however, some patients require surgical intervention. There are 3 common procedures offered: open tenotomy, arthroscopic tenotomy, and percutaneous microtenotomy. In comparison, percutaneous microtenotomy has been proven as a less invasive procedure to treat lateral epicondylitis. We reviewed the literature on the safety and efficacy of using a microdebrider coblation wand to treat lateral epicondylitis, and we compared its outcomes to open and arthroscopic tenotomy.

Methods: A search was completed through PubMed Central, Google Scholar, EBSCO host, and Embase for studies that performed percutaneous microtenotomy with a microdebrider coblation wand to treat lateral epicondylitis. Studies were then screened to determine if they met inclusion and exclusion criteria and were reviewed for data analysis and potential risks of bias.

Results: A total of 27 articles were identified and 9 articles (eight studies) met the inclusion criteria. Small sample sizes in the studies and heterogeneity of the methodology limited the capacity to carry out a meta-analysis. Percutaneous microtenotomy outcomes seem to be favorable for reduced pain, increased grip strength, and improved functional outcomes, which were similar to outcomes reported with the other surgical techniques. There were no major adverse events reported in the studies secondary to the use of the microdebrider coblation wand. Procedure time and return to daily activities were shorter for the microtenotomy group.

Conclusion: Percutaneous microtenotomy performed with a microdebrider coblation seems to be an effective treatment for lateral epicondylitis that provides similar outcomes to the surgical techniques with a lower rate of complications.

Abbreviations: DASH = disabilities of the arm, shoulder and hand, MEPS = Mayo Elbow Performance Score, MRI = magnetic resonance imaging, NRS = numerical rating scale, PRP = platelet-rich plasma, RCT = randomized controlled trials, VAS = visual analog scale.

Key words: lateral epicondylitis, tennis elbow, coblation, microdebridement, and microtenotomy

1. Introduction

Lateral epicondylitis, also known as tennis elbow, occurs when the extensor tendons of the wrist and fingers are strained from overuse at the tendon origin in the lateral epicondyle of the humerus.[1,2] Repetitive loading of the extensor muscles causes inflammation and microtears in the tendon.[1–4] The microtears are usually observed due to loaded and repeated gripping, wrist and finger extension, or supinator muscle contraction.[3,5,6] Patients experience pain in the lateral part of the elbow and weakness of their wrist extension and grip strength.[1,3–5] Pain can range from intermittent and low grade to constant and severe.[3,6] A study of Finnish adults (aged 30–64 years) reported 1.3% overall prevalence of lateral epicondylitis, with the highest prevalence in individuals between the ages 45 to 54 years, and no statistically significant difference between males and females.[4]

There are various imaging modalities to diagnose lateral epicondylitis. Ultrasound imaging has recently become the preferred tool to detect lateral epicondylitis; however, X-rays and magnetic resonance imaging (MRI) have also been used to detect pathology in the tendon.[3,6] Ultrasound imaging permits the visualization of structural changes of the tendon such as thickening, tendon microtears, cortical bone irregularities.

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Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

The review was not registered and there is no protocol to report.

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Additionally, calcific deposits at the enthesis are better seen using ultrasound, compared with MRI.[6]

Most patients recover from lateral epicondylitis with conservative treatments such as nonsteroidal anti-inflammatory drugs, physical therapy, brace, and shockwave therapy.[7–9] In cases recalcitrant to conservative treatments, various injections have been reported to provide symptomatic relief.[7–10] Corticosteroid injections have been the gold standard for decades in treating lateral epicondylitis, and have been recognized to provide pain relief in the short term.[7,8,10] Recent studies have proven that platelet-rich plasma injections and autologous blood injections provide intermediate or long-term symptomatic relief compared with corticosteroid injections that provide short-term relief.[7–10] Moreover, bone marrow aspirate concentration injections have also been studied, although more studies are needed to assess its long-term efficacy.[8,9] Unfortunately, around 4% to 11% of patients have severe cases of lateral epicondylitis and do not experience relief from these treatments. For these cases, surgical options should be considered.[7,8]

Three surgical procedures have been used to treat severe cases: open tenotomy, arthroscopic tenotomy, and percutaneous microtenotomy.[7,8,11] All 3 methods have been shown to successfully relieve patients' symptoms. Solheim et al claimed that the arthroscopic technique provides slightly better outcomes for patients compared to open tenotomy.[7,11] Recent studies have expressed concern about the invasive nature of the open and arthroscopic tenotomy techniques and proven that a percutaneous microtenotomy procedure is an effective treatment option for lateral epicondylitis given that the procedure can be performed under live ultrasound guidance without having to dissect the soft tissue down to the tendon.[12–20]

