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Platelet-rich plasma versus Tenex in the treatment of medial and lateral epicondylitis

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Background: Medial epicondylitis and lateral epicondylitis are among the most common elbow pathologies affecting people aged between 40 and 50 years. Although epicondylitis is often a self-limiting condition that improves with conservative treatment, the condition can be difficult to eradicate. The purpose of this study was to compare the effectiveness of platelet-rich plasma (PRP) injections and ultrasound-guided percutaneous tenotomy (Tenex) for the treatment of medial or lateral epicondylitis. Our hypothesis was that the Tenex procedure would not be inferior to PRP injections in the treatment of medial or lateral epicondylitis.
Methods: In this retrospective review, 62 of 75 patients were available for contact via phone and e-mail to complete post-procedure patient-reported outcome surveys. Subjective assessment of pain and function included a visual analog scale for pain; the Quick Disabilities of the Arm, Shoulder and Hand questionnaire; and the EuroQol-5D questionnaire. The inclusion criteria included age of 18 years or older and previous failure of nonoperative treatment.
Results: The average ages in the PRP and Tenex groups were 47 years and 51 years, respectively. The PRP cohort (n = 32) included 10 female and 22 male patients, whereas the Tenex cohort (n = 30) included 12 female and 18 male patients. The PRP and Tenex groups both demonstrated clinical and statistical improvement in visual analog scale pain scores; Quick Disabilities of the Arm, Shoulder and Hand scores; and EuroQol-5D scores. No statistically significant difference was found between the 2 treatment modalities.
Conclusion: The PRP and Tenex procedures were both successful in producing clinically and statistically significant improvements in pain, function, and quality of life.
Level of evidence: Level III; Retrospective Cohort Design; Treatment Study

Keywords: Elbow pain; epicondylitis; platelet-rich plasma; Tenex; tennis elbow; golfer's elbow

Epicondylitis is a common disease that affects the mobility and function of the arm and impairs quality of life. The prevalence of lateral epicondylitis (LE), known as "tennis elbow," and medial epicondylitis (ME), known as "golfer's elbow," often peaks between 40 and 50 years of age, and the 2 conditions have very similar pathologies.[32] Pain symptoms commonly arise owing to repetitive movements of the forearm and wrist. Although previously posited to be caused by increased inflammation, this condition is now believed to be tendinosis, comprising degeneration of the tendinous insertion about the elbow in addition to a molecular inflammatory response.[1,8,19,23,32] With the aging population and the increasing percentage of this population remaining physically active, the incidence of LE or ME is likely to increase significantly in the coming years.

This retrospective review was approved by the institutional review board before initiation of the study (Emory University IRB00091245).

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A variety of surgical and nonsurgical methods are available to treat LE or ME.[3,17-19,22,32,35] The majority of patients with LE or ME seek out conservative treatment before turning to surgery. Several studies have reported that these nonsurgical treatments (rest, physical therapy, nonsteroidal anti-inflammatories, and bracing) have shown some long-term efficacy whereas corticosteroid injections alone have not demonstrated a long-term effect on pain or function.[17,18,35] In general, there is no consensus on which treatments are the most effective in managing epicondylitis (Table I). Because of the lack of consistency regarding treatment success reported in the literature, it is important to investigate new nonsurgical techniques that can be used in the treatment and recovery of patients with epicondylitis.

Platelet-rich plasma (PRP) injections and ultrasound-guided percutaneous tenotomy (Tenex in this study; Tenex Health, Lake Forest, CA, USA) are 2 such treatment methods that may prove effective in treating refractory epicondylitis. With PRP injections, blood from the patient is collected and centrifuged to achieve a very high concentration of platelets; then, the plasma is injected into the damaged area.[3,22] This injection saturates the damaged tissue with supraphysiological levels of growth factors to augment and improve the healing process.[24] The minimally invasive Tenex procedure is performed through a small skin incision and uses ultrasonic energy to break down and remove scar tissue in the damaged region, creating an acute inflammatory reaction and facilitating tendon healing.[13] Alternatively, an additional method for percutaneous tenotomy can be performed with an ultrasound and an 18-gauge needle whereby the tendon is fenestrated multiple times. For this study, the proprietary Tenex machine was used. Although results using PRP and Tenex for the treatment of LE or ME have been promising thus far,[2,3,15,22,25,26] it is unclear whether 1 technique is more effective, and there has never been a direct comparison between the 2 treatment modalities to our knowledge. However, a prior study compared PRP with conventional needling alone (non-Tenex) and demonstrated a late benefit with PRP.[25]

