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Ultrasound-guided tenotomy improves physical function and decreases pain for tendinopathies of the elbow: a retrospective review

Daniel Stover, BA[a], Benjamin Fick, BS[a], Ruth L. Chimenti, DPT, PhD[b], Mederic M. Hall, MD[c,*]

[a]*Carver College of Medicine, University of Iowa, Iowa City, IA, USA*
[b]*Department of Physical Therapy & Rehabilitation Science, University of Iowa, Iowa City, IA, USA*
[c]*Department of Orthopedics & Rehabilitation, University of Iowa Sports Medicine, Iowa City, IA, USA*

Background: Tendinopathy is a common cause of elbow pain in the active population. Ultrasound-guided tenotomy (USGT) is a minimally invasive treatment option for cases recalcitrant to conservative management. Several case studies have shown promising preliminary results of USGT for common extensor tendinopathy and common flexor tendinopathy, but none have included USGT for triceps tendinopathy. This larger retrospective study evaluates the effectiveness and safety of USGT for all elbow tendinopathy sites at short- and long-term follow-up.

Methods: Retrospective chart review identified 131 patients (144 procedures; mean age ± standard deviation [SD], 48.1 ± 9.8 years; mean body mass index ± SD, 32.2 ± 7.7; 59% male) with elbow tendinopathy (104 common extensor tendinopathy, 19 common flexor tendinopathy, 8 triceps tendinopathy) treated with USGT over a 6-year period by a single physician. Pain and quality-of-life measures were collected at baseline. Pain, quality-of-life, satisfaction with outcome, and complications were collected at short-term (2-, 6-, and 12-week) and long-term (median 2.7 years, interquartile range = 2.0-4.0 years) follow-up.

Results: Overall, USGT for elbow tendinopathy decreased pain from moderate/severe at baseline to mild/occasional at short- and long-term follow-up ($P < .01$). Quality-of-life assessments showed significant improvement in physical function at short- and long-term follow-up ($P < .01$). The majority (70%) of patients were satisfied with the procedure. There was a 0% complication rate.

Conclusion: Benefits of USGT include pain relief, improved physical function, and high patient satisfaction. USGT is a safe, minimally invasive treatment for refractory elbow tendinopathy.

Level of evidence: Level IV; Case Series; Treatment Study

Keywords: Tendinopathy; epicondylitis; sports medicine; elbow

Elbow tendinopathy is a common ailment that can affect an individual's ability to perform his or her job, recreational activities, and activities of daily living. Elbow tendinopathy may be experienced at multiple sites, including the common extensor tendon, common flexor tendon, and triceps

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*Reprint requests: Mederic M. Hall, MD, UI Sports Medicine, 2701 Prairie Meadow Drive, Iowa City, IA 52242, USA.

E-mail address: mederic-hall@uiowa.edu (M.M. Hall).

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tendon. Initial treatment for all diagnoses consists of conservative measures such as rest, activity modification, bracing, and physical therapy. However, there are no accepted standards of care if the cases are recalcitrant to these conservative measures.

One minimally invasive option is ultrasound-guided tenotomy (USGT). Because the most common elbow tendinopathy is common extensor tendinopathy, most of the research on USGT has been done at this location.[2,3,8-10,12] These studies have shown promising results with high patient satisfaction (>70%), improvements in pain (>60%), and no major complications; however, they have had relatively small sample sizes (N < 60). There has been minimal published research on USGT for common flexor tendinopathy,[1,2,4,5] with the largest sample size of N=7. There is even less information on USGT for triceps tendinopathy. To date, there is only 1 case report, which showed sustained improvement at 3 years.[6] Most of the information guiding care has thus generalized the aforementioned studies on common extensor tendinopathy to all elbow tendinopathies.

This retrospective chart review has the largest sample size to date in the current literature on USGT for elbow tendinopathy (N=131). Further subgroup analysis of USGT for common extensor tendinopathy will also provide the largest sample of USGT specific to common extensor tendinopathy (n = 104). Descriptive statistics of USGT for common flexor tendinopathy and triceps tendinopathy will indicate safety of the procedure at these sites and provide the groundwork for further research. The primary outcomes assessed in this study include (1) changes in self-reported pain and quality-of-life (physical function and mental health subscores), (2) patient satisfaction at short-term follow-up, and (3) complication rate. We hypothesize that USGT for elbow tendinopathy will decrease pain, improve quality-of-life, and have high patient satisfaction with no major complications.