There are various instruments that can be used for performing a percutaneous microtenotomy, including a microdebrider coblation wand (Topaz EZ, Smith & Nephew Arthrocare, Austin, Texas), and 2 ultrasonic devices (Tenex Health, Lake Forest, CA; TenJet, HydroCysion, Inc., North Billerica, MA). Of the 3, the microdebrider coblation wand instrument is the only one that does not require making an incision in the skin to introduce the instrument and is capable of debriding the tendon and also cauterizing neovessels in the tendon. The primary objective of this study was to systematically review the literature on the safety and efficacy of the microdebrider coblation wand to treat lateral epicondylitis. Additionally, we compared the outcomes and complication of this technique to the other 2 surgical methods, open tenotomy and arthroscopic tenotomy.

2. Methods

2.1. Search methodology

This systematic review followed the PRISMA guidelines.[21] Additionally, we did not include human subject data, so an institutional review board was not required for this study. Literature searches were completed using the PubMed, Google Scholar, EBSCO host, and Embase online databases between February 2020 and August 2020. The search strategy included various strings of: "(microdebrider OR coblation OR coblation wand OR microtenotomy OR topaz microdebrider OR topaz coblation OR topaz wand OR radiofrequency-based microtenotomy OR radiofrequency microtenotomy OR radiofrequency microdebrider OR topaz micro debrider OR topaz microtenotomy OR topaz micro tenotomy OR topaz procedure)" AND "(elbow OR epicondylitis)." There were no limitations set on these search strategies.

Two investigators (XXX, XXX) analyzed each of the studies from the search by first reading the title and abstract and removing any studies that were not relevant. They then read the papers to determine which studies met inclusion and exclusion criteria. Furthermore, references listed in the studies were also reviewed for consideration.

Inclusion criteria were the following: (1) the studies had to present original data, (2) include human participants, and (3) utilize a microdebrider coblation wand in the management of lateral epicondylitis. Studies were excluded based on the following criteria: (1) not written in English, (2) not published in a peer-reviewed scientific journal, or (3) the patients had not received and failed conservative management of lateral epicondylitis for at least 3 months before percutaneous microtenotomy.

2.2. Data analysis and risk of bias assessment

The studies included were reviewed to gather patient outcomes, return to activity, efficacy, and complications. Data were grouped according to the outcome measurements used by the various studies. The potential risk of bias was determined for each of the studies using 2 different guidelines: randomized controlled studies were assessed using the quality criteria from the Centre for Reviews and Dissemination (CRD) guidelines, and the other studies were assessed using the Critical Appraisal Skills Programme guidelines.[22,23]

3. Results

Of the 27 articles identified, 9 articles (eight studies) met the inclusion and exclusion criteria for this systematic review.[12–20] Results from the search are shown in Figure 1. The 9 articles represented only 8 studies because outcomes from 1 study were published for 2 different follow-up time periods in 2 separate papers.[16,17]

Among the 8 studies, 288 participants received treatment for lateral epicondylitis and 11 for medial epicondylitis. Of the 288 lateral epicondylitis patients, 211 were treated with a microdebrider coblation wand (Topaz EZ, Smith & Nephew Arthrocare, Austin, Texas) and were included in this systematic review. Details of the studies included are summarized in Table 1.

Postprocedure follow-up ranged from 24 hours up to 7 years, with the average range between 3 and 24 months. Four studies were prospective, randomized, controlled trials,[12,13,15–17] of which one reported the results of the same participant cohorts at various follow-up times.[16,17] In these 4 studies, the control arm varied among procedures between electrocautery microtenotomy,[12] open tenotomy,[13,14,16] or arthroscopic tenotomy.[15] All 4 studies had the study group treated with the microdebrider coblation wand. Four other studies were prospective cohort studies on the microdebrider coblation wand without a control group.[14,18–20] The remaining study was a retrospective comparison between patients treated with the microdebrider coblation wand versus open tenotomy.[4]

3.1. Risk of bias assessment

All the randomized controlled trials (RCT) showed an adequate method to generate random allocations (Table 2). However, most RCT studies did not include an intention-to-treat analysis to account for missing data. Of the RCT studies, the studies by Meknas et al had the lowest risk of bias, while the study by Hamlin et al showed the highest risk of bias (Table 3). The observational studies had a higher risk of bias overall, with most studies not identifying all the important confounding variables. Of the observational studies, the study by Tasto et al in 2005 showed the lowest risk of bias, while the study by Tasto et al in 2016 had the highest risk of bias.