The purpose of this study was to compare the effects of a single PRP injection versus Tenex on pain and function in the treatment of LE or ME, as well as to determine whether 1 treatment is superior to the other. Our hypothesis was that the Tenex procedure would not be inferior to PRP injections in the treatment of ME or LE.

Materials and methods

The inclusion criteria included (1) a trial of conservative therapy as defined by a subjective failure of physical therapy for at least 3 months; (2) patients with a clinical diagnosis of LE or ME who underwent any type of PRP or Tenex procedure at a single institution from September 1, 2014, to May 1, 2017; and (3) patients aged 18 years or older. The exclusion criteria included (1) patients younger than 18 years or older than 80 years and (2) vulnerable subjects (pregnant patients, prisoners, and so on).

Treatment modality decision

Information on both PRP and Tenex was provided to patients with chronic ME or LE with refractory pain in whom relief with other conservative measures had been previously attempted. Patient preference and the patient's prior experience, insurance coverage, and out-of-pocket expense were the main drivers in deciding which treatment modality was chosen. Specifically, PRP is not conventionally covered under insurance, whereas the Tenex procedure is covered by most insurance groups. As such, it is possible that patients with a lower socioeconomic status or aversion to spending money outside of their insurance plan may have been biased to the Tenex group. In addition, most patients had previously undergone advanced imaging with magnetic resonance imaging and/or ultrasound. In some instances in which there was overt tearing of the tendon as defined by a musculoskeletal radiologist, patients were more likely to be triaged to the Tenex group, given the ability to "débride" the tear. After the patient was presented with the risks, benefits, and alternative procedures and decided on a treatment modality, informed consent was obtained.

PRP procedure protocol

After the patient was prepared for a blood draw, approximately 30 mL of whole blood was harvested from the antecubital fossa of the arm. The blood was processed on site using the Emcyte PurePRP II concentrating system and centrifuge (Emcyte, Fort Myers, FL, USA). The blood was spun in 2 cycles, 1.5 minutes and 5.0 minutes, at 3800 revolutions/min. Approximately 3 mL of leukocyte-poor (LP) and red blood cell–poor PRP was produced. On completion of the blood-processing component of the procedure, the plasma coagulate concentrate was taken directly into the patient's room. The patient was then positioned supine on the table and re-prepared in a sterile fashion. A minimal amount of local anesthetic, ropivacaine 0.2%, was either added to the PRP mixture or injected locally as necessary. The plasma coagulate was then infused at the site of pathology using ultrasound guidance. After the procedure was completed, the patient remained supine for 10 minutes and was given post-procedure instructions and protocols (Table II).

Tenex procedure protocol

The patient was placed in the supine position, and the affected limb was then prepared and draped in a sterile fashion. A sterile sleeve was placed over the ultrasound transducer, and a diagnostic ultrasound was performed to identify the anatomy and visualize the pathologic tissue.

The area was again prepared with an antimicrobial solution and injected with 1% lidocaine using a 23-gauge needle. By use of a No. 11 blade, a tract was made to facilitate the entry of the TX MicroTip (Tenex Health) into the pathologic tissue. The blade continued through the subcutaneous tissue, incising the fascia and tendon down to the site of the pathologic tissue. Next, the TX MicroTip handpiece was introduced under ultrasound guidance. Once the tip of the instrument was confirmed to be at the site of pathology, the foot pedal was depressed and the diseased portion of the tissue was débrided. Up to 3 minutes of ultrasonic energy was delivered based on the amount of débridement necessary. After the procedure, Steri-Strips (3M Healthcare, St Paul, MN, USA) were placed over the incision, followed by Tegaderm dressing (3M Healthcare) application.