Materials and methods

This retrospective review of charts dated between September 2013 and January 2019 identified 131 patients with a total of 144 USGT procedures for their elbow tendinopathy pain. Three patients had repeat procedures at the same site and 10 patients had 2 procedures at different sites. The 3 diagnoses analyzed were common extensor tendinopathy (patients=104, procedures=109), common flexor tendinopathy (patients=19, procedures=24), and triceps tendinopathy (patients=8, procedures=11). The patients had a median duration of symptoms of 14 months (interquartile range = 10-24 months) prior to USGT. Most of these patients had failed other forms of treatment, such as physical therapy (86 of 131 patients), corticosteroid injections (78 of 131 patients), or PRP (8 of 131 patients) prior to the USGT procedure. Further, more than half of patients (67/131) had failed more than 1 mode of treatment before USGT.

Outcomes were assessed at short-term follow-up (2, 6, and 12 weeks) and long-term follow-up (median = 2.74 years, interquartile range = 1.97-4.07 years). At the time of procedure, baseline metrics were collected to monitor improvement. After the procedure, patients were scheduled for follow-up appointments in the clinic at 2, 6, and 12 weeks. Repeat outcome measures, patient satisfaction, return to normal activity, and complications were collected at these visits. Long-term data was collected via email and phone surveys, with 77 of the 131 patients (59%) responding to our long-term survey.

Quality-of-life was assessed using the Short-Form 12-Item Survey (SF-12) or the Patient Reported Outcome Measurement Information System v1.1–Global (PROMIS Global Health). The SF-12 includes 12 questions and produces Physical Component Summary (PCS) and Mental Component Summary (MCS) subscores.[11] The PROMIS Global Health is 10 questions and produces Global Physical Health (GPH) and Global Mental Health (GMH) subscores.[7] Both the SF-12 and the PROMIS Global Health compare the patient's scores to the general population using *t* scores (mean 50; standard deviation [SD] 10).[7,11] The baseline quality-of-life survey was changed from the SF-12 to the PROMIS Global Health in September 2017 when clinic procedures changed from paper to electronic data capture. Out of 101 patients with quality-of-life data, 76 (75%) patients were assessed with the SF-12 from baseline through short- and long-term follow-up, and 25 (25%) patients were assessed with the PROMIS Global Health from baseline through short- and long-term follow-up. All patients completed follow-up surveys using the same quality-of-life outcome measure that they completed at baseline.

Pain was quantified on a 4-point scale using a question from the Mayo Elbow Performance Score (0 = none, 1 = mild/occasional, 2 = moderate/daily, and 3 = severe/constant) or asking the patient, "Which number best describes your current pain right now?" on a 10-point numerical rating scale (0 = none; 1-3 = mild; 4-6 = moderate; 7-10 = severe). The 10-point numerical rating scale was used after patients were no longer asked to fill out the Mayo Elbow Performance Score when data capture was transitioned from paper to electronic in September 2017.

Patient satisfaction was assessed at short-term follow-up (2, 6, and 12 weeks) by asking the patient, "Are you satisfied with the procedure and outcome?" via a 5-point scale (1 = very satisfied; 2 = somewhat satisfied; 3 = neutral; 4 = somewhat dissatisfied; and 5 = very dissatisfied). Complications were recorded as a part of routine clinical care in short-term follow-up visits and via patient report on long-term follow-up. Our definition of complication included any associated infection, postprocedure tendon tear, or neurovascular injury associated with the procedure.

Procedure Description

All procedures were performed by a single physician (M.M.H.) with fellowship training in sports medicine and ultrasound-guided procedures. The procedures were performed in an outpatient clinical procedure suite under sterile conditions including use of a sterile transducer cover and sterile acoustic coupling gel. All patients had undergone a diagnostic ultrasonography confirming location and extent of pathology before the procedure (Fig. 1). Only patients with both clinical symptoms of tendinopathy and imaging-identified pathology amenable to treatment with USGT