3.2. Patient outcomes

Most of the studies reported patient outcomes for pain using the visual analog scale (VAS) or the numerical rating scale.[12–15,17–20] Each of these studies saw pain reduction in their first measurement posttreatment, with 8 of the studies identifying significant

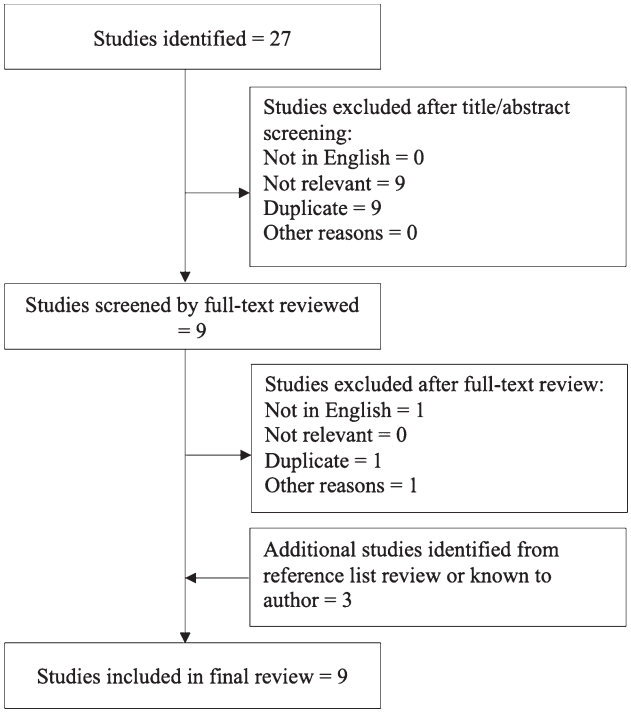

Figure 1. Flowchart of study selection.

pain reduction in comparison to pretreatment.[12–19] Tasto et al reported a decrease in VAS from 6.9 to 1.3 between pre- and posttreatment, but they did not provide statistical analysis.[20] Hong et al analyzed pain reduction with the Self-administered Roles and Maudsley Pain score; 71% of their patients reported at least 1 level of improvement 12 months postmicrotenotomy treatment.[14]

Five of the studies compared microtenotomy with a different surgical procedure. All 5 studies reported improvement in both treatment groups and no significant difference of posttreatment pain reduction in the VAS scale between microtenotomy and the other surgical procedures at the final follow-up encounter.[12,13,15–17] Meknas et al documented that microtenotomy provided significant pain reduction in half the time compared with open tenotomy, 3 weeks posttreatment ($P < .05$) versus 6 weeks ($P < .04$).[17] On the contrary, Hamlin et al reported that open tenotomy provided significantly more pain reduction at 6 weeks compared to microtenotomy ($P = .002$)[13]; nevertheless, both groups had equal improvement at the final follow-up.

Five studies measured grip strength, out of which 4 were randomized controlled trials.[13,15–17] All 5 reported an improvement in grip strength.[12,15–17,19] Two studies observed an increase in grip strength, but was either not significant or they did not provide statistical analysis.[13,15] Tasto et al reported significant increase in grip strength 4 to 6 weeks posttreatment ($P < .01$) that plateaued at 6 months.[19] Moreover, Meknas et al reported significant increase in grip strength 12 weeks posttreatment ($P < .001$)[17] that qualitatively remained increased 5 to 7 years posttreatment, but without statistical significance.[16] The randomized controlled trials reported equal increase of grip strength posttreatment between microtenotomy and other surgical procedures.[12,15–17] Meknas et al noted that the difference between pretreatment and 12 weeks posttreatment was statistically significant in the microtenotomy group and was not significant in the open tenotomy group.[17]

Five studies reported patient function using the Mayo Elbow Performance Score (MEPS).[12,15–18] Meknas et al reported a significant increase in function from pretreatment to posttreatment at 12 weeks ($P < .001$) and at 5 to 7 years ($P < .01$).[16,17] Canquerini and Gomes and Lee et al also reported a significant increase in MEPS posttreatment at 6 months ($P < .001$) and 2 years ($P < .01$), respectively; however, these studies did not describe at what time point was the increase significant.[12,15] Seitz and Lall observed an increase in MEPS 6 months posttreatment from 55 to 90.[18] In comparative studies, there were similar increases in MEPS between microtenotomy and other surgical procedures.[12,15–17]