Table I Literature review of epicondylitis treatment options

Treatment	Studies and conclusions
Corticosteroid injection	Assendelft et al[4] (1996) performed a systematic review that identified 12 RCTs. Pooled data showed short-term effectiveness but no difference at long-term follow-up. Conclusion: Existing evidence on corticosteroid use in epicondylitis is inconclusive.
	Barr et al[5] (2009) performed a systematic review that identified 5 RCTs. Large effect sizes were demonstrated in favor of corticosteroid use in the short-term follow-up period. At intermediate- and long-term follow-up, physiotherapeutic interventions were more effective than steroids. Conclusion: Steroids are effective in the short term, and physiotherapy is effective in the intermediate and long term.
	Olaussen et al[27] (2013) performed a systematic review that identified 11 RCTs. Corticosteroids had a significant effect on reduction of pain in the short term versus no intervention or NSAIDs. At intermediate-term follow-up, there was an increase in pain, reduction in grip strength, and negative effect on overall improvement. Conclusion: Steroid injections have a positive effect on lateral epicondylitis in the short term but a negative effect in the intermediate term.
	Smidt et al[34] (2002) performed a systematic review that identified 13 RCTs. Statistically significant and clinically relevant differences were found regarding pain, global improvement, and grip strength for corticosteroids compared with placebo in the short term (<6 weeks), but no difference was found in the intermediate and long term. Conclusion: It is not possible to draw firm conclusions on the effectiveness of corticosteroids because of the lack of high-quality studies.
Wait and see	Sims et al[33] (2014) performed a systematic review that identified 58 RCTs. It was shown that corticosteroids may have some short-term benefit, but there is no long-term pain relief. Other noninvasive treatments did not appear to be effective in improving pain. Conclusion: There is not a preferred method of nonsurgical treatment for this condition. Epicondylitis usually is self-limited and resolves within 12-18 months with no treatment.
	Smidt et al[35] (2002) performed an RCT with 185 participants who either received corticosteroid injections, underwent physiotherapy, or underwent a wait-and-see policy. At 6 weeks, patients in the injection group reported more pain improvement; however, by 1 year, the physiotherapy group and wait-and-see group showed the most improvement. Conclusion: In the long term, physiotherapy and a wait-and-see policy are better options for treating epicondylitis than corticosteroids.
Physical therapy	Bisset et al[7] (2006) performed an RCT with 198 participants who received 8 sessions of physiotherapy, underwent corticosteroid injections, or underwent a wait-and-see policy. Corticosteroid injections showed significantly better effects at 6 weeks but with high recurrence rates and significantly poorer outcomes in the long term compared with physiotherapy. Patients who received physiotherapy sought less additional treatment than those in the other 2 groups. Conclusion: Physiotherapy is superior to a wait-and-see policy in the short term and corticosteroid injections in the long term.
	Olaussen et al[27] (2013) performed a systematic review that identified 11 RCTs. Manipulation and exercise versus no intervention showed a beneficial effect at short-term follow-up. Moderate evidence was found for a benefit with eccentric exercise and stretching versus no intervention at short- and long-term follow-up. Conclusion: Manipulation and/or exercise and exercise and/or stretching are effective in the short term and long term, respectively.
Surgery	Grewal et al[12] (2009) performed a study of 36 patients who underwent arthroscopic release of the extensor carpi radialis brevis for epicondylitis. Of the 36 patients, 30 reported improvement in pain, strength, motion, and function with surgery. Patients in physically demanding or repetitive occupations and those with workers' compensation claims had significantly worse outcomes. Conclusion: Arthroscopic release for epicondylitis provides symptomatic improvement in most patients; patient selection has an important role in outcomes.
	Owens et al[28] (2001) performed a study of 16 patients who underwent arthroscopic release of the extensor carpi radialis brevis. All patients reported pain improvement at an average follow-up of 24.1 months. Conclusion: Arthroscopic release effectively treats lateral epicondylitis.
PRP injection	Arirachakaran et al[3] (2016) performed a systematic review of 10 RCTs. PRP injection significantly improved pain and function when compared with corticosteroid injection and autologous blood injection and had a lower complication risk. Conclusion: PRP can improve pain in the treatment of epicondylitis.
	Krogh et al[17] (2013) performed a systematic review of 17 RCTs on injection therapies in the treatment of lateral epicondylitis. Both PRP trials found that PRP was statistically superior to placebo. Conclusion: There is a paucity of evidence from unbiased trials.
	Palacio et al[29] (2016) performed a study of 60 patients who were randomized to receive either PRP, 0.5% neocaine, or dexamethasone injections. Patient outcomes were assessed using DASH and PRTEE scores. Symptom improvement occurred in 81.7% of all patients. Conclusion: There is no statistically significant difference between the treatments.
	Peerbooms et al[30] (2010) performed a study of 100 patients who were randomly assigned to PRP or corticosteroid injections for the treatment of lateral epicondylitis. The outcomes measured were VAS and DASH scores. Conclusion: Treatment with PRP significantly reduces pain and improves function as compared with corticosteroid injections.
	Rodik and McDermott[31] (2016) performed a review of 3 RCTs and 1 cohort study. All studies demonstrated significant improvements with PRP over comparison injections or no injections. Conclusion: PRP injections provide more favorable pain and function outcomes than whole blood and corticosteroid injections for 1-2 years after injection.