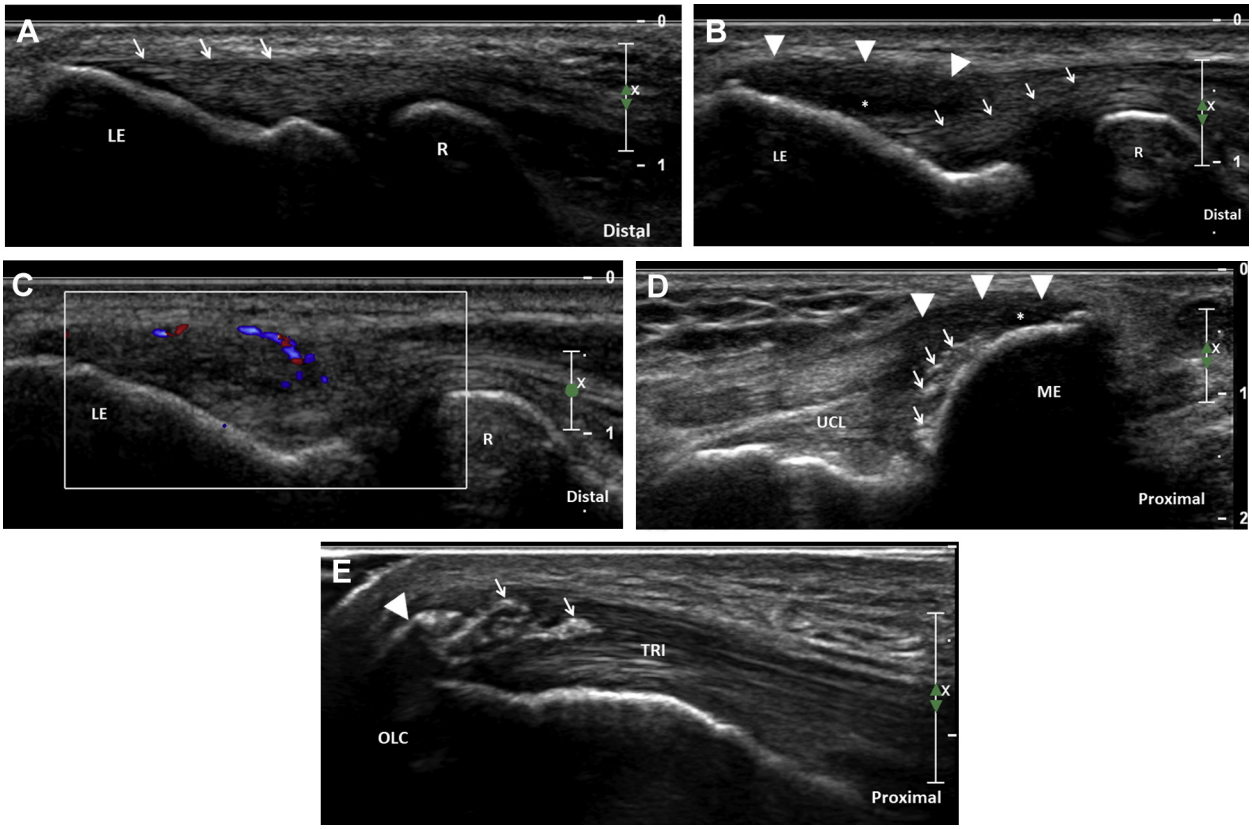

Figure 1 Preprocedure diagnostic ultrasound demonstrating the typical findings of tendinosis amendable to ultrasound-guided tenotomy. (**A**) Normal long axis appearance of the common extensor tendon with tightly packed and well-organized hyperechoic fibers (→). (**B**) The common extensor tendon origin is swollen and hypoechoic with loss of the tightly packed fibrillar structure represented as heterogeneity of the tendon (►). A linear region of anechogenicity (*) likely represents a small partial-thickness intrasubstance tear. Note the normal appearance of the radial collateral ligament deep to the common extensor tendon (→). (**C**) Color Doppler image demonstrating neovascularity (color flow) within the region of tendinosis. (**D**) Long-axis image of the common flexor tendon with similar findings of tendinosis including hypoechoic swollen tendon origin (►) with region of high-grade tendinosis vs. partial-thickness tear (*). Small calcifications (→) are also appreciated that extend into the ulnar collateral ligament (UCL) humeral attachment. (**E**) Long-axis image of triceps tendon (TRI) insertion demonstrating amorphous intratendinous calcification (→) adjacent to an olecranon enthesophyte (►). *LE*, lateral epicondyle; *R*, radius; *ME*, medial epicondyle; *OLC*, olecranon.