Patients' function was reported in 3 studies using the Disabilities of the Arm, Shoulder and Hand (DASH) measurement, which all observed a significant improvement in this score posttreatment with microtenotomy.[13,15,19] Hamlin et al and Tasto et al (2005) reported significant increase in DASH scores as early as 4 to 6 weeks posttreatment.[13,19] Hamlin et al and Lee et al reported that there was equal improvement in DASH measurement between microtenotomy and other surgical procedures.[13,15]

Two studies provided other outcome measurements.[14,19] Tasto et al (2005) provided a 36-Item Short Form Survey at 6 to

Table 1

Studies included in the systematic review

Paper	Type of study	Patient population	Patient outcome measurements	Comparison
Tasto et al[20]	Prospective, nonrandomized, single-center clinical study	80 patients (69 with lateral epicondylitis and 11 medial epicondylitis)	VAS	
Seitz and Lall[18]	Prospective nonrandomized, single-center clinical study	40 patients	MEPS, VAS	
Tasto et al[19]	Prospective, nonrandomized consecutive case series study	13 patients	Grip strength, DASH, VAS	
Meknas et al[17]	Randomized controlled trial study	24 patients	Grip strength, MEPS, VAS	Extensor tendon tenotomy and repair
Meknas et al[16]	Prospective, randomized trial study	24 patients	Grip strength, MEPS, VAS	Open tenotomy
Lee et al[16]	Prospective,randomized controlled study	46 patients	DASH, grip strength, MEPS, VAS	Arthroscopic tenotomy
Hamlin et al[13]	Prospective, randomized controlled trial study	41 patients	DASH, grip strength, NRS	Open tenotomy
Hong et al[14]	Prospective cohort study	15 patients	Self-administered Roles and Maudsley Pain score, VAS	
Canquerini and Gomes[12]	Prospective, randomized, controlled trial study	16 patients	MEPS, VAS	Microtenotomy with monopolar electrocautery

DASH = Disability Arm, Shoulder and Hand Score, MEPS = Mayo Elbow Performance Score, NRS = Numerical Rating Scale, VAS = Visual Analog Scale.

Table 2

Assessing risk of bias for RCT included within the analysis

	Meknas et al[17]	Meknas et al[16]	Lee et al[15]	Hamlin et al[13]	Canquerini et al[12]
Was the method used to generate random allocations adequate?					
Was the allocation adequately concealed?					
Were the groups similar at the outset of the study?					
Were care providers, participants and assessors blinded to treatment allocation?					
Were any drop-outs balanced between groups?					
Have all outcomes measured by the authors being reported, or is there evidence to suggest otherwise?					
Was an intention-to-threat analysis included? If so, were appropriate methods used to account for missing data?					

Quality criteria were taken from CRD guidelines for the assessment of risk of bias in RCTs.[22]

CRD = Center for Reviews and Dissemination, Green = yes, N/A = not applicable, RCT = randomized controlled trials, Red = no, Yellow = partially or unclear.

Table 3

Assessing risk of bias for observational studies included within the analysis

	Tasto et al[20]	Seitz and Lall[18]	Tasto et al[19]	Hong et al[14]
Was the cohort recruited in an acceptable way?				
Was the exposure accurately measured to minimize bias?				
Was the outcome accurately assessed to minimize bias?				
Have the authors identified all important confounding factors?				
Have the authors taken account of the confounding factors in the design and/or analysis				
Was the follow-up of patients complete?				
Are the results precise (for example, were confidence intervals and p values provided)?				

Criteria were adapted from CASP guidelines.[23]

CASP = Critical Appraisal Skills Programme, Green = yes, Red = no, Yellow = partially or unclear.