RCT, randomized controlled trial; *NSAIDs*, nonsteroidal anti-inflammatory drugs; *PRP*, platelet-rich plasma; *DASH*, Disabilities of the Arm, Shoulder and Hand; *PRTEE*, Patient-Rated Tennis Elbow Evaluation; *VAS*, visual analog scale.

Table II Post-procedure protocol

Phase	Length of time	Restrictions	Rehabilitation
Phase I: tissue protection	0-3 d	Consider using sling for comfort No weight training Avoid NSAIDs and ice	Relative rest Activities as tolerated; avoid excess loading or stress to treated areas Gentle movement of extremity (active range of motion)
Phase II: early tissue healing	4-14 d	Progress to full weight bearing without protective device Avoids NSAIDs and ice	Light activities to provide motion to tendon Gentle prolonged stretching May work on core strengthening and strengthening away from injury site
	2-6 weeks	Avoid eccentric exercises Avoid NSAIDs and ice	Low-weight, high-repetition exercise with pain rating < 3 of 10 Soft-tissue work on tendon, such as deep tissue massage "Dynamic" stretching
Phase III: collagen strengthening	6-12 weeks		Eccentric exercises with pain rating < 3 of 10 Plyometrics; proprioceptive training and other sport-specific exercises Progress load-bearing activities and consider return to sport if pain rating < 3 of 10
	≥3 mo	Reassess improvement: if not >75% improved, consider repeat injection and return to phase I	Progress back to functional sport-specific activities with increasing load on tendon as pain allows

NSAIDs, nonsteroidal anti-inflammatory drugs.

Post-procedure protocol

The post-procedure protocol for PRP and Tenex patients was in accordance with the protocol published by Mautner et al[21] in 2011 (Table II).

Data collection

At our institution, patients are contacted to complete patient-reported outcome surveys as standard of care both before the procedure and at various follow-up times. The 75 individuals who met the inclusion criteria, regardless of whether they had previously completed outcome surveys, were contacted via phone or e-mail to complete post-procedure patient-reported outcome surveys at the initiation of the study. Data collection included age, sex, affected joint, date of the procedure, interventions before and after the procedure, satisfaction with the procedure, and data from patient-reported questionnaires before and after treatment. In addition, a retrospective chart review was performed to determine the length of pain before the procedure and confirm information collected by the survey, including sex, affected joint, date of the procedure, and interventions before and after the procedure.

Subjective assessment of pain and function was obtained before and after the procedure using a visual analog scale (VAS) for pain; the Quick Disabilities of the Arm, Shoulder and Hand (QDASH) questionnaire; and the EuroQol-5D (EQ5D) questionnaire. Patient baseline scores were recorded immediately before the procedure. Post-procedure scores were obtained routinely via e-mail voluntarily at 3 months and 6 months after the procedure. In this case we contacted patients to complete a current survey owing to missing data after the procedure. Before analysis, the patients were split into 2 cohorts: those who received PRP (cohort 1) and those who received the Tenex procedure (cohort 2).

