

Sonographically Guided Percutaneous Needle Tenotomy for Treatment of Common Extensor Tendinosis in the Elbow

Is a Corticosteroid Necessary?

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Objective. Chronic refractory common extensor tendinosis of the lateral elbow has been shown to respond to sonographically guided percutaneous needle tenotomy (PNT) followed by corticosteroid injection. In this analysis, we attempted to determine whether the corticosteroid is a necessary component of the procedure. **Methods.** We performed PNT on 57 consecutive patients (age range, 34–61 years) with persistent pain and disability resulting from common extensor tendinosis. Under a local anesthetic and sonographic guidance, a needle was advanced into the tendon, and the tip of the needle was used to fenestrate the tendinotic tissue, break up any calcifications, and abrade the adjacent bone. After the procedure, patients underwent a specified physical therapy protocol. During a subsequent telephone interview, patients answered questions about their symptoms, the level of functioning, and perceptions of the procedure outcome. **Results.** Of the 52 patients who agreed to participate in the study, 30 (57.7%) reported excellent outcomes, 18 (34.6%) good, 1 (1.9%) fair, and 3 (5.8%) poor. The average follow-up time from the date of the procedure to the telephone interview was 22 months (range, 7–38 months). No adverse events were reported, and 90% stated that they would refer a friend or close relative for the procedure. **Conclusions.** Sonographically guided PNT for refractory lateral elbow tendinosis is an effective procedure, and subsequent corticosteroid injection is not necessary. **Key words:** common extensor tendon; elbow; needle; sonography; tendinosis; tennis elbow.

Abbreviations

CET, common extensor tendon; PNT, percutaneous needle tenotomy

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Tendinosis of the common extensor tendon (CET), also known as “tennis elbow” or “lateral epicondylitis,” is a frequent cause of elbow pain in adults. In some cases, symptoms can be difficult to treat, leading to persistent pain, disability, and varying degrees of restriction of daily activities. We recently reported our experience with sonographically guided percutaneous needle tenotomy (PNT) for the treatment of common extensor tendinosis in 58 consecutive patients.¹ In that study, all patients were injected with 1 mL of a corticosteroid into the affected tendon after initially “needling” the tendon percutaneously. We thought that the corticosteroid might, through its catabolic properties, reduce the amount of thickened tendinotic tissue that would form after the procedure. Our results were

encouraging but left an important question unanswered: was the corticosteroid necessary to achieve a satisfactory procedure outcome?

To determine whether sonographically guided PNT without corticosteroid injection would be an effective procedure, we studied another cohort of patients who had chronic common extensor tendinosis. In this group of patients, we performed PNT but did not inject a corticosteroid into the tendon. Here we describe our experience with these patients.

Materials and Methods

Patients

Between August 2003 and January 2005, we performed sonographically guided PNT on 57 consecutive patients with persistent pain and disability from tendinosis of the CET. All 57 individuals were patients of 1 author (J.M.M.) before undergoing the procedure. Before being offered the procedure, all patients had recalcitrant pain in the lateral epicondyle that was aggravated by use of the affected limb, especially with lifting, gripping, and twisting with the hand. In addition, they all had palpable tenderness localized to the CET and sonographic evidence of tendinosis. The inclusion and exclusion criteria were the same as in our previous study.¹ All patients had failed at least 3 of the following 5 nonsurgical treatments: corticosteroid injection,

nonsteroidal anti-inflammatory medications, counterforce bracing, physical therapy, and cock-up wrist splinting.

Of the patients who underwent the procedure, 52 of 57 (91%) were contacted by telephone and agreed to participate in the study. The other 5 could not be reached.

As Table 1 indicates, of the 52 patients interviewed, there were 31 women and 21 men with an age range of 34 to 61 years (mean, 49 years). Forty-five of the 52 patients (86.5%) had received prior steroid injections, and 40 (76.9%) had undergone at least 6 weeks of formalized physical therapy. Of the patients who had steroid injections, 90% had also failed physical therapy.

Bilateral treatments (done at least 3 months apart) were performed on 3 patients for a total of 55 elbows. Forty-three of the 55 elbows (78.1%) were symptomatic for more than 9 months before the needle procedure. Most patients identified themselves as right-handed. Of the 30 right-handed patients, 86.7% had only their right arm treated; 3.3% had only their left arm treated; and 10% had bilateral treatments.

The patients answered questions about their experience with the procedure and their perceptions of the procedure outcome. Bilateral treatments (done at least 3 months apart) were performed on 3 patients. To keep the data statistically consistent, we analyzed only the outcome of the elbow that had been more symptomatic

Table 1. Patient Demographic and Clinical Characteristics

Characteristic	n (%)
Male/female	21 (40.4)/31 (59.6)
Treatment being attempted before procedure ^a	
Steroid injections	45 (86.5)
Nonsteroidal anti-inflammatory medications	47 (90.4)
Physical therapy	40 (76.9)
Cock-up splints	5 (9.6)
Other treatments	2 (3.8)
Right handed/left-handed	44 (84.6)/8 (15.4)
Time from onset of symptoms to procedure, mo	
1-3	5 (9.6)
3-6	3 (5.8)
6-9	4 (7.7)
9-12	7 (13.5)
12-60	29 (55.8)
>60	4 (7.7)
Mean age (range), y	49 (36-61)

^aPrevious treatment categories are not mutually exclusive because all patients had more than 1 type of treatment before the procedure.

before treatment. This study was approved by and conducted in accordance with guidelines set by the Institutional Review Board at our institution. All patients provided informed consent before answering any study-related questions.