(degenerative or calcific regions of tendon) were indicated for the procedure. Any associated instability of the lateral or medial elbow was noted. The location of the ulnar nerve was specifically documented in all cases of common flexor tendinopathy.

Patient positioning varied by site. For the common extensor tendon, patients were placed supine with the head of the bed elevated 30°, and the elbow resting on the procedure table in pronation and slight flexion. Patients undergoing treatment of the common flexor tendon were supine or side-lying with the upper limb abducted and the elbow supinated and extended. Treatment of the triceps tendon was performed with the patient prone with the upper limb abducted and elbow flexed 90° with the forearm and hand hanging free off the edge of the procedure table.

All procedures were performed under constant live ultrasound guidance using a Philips iU22 or Epiq ultrasound cart (Philips Healthcare, Bothell, WA, USA) and a 12.5-MHz or 18.5-MHz high-frequency linear array transducer. Local anesthesia was provided with either 1% lidocaine without epinephrine only or a combination of 1% lidocaine without epinephrine and 0.5% ropivacaine. On average, approximately 5 mL of local anesthetic was used. No one required sedation or any other form of anesthesia outside of local infiltration. The TX 1 or TX 2 (Tenex Health, Lake Forest, CA, USA) ultrasonic cutting instrument was used to perform all tenotomy and tendon débridement procedures (Fig. 2). Both devices function in a similar fashion using ultrasonic energy to cut and débride tissue, with the only differences being in length and external manufacturing, which do not affect the cutting mechanism of the device. A distal to proximal approach was used for the common extensor and common flexor tendon, whereas a proximal to distal approach was used for the triceps tendon.

The goal of the procedure was to débride regions of degenerative tissue (tendinosis) and any associated calcifications that were present in the tendon. Ultrasound characteristics of the tissue were used to determine extent of tenotomy performed. Following the procedure, all incisions were closed with a single adhesive wound closure strip followed by a transparent film dressing and a compressive sleeve. Special considerations were required at each individual site. At the lateral elbow, care was taken not to débride the radial collateral ligament humeral attachment to avoid inadvertently destabilizing the elbow. At the medial elbow, extreme care was taken to avoid the ulnar nerve both during the initial