Statistical analysis

A department-designated statistician performed the analysis of the collected data. Repeated-measures analyses were used to analyze the QDASH scores, VAS pain scores, and quality-of-life scores using a means model via the SAS MIXED Procedure (version 9.4; SAS Institute, Cary, NC, USA), providing separate estimates of the means by treatment group and time in the study (baseline and after procedure). A compound-symmetrical variance-covariance form in repeated measurements was assumed for each outcome, and robust estimates of the standard errors of parameters were used to perform statistical tests and construct 95% confidence intervals.[9] Model-based means are unbiased with unbalanced and missing data, as long as the missing data are noninformative (missing at random). Predictors included in each model were treatment group, follow-up time, and the interaction between treatment group and follow-up time. All specific statistical tests were performed within the framework of the mixed-effects linear model, using t tests to compare differences between the model-based means. The results were summarized with adjusted means and 95% confidence intervals by treatment group and follow-up time. Statistical tests were 2-sided and unadjusted for multiple comparisons. $P \leq .05$ was considered statistically significant. Before study initiation, sample size calculations performed for a paired t test using an α of .05, a β of .20, and an effect size of 0.50 revealed that cohorts of 30 patients were needed for each treatment group to discern a difference in VAS score. In addition, a simple matched-pair t test was performed for available applicable data.

Results

Of the 75 patients who met the inclusion criteria, 62 completed the post-procedure patient-reported outcome surveys

Table III Descriptive statistics by treatment

Characteristics	PRP (n = 32)	Tenex (n = 30)	*P* value
Age, yr	47 ± 12 (18-73), n = 32	51 ± 8 (39-69), n = 30	.11*
Length of pain, mo	26 ± 24 (3-98), n = 31	25 ± 21 (2-75), n = 29	.80*
Follow-up, mo	17 ± 11 (1-34), n = 32	10 ± 6 (2-27), n = 30	.0020*
Satisfaction	3.8 ± 1.5 (0.0-5.0), n = 29	3.6 ± 1.4 (0.0-5.0), n = 30	.68*
Sex			
Female	10/32 (31.3%)	12/30 (40.0%)	.47†
Male	22/32 (68.8%)	18/30 (60.0%)	
Satisfaction			
0	1/29 (3.4%)	1/30 (3.3%)	.80†
1	3/29 (10.3%)	2/30 (6.7%)	
2	2/29 (6.9%)	3/30 (10.0%)	
3	2/29 (6.9%)	6/30 (20.0%)	
4	9/29 (31.0%)	8/30 (26.7%)	
5	12/29 (41.4%)	10/30 (33.3%)	
Elbow			
Right	22/32 (68.8%)	17/30 (56.7%)	.33†
Left	10/32 (31.3%)	13/30 (43.3%)	
Lateral	26/31 (83.9%)	25/30 (83.3%)	.99†
Medial	5/31 (16.1%)	5/30 (16.7%)	

PRP, platelet-rich plasma.
Data are presented as mean ± standard deviation (minimum-maximum) or as frequency/total (percentage).
* Two-sided 2-sample equal variance *t* test.
† Fisher exact test.

(83% follow-up rate). The 62 patients included in the analysis were divided into 2 groups based on treatment: 32 underwent PRP procedures, and 30 underwent Tenex procedures. No statistically significant difference in average age, sex, affected elbow, length of elbow pain before the procedure, or type of epicondylitis was found between the PRP and Tenex groups. The mean follow-up length in the PRP group and Tenex group (17 months and 10 months, respectively) varied significantly ($P = .002$). There was no statistically significant difference in patient satisfaction between groups, as 79.3% of PRP patients and 80% of Tenex patients reported being satisfied with the procedure (Table III). All patients had previously tried activity modification, physical therapy, massage therapy, or corticosteroid injections—or a combination thereof—and the use of all of these conservative treatments was statistically equivalent between the PRP and Tenex groups (Table IV). In 5 PRP patients (16%) and 6 Tenex patients (20%), additional procedures were performed for their ME or LE because of refractory pain. Of these 11 patients, only 1 in the Tenex group and none in the PRP group underwent surgical intervention.