24 months to determine quality of life, reporting that they were similar to standard populations.[19] Hong et al reported that 47% of their patients rated improvement in their function.[14]

3.3. Efficacy

Two studies analyzed the injured tendon using MRI.[16,19] Tasto et al (2005) identified 11 patients with MRI findings consistent with tendinosis pretreatment.[16] At 6 months, 10 patients had complete or near-complete resolution compared with their initial scan, whereas the other patient showed some improvement.[16] Nine patients later underwent another MRI and all of them showed improvement.[16] Meknas et al (2013) did MRI scans on 12 patients 5 to 7 years postmicrotenotomy treatment, and reported that 11 patients had a normal (healed) tendon and 1 patient had residual MRI findings of lateral epicondylitis.[19]

Patient satisfaction following microtenotomy was reported in 2 studies.[12,18] Seitz and Lall asked their 40 patients to rate their satisfaction with the microtenotomy procedure on a scale of 0 to 10, and they reported a satisfaction rate of 9.1 (range, 4–10).[18] Canquerini and Gomes reported that 100% of patients were satisfied.[12]

Three studies determined surgical success based on different measurements.[12,15,20] Tasto et al (2016) defined clinical success as "pain improvement >50%"; 91% of patients achieved this clinically successful outcome.[20] Lee et al reported that 91% of patients had a MEPS score >90 at 2 years, which they defined as clinical success.[15] Canquerini and Gomes also used MEPS, defining clinical success as a score >75 at 2 months, which 100% of their patients achieved.[12] Similarly, Lee et al reported that all of their patients had a MEPS score >75.[15]

3.4. Surgery time

Two randomized controlled trials included data about the surgical procedure time for the treatment of lateral epicondylitis.[15,16] Meknas et al concluded that the average procedure time for the microtenotomy with the microdebrider coblation wand (18 min; range, 10–27 min) was significantly faster than the open tenotomy procedure (30 min; range, 22–40 min) (P = .02).[16] Similarly, Lee et al observed that the microtenotomy procedure lasted 15.6 ± 3.6 minutes, which was significantly faster that the arthroscopic tenotomy of 41.4 ± 5.2 minutes.[15]

3.5. Return to activity

Three studies observed return to activity, which included basic activities of daily living, return to work, and return to same level of activity before the incident.[12,17,19] Tasto et al (2005) reported that the return to preinjury activities averaged between 4 and 5 weeks.[19] Meknas et al (2008) did not find any significant difference in patients obtaining full clearance for return to work without restrictions between the microtenotomy group (10.7 ± 2.5 weeks) and the open tenotomy group (11.5 ± 6.3 weeks).[17] Five patients in the microtenotomy group did not return to work due to another medical condition or losing their previous job.[17] Similarly, Canquerini and Gomes found no significant difference (P = .88) for patients in return to sedentary duty work between microtenotomy (5.5 ± 3.8 days) and electrocautery (6.5 ± 4.9 days).[12] Additionally, they found no significant difference (P = .80) in return to basic activities of daily living between the microtenotomy (2.6 ± 1.8 days) and electrocautery groups (2.8 ± 1.6 days).[12]

3.6. Complications and residual symptoms

Six studies reported that there were no adverse events or complications related to treatment with the coblation wand.[12–14,16,18,19] Lee et al did have 1 patient treated with the coblation wand that had a minor complication: a 58-year-old male patient experienced swelling due to a hematoma at the procedure site during the first week posttreatment.[15] This complication eventually resolved.

Some studies reported patients with residual symptoms after being treated with the coblation wand.[13,16,18,20] Tasto et al stated that 6 patients (9%) did not experience improvement of

symptoms posttreatment, with 2 of the patients (3%) repeating the procedure.[20] Seitz and Lall reported that 2 patients (5%) had persistent symptoms posttreatment, but they decided to forego a second procedure.[18] Hamlin et al reported 2 patients (9%) that had persistent symptoms posttreatment and decided to undergo open tenotomy surgery.[13] One of the patients improved within 1 year, but the other patient was still experiencing symptoms after the open tenotomy.[13] Similarly, Meknas et al had 1 patient (8%) that underwent open tenotomy after their initial microtenotomy procedure, but they do not report the outcomes after the open tenotomy.[16]

4. Discussion

This systematic review of the literature found that most patients treated with percutaneous microtenotomy using the microdebrider coblation wand had similar positive outcomes compared with the open or arthroscopic tenotomy techniques. First, the improvement in pain and functional outcomes was similar in all groups with no statistically significant difference. In addition, the shorter surgical procedure time for percutaneous microtenotomy was statistically significant. This finding is notable because it directly correlates with a lower exposure time to the anesthetic medications used for conscious sedation or general anesthesia.