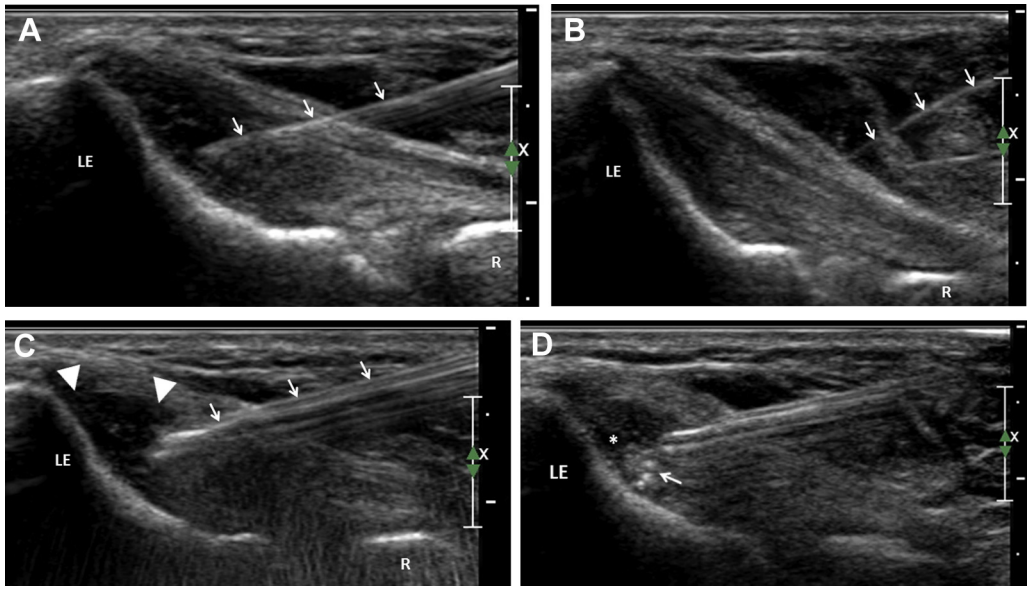

Figure 2 Ultrasound-guided tenotomy of the common extensor tendon. (**A**) Local anesthesia is delivered with a 27- or 25-gauge needle (→) into the subcutaneous tissues and down to the region of tendinosis. (**B**) A No. 11 scalpel blade (→) is used to make a 5-mm incision down to the tendon to allow introduction of the cutting device. (**C**) The TX 2 device (→) débrides the region of hypoechoic degenerative tissue (►). (**D**) Once débridement is complete, the hypoechoic degenerative tissue is replaced with anechoic irrigation fluid (*) and hyperechoic microbubbles (→). *LE*, lateral epicondyle; *R*, radius.

incision and the débridement itself. When treating the triceps tendon, overdistension of the olecranon bursa from irrigation fluid was avoided and aggressive postprocedure compression was recommended.

Postprocedure rehabilitation was individualized, but generally consisted of 2 weeks of relative rest with early range of motion beginning on postprocedure day 1. Activities of daily living were resumed as tolerated, with the exception of a 5-lb lifting restriction through the first 6 weeks. A progressive strengthening program was started at 2 weeks (within the aforementioned weight restriction) and then progressed at 6 weeks and continued until the patient reached desired functional status and full return to sport and work. In certain cases, the lifting restriction was modified based on preprocedural functional status and degree of tendon pathology. This was particularly common for the triceps tendon cohort, which was composed of a large number of competitive powerlifters and strongmen. Full return to sport and work was individualized based on functional assessment, but this typically occurred between 6 and 12 weeks or sooner for those with low physical demand jobs.

Analysis

Descriptive statistics were used to report characteristics for the sample as a whole and by elbow tendinopathy type (common flexor, common extensor, triceps). Nonparametric (Wilcoxon signed rank) and parametric (paired *t* test) tests were used to compare repeated measures (baseline to short-term follow-up and baseline to long-term follow-up). Because repeated measures compare changes within individuals over time, the use of SF-12 by some participants and PROMIS Global Health by others did not affect the statistical analyses. Descriptive data for each quality-of-life outcome measure was provided to allow for comparison to other studies. Type I error rate was maintained at 0.05 by using Bonferroni adjustment for multiple comparisons (0.05/3 for 3 self-reported outcome measures: Pain, Physical Function, Mental Health). Descriptive data, rather than statistical comparisons, were provided when the number of participants with data at both baseline and a follow-up time was <15 (common extensor and triceps) owing to insufficient power. To maintain independence of observations in the analyses, patient-reported outcomes of pain and quality-of-life are reported per patient (N=131).

Descriptive statistics were used to report patient satisfaction and complications. Patient satisfaction is reported per patient (N=131) and complications are reported per procedure (N=144). To minimize sample bias and maximize the inclusion of the patients from all identified in the retrospective review, data on patient satisfaction and complication rate were included from any time point.

Results

The sample of 131 patients had a mean age ± SD of 48.1 ± 9.8 years and a mean BMI ± SD 32.2 ± 7.7, which is in the obese category. The sample was predominately white (94%) and male (59%). Overall, pain decreased significantly at short- and long-term follow-up (Table I; $P < .01$). Pain decreased significantly at short- and long-term follow-up for the common extensor tendinopathy subgroup (Table II; $P < .01$). Although not statistically compared over time, the percentage of respondents with moderate to severe pain at the common flexor location decreased from 93% at baseline to 0% at long-term follow-up. (Table II). The triceps location was not statistically compared over time;

Table I Pain at baseline, short-term (6- or 12-week), and long-term follow-up

	Baseline	Short-term follow-up*	Long-term follow-up†
Response rate, %	63	63	59
None, n (%)	0 (0)	7 (8)	36 (47)
Mild/occasional, n (%)	9 (11)	55 (66)	33 (43)
Moderate/daily, n (%)	55 (67)	16 (19)	6 (8)
Severe/constant, n (%)	18 (22)	5 (6)	2 (3)

Unless otherwise noted, values are presented as number (% of respondents). The number of respondents varied by time point. Short-term follow-up: 6 weeks, n = 26; 12 weeks, n = 57. Long-term follow-up: median = 2.74 years (interquartile range = 1.97-4.07 years).
* Wilcoxon signed-rank test, n = 52 compared to baseline, $P < .01$.
† Wilcoxon signed-rank test, n = 44 compared to baseline, $P < .01$.

however, the percentage of respondents with moderate to severe pain decreased from 100% at baseline to 0% at short-term follow-up.