Overall, QDASH scores improved from baseline in both the PRP and Tenex treatment groups. The QDASH score decreased from 30.0 ± 3.4 to 9.4 ± 3.3 ($P < .0001$) in the PRP group and from 35.9 ± 5.0 to 12.5 ± 3.4 in the Tenex group ($P < .0001$). No statistically significant difference in improvement was found between groups: 20.6 for PRP and 23.4 for Tenex ($P = .68$).

Both treatment groups demonstrated significant improvement in VAS pain scores. The VAS score decreased from 4.2 ± 0.5 to 2.3 ± 0.5 ($P = .0051$) in the PRP group and from 5.5 ± 0.8 to 2.2 ± 0.5 ($P = .0005$) in the Tenex group. No difference in pain improvement was noted between groups ($P = .17$). In addition, matched pairs were compared within

Table IV Treatment before PRP or Tenex procedure

Pre-procedure treatment	PRP (n = 32)	Tenex (n = 30)	*P* value*
Activity modification	32/32 (100.0%)	30/30 (100%)	
Physical therapy			
Yes	27/32 (84.4%)	27/30 (90.0%)	.71
No	5/32 (15.6%)	3/30 (10.0%)	
Massage therapy			
Yes	4/32 (12.5%)	5/30 (16.7%)	.73
No	28/32 (87.5%)	25/30 (83.3%)	
Corticosteroid injection			
Yes	17/32 (53.1%)	15/30 (50.0%)	.99
No	15/32 (46.9%)	15/30 (50.0%)	
PRP			
Yes	4/32 (12.5%)	6/30 (20.0%)	.50
No	28/32 (87.5%)	24/30 (80.0%)	
Tenex			
Yes	1/32 (3.1%)	1/30 (3.33%)	.99
No	31/32 (96.9%)	29/30 (96.7%)	

PRP, platelet-rich plasma.
Data are presented as frequency/total (percentage).
* Fisher exact test.

pairs and among pairs between cohorts. PRP demonstrated a mean difference of 1.84, whereas Tenex showed a difference of 3.55. No statistically significant difference was noted between cohorts ($P = .47$). However, between pairs in each cohort, a statistically significant difference was noted ($P < .0001$).

The EQ5D scores also improved after PRP or Tenex treatment. The EQ5D score increased from 0.73 ± 0.03 to 0.93 ± 0.03 in the PRP group ($P < .0001$) and from 0.65 ± 0.04 to 0.89 ± 0.03 in the Tenex group ($P < .0001$). No difference in improvement was found between groups ($P = .55$).

Discussion

ME and LE are common conditions that affect between 1% and 3% of the population, mainly in persons aged 35 to 55 years.[2,32] Fortunately, these are self-limiting conditions in the majority of patients.[2] Although a multitude of treatment options are available, there is currently no clear gold-standard treatment for patients with chronic pain. With the aging population, successful, less invasive treatment modalities are essential. The purpose of this study was to compare 2 treatment options, PRP and Tenex, for the treatment of epicondylitis.

Our results showed significant improvements in pain, function, and quality of life in patients in both the PRP and Tenex treatment groups. In addition to the statistically significant improvement noted in patients, there was a clinically significant improvement. The minimal clinically important difference has been reported to be between 14 and 16 points on a 100-point scale for the QDASH score, 1.2 points on a 10-point scale for the VAS score, and between 0.04 and 0.08 for the EQ5D score.[11,14,16,20,36] The QDASH score improved by 20.6 points in the PRP group and 23.4 points in the Tenex group; the VAS score improved by 1.9 points and 3.3 points, respectively; and the EQ5D score improved by 0.20 and 0.24, respectively. All of these changes are well above the cited minimal clinically important difference values and illustrate the clinical improvements made in these patients.