The percutaneous microtenotomy using the microdebrider coblation wand is a safe procedure with minimal risk of complications. Out of 222 patients treated with the microdebrider coblation wand, there was only 1 patient who had a minor complication of bleeding at the treatment site. This was concluded to be a sentinel event as there was no other similar complication reported in the other studies. Overall, <10% of patients may experience residual symptoms after the microtenotomy procedure, and <1% of patients experienced any complications. Furthermore, bleeding at the treatment site is a known risk factor for open and arthroscopic tenotomies too. Pomeratz reviewed 67 studies reporting outcomes of lateral epicondylitis treatments, and reported complication rates for open tenotomy (4.3%) and arthroscopic tenotomy (1.1%).[24] Wang et al presented the results of patient self-reported complications, and they observed no significant difference between open tenotomy (4.4%) and arthroscopic tenotomy (5.5%).[25] The lower complication rate for the percutaneous microtenotomy compared with other surgical techniques favors recommending the use of the microtenotomy technique using the microdebrider coblation wand.

Return to work and activities of daily living was the same with the microtenotomy group compared with the other surgical techniques. Therefore, this parameter should not be considered as a reason to justify favoring a microtenotomy, open tenotomy, or arthroscopic tenotomy for the treatment of lateral epicondylitis. Future studies should look at specific work restrictions after these procedures, that is, how long are the patients restricted to sedentary, light, and moderate duty before they are released to work with no restrictions.

Although there are various percutaneous microtenotomy procedures that have been used to treat lateral epicondylitis,[26–28] the microdebrider coblation wand is the only device that currently uses coblation. Two other devices that use an ultrasonic stream of water (Tenex and TenJet) have been studied for percutaneous microtenotomy treatment of lateral epicondylitis. Boden et al compared platelet-rich plasma (PRP) injections to ultrasound-guided percutaneous microtenotomy using the Tenex instrument to break down and remove tendinopathic tissue and found no significant difference between the 2 procedures.[26] Both the Tenex and PRP treatments provided significant improvement in VAS, QuickDASH, and EuroQol-5D scores.[26] There are currently no peer-reviewed studies on the efficacy of the TenJet hypersonic water jet debrider to treat lateral epicondylitis. There are 2 case reports by HydroCision, Inc., of a 46-year-old male and a 55-year-old female that reported significant pain improvement at 2 weeks and 6 weeks posttreatment using the TenJet device.[27,28] These 2 case reports were not published in peer-reviewed journals. Given the extremely limited data published, an appropriate analysis of the outcomes using these instruments is not feasible at this time.

There are several limitations to this study. There were only ten studies on percutaneous microtenotomy for the treatment of lateral epicondylitis that qualified for inclusion in this systematic review and the sample sizes in each of the studies were small. Therefore, the meta-analysis lacked power due to the limited sample size. The meta-analysis was also affected by the heterogeneity in the control groups. Some of the studies did not provide sufficient data in their manuscripts, which limited the extent of the data analysis.[15–17,20] Tasto et al reported the average pre- and postoperative VAS scores of their patients without including any other significant data such as a range, standard deviation, or a *P* value.[20] Meknas et al reported a standard deviation of ± 2.3 for the posttreatment VAS with a mean of 1.4 and a range of 0 to 5 for patients in the radiofrequency microtenotomy group, which means that some patients had 4 to 5 out of 10 pain posttreatment.[16] In addition, Lee et al only presented a figure of the DASH scores for their patients in the tenotomy group and microtenotomy group, which made it difficult to extract data.[15] There was also a wide range of follow-up times reported by the studies. Some studies had their final follow-up 12 months postprocedure,[13,14] while other studies had as low as 6 months[12,18] or as high as 24 months.[15,19] Tasto et al reported that their follow-up of patients ranged from 6 months to 9 years with an average of 2.5 years.[20] This variability in timeframe for collecting data limited the comparison of the different studies.

Future studies should collect data at multiple follow-up times from 2 weeks to 2 years posttreatment to assess better the overall outcomes of patients treated with the microdebrider coblation wand versus the other available treatment options. Moreover, future studies should gather more specific data from patients in regard to their return-to-work status. Finally, they should compare return to activity between the percutaneous microtenotomy, open tenotomy, and arthroscopic tenotomy using standardized outcome measurement tools such as the DASH score.

5. Conclusion

The percutaneous microtenotomy procedure performed with the microdebrider coblation wand seems to be a safe and effective technique for treating lateral epicondylitis. This procedure may offer similar outcomes to the other surgical techniques, with a lower risk of adverse events and a statistically significant shorter procedure time. However, the small sample sizes and heterogeneity of the methodology in the studies limited the capacity to carry out meta-analysis in this systematic review.

Author contributions

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Project administration: Ricardo E. Colberg, Glenn S. Fleisig.

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