USGT improved physical function from baseline to short- and long-term follow-up ($P < .01$ for both comparisons, Table III). A similar pattern of improvement in physical function was seen in the common extensor tendinopathy group from baseline to short- and long-term follow-up ($P < .01$ for both comparisons; Table IV). Although not statistically compared over time, other subgroups demonstrated increases in physical function at short and long-term follow-up. In our sample, the average mental health score was at or above average at baseline (t score $>$ 50), and USGT did not adversely affect mental health (t score $\geq$ 50 at all time points).

At 6-week follow-up, 22 of 70 respondents had resumed normal activity. At 12-week follow-up, 37 of 57 respondents had resumed normal activity.

At short-term follow-up, the majority (70%) of respondents were satisfied (39% very satisfied; 31% somewhat satisfied) with the procedure and the outcome (Table V). A minority of patients reported being neutral (16%) or dissatisfied (14%) with the procedure. There were no reported complications at any site.

Discussion

This is the largest study on the safety and effectiveness of USGT for elbow tendinopathy (N=131), and the first to include complication rate for the procedure in patients with common extensor, common flexor, and triceps tendinopathy. The results show that USGT usually reduces elbow tendinopathy pain, increases physical function components of quality-of-life, and has high patient satisfaction. This study provides encouraging long-term outcomes of USGT for elbow tendinopathy (median long-term follow-up: 2.74 years, longest follow-up of 5.9 years). Although these findings should be considered preliminary because of the retrospective study design (Level IV evidence), our findings are consistent with previous research on USGT for elbow tendinopathy and further support its use for chronic elbow tendinopathy pain.[2-4,8,9,12]

Table II Pain at baseline, short-term (6- or 12-week), and long-term follow-up separated by elbow tendinopathy location

	Baseline	Short-term follow-up*	Long-term follow-u†
Common extensor			
Response rate, %	61	65	59
None, n (%)	0 (0)	4 (6)	30 (49)
Mild/occasional, n (%)	8 (13)	46 (68)	24 (39)
Moderate/daily, n (%)	38 (60)	14 (21)	5 (8)
Severe/constant, n (%)	17 (27)	4 (6)	2 (3)
Common flexor			
Response rate, %	74	53	58
None, n (%)	0 (0)	1 (10)	6 (55)
Mild/occasional, n (%)	1 (7)	6 (60)	5 (45)
Moderate/daily, n (%)	12 (86)	2 (20)	0 (0)
Severe/constant, n (%)	1 (7)	1 (10)	0 (0)
Triceps			
Response rate, %	63	63	13
None, n (%)	0 (0)	2 (40)	0 (0)
Mild/occasional, n (%)	0 (0)	3 (60)	0 (0)
Moderate/daily, n (%)	5 (100)	0 (0)	1 (100)
Severe/constant, n (%)	0 (0)	0 (0)	0 (0)

Unless otherwise noted, values are presented as number (% of respondents). The number of respondents varied by time point.
Common extensor: short-term follow-up: 6 weeks, n = 22; 12 weeks, n = 46. *Wilcoxon signed-rank test for common extensor only, n = 43 compared to baseline, $P < .01$.
Common extensor long-term follow-up: median = 2.67 years (interquartile range= 1.86 to 4.04 years). †Wilcoxon signed-rank test for common extensor only, n = 34 compared to baseline, $P < .01$.

We found that USGT for chronic elbow tendinopathy significantly decreased pain ($P < .01$) from a median of moderate/daily pain at baseline to mild/occasional pain at short- and long-term follow-up. Further, 36 of the 77 patients with long-term data reported no pain. Our findings on changes in pain are consistent with current literature[2-4,8-10] and provide further evidence for the effectiveness of USGT in chronic elbow tendinopathy.