Despite myriad studies evaluating the efficacy of PRP, there is little consensus about its use in the treatment of LE owing to the various methods of preparation and the lack of standardization of the technique. In our study, LP PRP was used over leukocyte-rich (LR) PRP. It is our belief that this reduces the risk of a proinflammatory response after injection. Controversy remains as to the implications of LR versus LP PRP. Yerlikaya et al[39] performed a double-blinded randomized controlled trial (RCT) of LR versus LP PRP and demonstrated no statistically significant difference for either group compared with a control group receiving saline solution in terms of pain or function. However, the study's endpoints were at 4 and 8 weeks, which may have failed to account for a time-dependent treatment. In our study, the PRP cohort had a 7-month longer follow-up, which may have skewed some of the results. In a study comparing LP PRP with bupivacaine, Behera et al[6] demonstrated a time-dependent benefit with the use of LP PRP regarding pain scores and patient-reported outcomes at 6 months and 1 year compared with a control group. A meta-analysis by Fitzpatrick et al[10] evaluated different PRP preparation methods and injection techniques and found that LR PRP methods had a stronger positive effect than LP PRP.

Other studies have looked at more conventional methods with adjuvant therapy, such as including PRP. Mishra et al[25] performed a double-blind, prospective, multicenter RCT of 230 patients who underwent ultrasound-guided percutaneous tenotomy with or without LR PRP. The study demonstrated a significant benefit in favor of the LR PRP group regarding pain and satisfaction at 24 weeks' follow-up. However, the study failed to demonstrate a difference at 12 weeks, showing that PRP may have a time-dependent response. Because patients were not followed up longer, it is unclear whether the 2 cohorts reach an equilibrium of response as time from treatment ensues.

Regarding more generalized data compared with conventional therapies, many studies have investigated PRP injections and Tenex and compared 1 method or the other with bracing, a wait-and-see policy, corticosteroid injections, lidocaine injections, saline solution injections, autologous whole blood injections, and arthroscopic and open releases.[2,3,17,18,22,35,38] A literature review conducted in 2015 by Murray et al[26] identified 6 RCTs comparing PRP with other treatment options and concluded that although PRP could be a safer and more cost-effective alternative to surgery, results throughout the literature were conflicting and, thus, more research was needed. Of the 6 RCTs, 4 showed that PRP provided a statistically significant improvement in pain compared with active control, corticosteroids, and autologous whole blood injections.[26] An RCT performed in 2017 concluded that PRP significantly reduces pain and increases function compared with corticosteroids at 6 months.[37] Tenex use in patients with recalcitrant LE has been shown to significantly improve VAS and Disabilities of the Arm, Shoulder and Hand scores in as little as 1 week and for as long as 12 months, with favorable sonographic tendon changes noted at 6 months.[15]

The strengths of our study include (1) the high follow-up rate, (2) the large number of patients, and (3) the length of follow-up time. Some limitations of the study include the following: (1) The follow-up times were different between groups; (2) the PRP was not analyzed and, thus, we are unable to correlate platelet counts with outcomes; and (3) the patients were not randomized into the treatment groups. Several aspects of the study may highlight potential treatment biases for LE or ME. First, the cost associated with each treatment may vary based on insurance status and location of the treatment. The Tenex procedure often requires a surgical suite, machine, disposable needle, and operating room staff that may prove to be more costly to the health care system as a whole. However, the burden of these costs is often shared by the insurance company and the patient. In contrast, PRP may ultimately be less expensive to the health care system but may require a higher out-of-pocket expense for the patient. In this study, patients were often presented with both choices and

a discussion was held with a financial counselor to see which would cost the patient less. The decision was ultimately patient driven with factors that may be less known to us. It is unclear what effect this had on patient bias across cohorts because, with the exception of patient follow-up, the patient variables showed no statistically significant difference. A clear understanding of how the disease entity ensues and how each treatment is effective in treating certain aspects of the disease process are clearly not known. Future RCTs with a larger number of patients and a standardized PRP protocol are needed to determine whether there is a significant clinical difference in how PRP and Tenex are able to treat ME and LE.

Conclusion

PRP and Tenex procedures are effective, minimally invasive, nonsurgical options for treating recalcitrant ME or LE. Both treatment modalities showed a clinically and statistically significant improvement in pain and function, and no statistically significant difference between PRP and Tenex was found regarding improvement in pain, function, or quality of life or treatment success.[4,5,7,12,17,27-31,33-35]

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