Sonographic Scanning

A radiologist (L.N.N.) with 12 years of experience in musculoskeletal sonography initially performed a diagnostic sonographic examination of the CET. Sonographic scans were performed using multifrequency linear array transducers with peak frequencies of 12 to 15 MHz on commercially available sonography units: an HDI 5000 system (Philips Medical Systems, Bothell, WA) or a Sonoline Elegra system (Siemens Medical Solutions, Issaquah, WA). Images were recorded on a picture archiving and communications system (Canon Medical Systems, Lake Success, NY). The CET was identified in the long axis with the use of the radiocapitellar joint and lateral epicondyle as bony acoustic landmarks. Tendinosis was diagnosed by 1 or more of the following findings: tendon thickening, heterogeneity, hypoechoic foci, intrasubstance tears, calcifications, and enthesophytes at the tendon origin.²

Sonographic Findings

Sonographic reports of the 52 patients were retrieved. If patients had more than 1 elbow treated, sonographic findings of the more symptomatic elbow were recorded. All 52 of the sonographic reports described tendon thickening, heterogeneity, and hypoechoic foci. Twenty-five of the 52 reports (48%) noted calcifications within the CET (Figure 1A); 44 (85%) noted intrasubstance tears; and 40 (77%) noted the presence of enthesophytes.

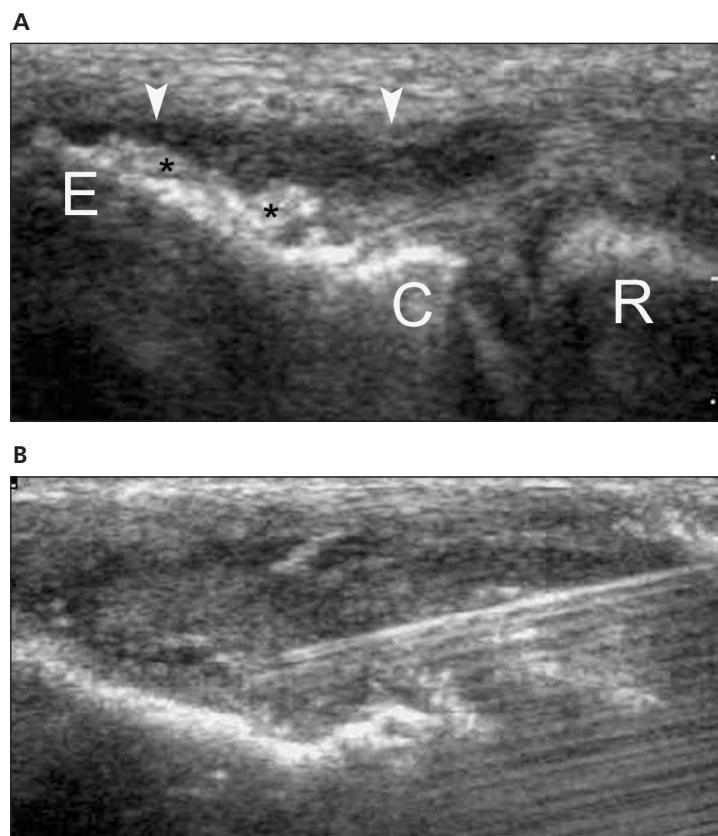
Procedure

During the procedure, all sonographic scanning and guidance were done either by the radiologist (L.N.N.) or a sonographer, and all anesthetic injections and needling were done by the lead author (J.M.M.). After informed consent had been obtained from the patient, the site to be injected was prepared with isopropyl alcohol and then sprayed with ethyl chloride to achieve cutaneous anesthesia. Next, with continuous

sonographic visualization, the skin and subcutaneous tissues overlying the lateral epicondyle were infiltrated with 0.5% bupivacaine (Marcaine; Abbott Laboratories, North Chicago, IL) and 1% sodium bicarbonate (50 mEq/50 mL; American Reagent Laboratories, Shirley, NY) via a 22-gauge hypodermic needle. The anesthetic solution was also instilled directly into the CET and periosteum of the lateral epicondyle.

Once adequate anesthesia was achieved, a 20-gauge needle was used to repeatedly fenestrate the tendinotic tendon by the same method we described previously.¹ If present, calcifications within the substance of the tendon, enthesophytes at the tendon origin, or both were mechanically fragmented (Figure 1B).