This study showed that USGT for elbow tendinopathy improved quality-of-life and had moderate satisfaction. The physical function component of the SF-12 improved from below average (greater than 1 SD below what is considered

Table III Quality-of-life surveys at baseline, short-term (6- or 12-week), and long-term follow-up

	Baseline	Short-term follow-up*	Long-term follow-up†
	n = 71	n = 62	n = 57
SF-12: PCS	37.2±7.0	42.3±9.7	48.0±5.5
SF-12: MCS	56.6±9.2	57.0±8.3	54.2±8.8
	n = 24	n = 21	
PROMIS: GPH	45.5±6.6	46.5±6.0	
PROMIS: GMH	51.4±6.7	50.9±5.3	

SF-12, 12-Item Short-Form Health Survey; *PCS*, Physical Component Summary; *MCS*, Mental Component Summary; PROMIS, Patient Reported Outcome Measurement Information System; *GPH*, Global Physical Health; *GMH*, Global Mental Health.

Values are presented as mean ± standard deviation. The number of respondents varied by time point.

SF-12 Short-term follow-up: 6 weeks, n = 24; 12 weeks, n = 38. *Paired *t* test, n = 78 compared to baseline, PCS: $P < .01$, MCS: $P = .92$.

SF-12 long-term follow-up: median = 2.74 years (interquartile range = 1.97-4.07 years). †Paired *t* test, n = 47 compared to baseline, PCS: $P < .01$, MCS: $P = .04$. PROMIS short-term follow-up: 6-week, n = 10; 12-week, n = 11. PROMIS long-term follow-up: not collected.

normal) to average ($P < .01$) at short- and long-term follow-up. The mean score improved to normal in the short term and continued to increase in the long term. The mental component of the SF-12 was normal at baseline and did not change in follow-up. The global physical health and global mental health subscores of the PROMIS Global Health were within the normal range at baseline and remained in the normal range at short-term follow-up. Our preliminary findings indicate that the PROMIS Global Health may be unable to detect physical dysfunction because of chronic upper extremity pain.

Most patients were satisfied with the procedure and its outcome. At the short term, 70% of respondents were satisfied with the procedure and outcome (39% very satisfied, 31% somewhat satisfied). Although this specific scale has not been validated in this population, these rates of satisfaction are consistent with what other researchers have found with USGT for elbow tendinopathy.[2,8,10]

Unique aspects of this study include its large sample size for USGT-treated elbow tendinopathy overall, large common extensor tendinopathy subgroup analysis, and promising preliminary groundwork research for USGT of the common flexor and triceps tendons. When viewed individually, common extensor tendinopathy (n = 104) showed statistically significantly decreases in pain, improved physical function in the SF-12, and moderate satisfaction. USGT for common flexor tendinopathy and triceps tendinopathy needs further study to determine its effectiveness and safety; however, our study was able to provide some necessary first steps in its evaluation. Regarding common flexor tendinopathy, only 1 of the 14 people with baseline data reported no or mild pain prior to procedure. At long-term follow-up, 11 people reported no or mild pain. In the triceps tendinopathy subgroup, all 5 patients with baseline data reported moderate pain. At short-term follow-up, all 5 respondents reported no or mild pain. Unfortunately, we only had 2 patients with long-term follow-up regarding their pain. One patient reported moderate pain whereas the other reported no pain. Missing data and small sample sizes of common flexor tendinopathy and triceps tendinopathy precluded us from performing quantitative subgroup statistical analysis of pain and quality-of-life. Yet the inclusion of these groups in the calculation of complication rate is needed to determine safety of this procedure for all types of elbow tendinopathy. The short-term results of USGT for triceps tendinopathy show promise, but further research with larger sample size and more robust follow-up is needed to guide care.

This study did not show any complications in either short- or long-term follow-up. After the procedure, patients were scheduled for 2-, 6-, and 12-week follow-ups to discuss any of their concerns, and were welcomed to call if they had any issues outside of their appointment times. It is possible that we did not capture complications in the 8 patients who did not return to the clinic for any post-procedure follow-up visits, contact clinic staff regarding procedure-related concerns, or respond to our long-term survey. The complication rate associated with USGT should be further examined in larger, prospective studies, yet our findings are consistent with other studies showing zero serious complications with USGT for elbow tendinopathy.[2,3,8,9] Our results are encouraging as the benefits must always be weighed with potential risks associated with the procedure.

USGT has many advantages over open surgical management for chronic elbow tendinopathy recalcitrant to conservative measures. Because it is minimally invasive, it allows patients to return to their normal activities sooner. Thirty-seven of 57 respondents had returned to their normal activity at 12 weeks. This minimally invasive technique allows for postoperative pain to be managed with nonopioid medications, reducing the risks associated with opioid abuse. The costs and resources required for USGT are vastly lower than for an open procedure as it can be performed safely in an outpatient clinic setting with only local anesthesia. At our institution, the cost of an open débridement of the common extensor tendon is greater than 3 times more than an USGT at this location.

A key limitation of this retrospective study was missing data on self-reported pain and quality-of-life measures, with a 63% (83/131) response rate at short-term follow-up. The long-term follow-up, with a 59% response rate, captured data on an additional 45 patients for a total response rate of 88% (115/131) at short- and/or long-term follow-up. Yet this did not compensate for those missing baseline data on pain and quality-of-life who were excluded from statistical comparisons over time. Thus, we provided

Table IV Quality-of-life surveys at baseline, short-term (6- or 12-week), and long-term follow-up separated by elbow tendinopathy location

Common extensor	Baseline	Short-term follow-up*	Long-term follow-up†
	n = 57	n = 53	n = 48
SF-12: PCS	36.4±6.2	41.2±8.7	48.4±5.3
SF-12: MCS	56.4±9.4	57.2±8.9	54.2±9.1
	n = 22	n = 19	
PROMIS: GPH	44.5±6.7	46.1±6.4	
PROMIS: GMH	51.0±7.1	50.7±5.5	
Common flexor	n = 14	n = 14	n = 10
SF-12: PCS	39.5±8.0	44.3±10.1	46.2±6.1
SF-12: MCS	57.3±9.2	57.5±4.2	53.8±7.0
	n = 2	n = 2	
PROMIS: GPH	49.3±2.2	49.3±2.2	
PROMIS: GMH	54.7±1.9	54.7±1.9	
Triceps	n = 5	n = 4	n = 1
SF-12: PCS	41.1±9.7	46.3±17.4	50.9
SF-12: MCS	59.1±5.3	54.3±8.2	59.0
	n = 1	n = 1	
PROMIS: GPH	52.5	47.7	
PROMIS: GMH	52.5	48.3	

SF-12, 12-Item Short-Form Health Survey; *PCS*, Physical Component Summary; *MCS*, Mental Component Summary; PROMIS, Patient Reported Outcome Measurement Information System; *GPH*, Global Physical Health; *GMH*, Global Mental Health.
Values are presented as mean ± standard deviation. The number of respondents varied by time point.
Common extensor: SF-12 short-term follow-up: 6 weeks, n = 23; 12 weeks, n = 30. SF-12 long-term follow-up: 2.67 years (interquartile range = 1.86-4.04 years). PROMIS short-term follow-up: 6 weeks, n = 10; 12 weeks, n = 9. * Paired *t* test, n = 62 compared to baseline, PCS: $P < .01$, MCS: $P = .52$. † Paired *t* test, n = 38 compared to baseline, PCS: $P < .01$, MCS: $P = .10$. PROMIS long-term follow-up: not collected.

Table V Patient satisfaction at short-term follow-up for 96 of 131 participants (73% response rate)

Very satisfied	37 (39)
Somewhat satisfied	30 (31)
Neutral	15 (16)
Somewhat dissatisfied	8 (8)
Very dissatisfied	6 (6)

Values are presented as number of participants (% of respondents) at short-term follow-up. Short-term follow-up: 6 weeks, n = 35; 12 weeks, n = 61.

descriptive statistics for all patients to provide a comprehensive report of the sample. Despite missing data, our descriptive statistics provide important insight into the long-term outcomes of USGT for elbow tendinopathy because of the current paucity of data in the literature. Lastly, all of the procedures were done by the same physician in the same geographic area. A large, prospective, multisite study is needed to further generalize the effectiveness and safety of USGT for chronic elbow tendinopathy.

Conclusions

USGT for elbow tendinopathy reduced pain, improved physical function components of quality-of-life, and had moderate patient satisfaction. These effects have been sustained in long-term follow-up. No reported complications provide additional evidence for the safety of this procedure for elbow tendinopathy. Further studies are needed to provide more evidence for the long-term effectiveness and safety of USGT for elbow tendinopathy and for outcomes specific to USGT for common flexor tendinopathy and triceps tendinopathy.

Disclaimer

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