Figure 1. Images from a 52-year-old man with refractory symptoms of common extensor tendinosis. **A**, Longitudinal sonogram obtained at the lateral elbow showing a heterogeneous CET (arrowheads) with numerous hyperechoic calcifications (asterisks) at its deep margin. C indicates capitellum; E, epicondyle; and R, radial head. **B**, Longitudinal sonogram showing placement of a 20-gauge needle within the tendon substance. The calcifications have been extensively fragmented by the needle tip.



In addition to fenestrating the tendon, the needle tip was used to abrade the periosteum of the lateral epicondyle.¹ When it was determined by sonographic visualization and by palpable softening of the tissue that the entire tendon had been treated, the needle was withdrawn; hemostasis was achieved by manual pressure; and an adhesive bandage was placed over the needle puncture site.

After the procedure, patients were instructed to passively stretch the tendon as often as possible. In addition, they were instructed to perform repetitive isometric resistance to wrist extension as a means of actively stretching the tendon. For pain relief after the procedure, patients were given a prescription for 37.5 mg of tramadol/325 mg of acetaminophen. They were instructed specifically not to take nonsteroidal anti-inflammatory medications during the postprocedure period.

Beginning on the day after the procedure, all patients began a formalized physical therapy program that they were instructed to attend twice a week for the following 12 weeks. All patients in this study were compliant with this regimen. The program involved stretching, isometric and eccentric loading of the tendon, and a progression toward restoring full elbow function. During the recovery period, patients were restricted from heavy lifting and were instructed to refrain from excessive repetitive use of the extremity that had been treated. The elbow was never immobilized and was able to be used for normal activities of daily living. Patients were followed by 1 author (J.M.M.) over the following 12 weeks.

Subjective Evaluation

For assessment of clinical and functional outcomes after treatment, patients were contacted by telephone, and a questionnaire was orally administered. To reduce the risk of bias, all interviews were conducted by 1 author (V.N.S), who had not been involved in the treatment of any of the patients and had never met any of the patients before contacting them by telephone. The questionnaire that was used was developed by modification of the Patient-rated Forearm Evaluation Questionnaire.^{3,4} This questionnaire uses a 10-point visual numeric scale to assess

pain levels and difficulty performing specific activities. Because this questionnaire was delivered via telephone, we eliminated the 10-point visual scale and asked patients to report their pain over the past week on a 4-point scale (none, mild, moderate, or severe) on a per-treated-elbow basis.

Also on a per-elbow basis, we asked patients to categorize their ability to perform various tasks over the past week on a 4-point scale (no difficulty, mild difficulty, moderate difficulty, or unable to do). On a per-patient basis, we asked about the perception of overall procedure-related improvement according to the following classification scheme: excellent if very happy with the procedure and had no room for improvement, good if happy with the procedure and had only mild room for improvement, fair if slight dissatisfaction with the outcome of the procedure and had room for considerable improvement, or poor if dissatisfied with the outcome of the procedure and had little or no improvement.

The data were entered into a Excel spreadsheet (Microsoft Corporation, Redmond, WA) that was then imported into SAS version 9.1 software (SAS Institute Inc, Cary, NC) for analysis. Descriptive statistics were calculated for the patient group. The Fisher exact test was used to determine the association between the outcome and categorical variables such as the dominant extremity and whether the injury was work related. Analysis of variance was used for assessing the association between the outcome and continuous variables such as patient age and the time between the procedure and the follow-up telephone call.

Results

The average follow-up time from the date of the procedure to the date of the interview was 22 months (range, 7–38 months). As indicated in Table 2, 42 (80.8%) of the 52 elbows were reported as having no pain at rest over the past week. Fifty of 52 elbows (96.2%) never had pain that woke the patients at night. Over the past week, the worst level of pain was none or mild in 42 of 52 elbows (80.8%). The per-elbow functional data gathered from telephone questionnaires are summarized in Table 3. In aggregate, 78.8%

Table 2. Responses to Telephone Interview (n = 52 Elbows)

Response	n (%)
Overall pain over the past week	
None	42 (80.8)
Mild	9 (17.3)
Moderate	1 (1.9)
Severe	0 (0)
Pain that woke patient at night	
Frequently	0 (0)
Sometimes	2 (3.8)
Never	50 (96.2)
Worst level of pain over the past week	
None	21 (40.4)
Mild	21 (40.4)
Moderate	9 (17.3)
Severe	1 (1.9)

(369/468) of the responses reported no difficulty, 13.9% mild difficulty, 1.1% moderate difficulty, 2.6% unable to do, and 3.6% not applicable. As reported in Table 4, 57.7% (30/52) of the respondents reported excellent outcomes, 34.6% good, 1.9% fair, and 5.8% poor. There was no significant relationship ($P > .05$) between the following parameters and the outcome: age, sex, dominant versus nondominant extremity, whether the injury was work related, the duration of symptoms before the procedure, and the time between the procedure and the follow-up telephone call. No adverse events were reported in any patients. Ninety percent (47/52) of respondents stated that they would refer a friend or close relative for the procedure.

Discussion

Common extensor tendinosis of the elbow is the most frequent cause of chronic lateral elbow pain and affects both men and women usually in their 40s or 50s.⁵ The pain is typically over the lateral aspect of the elbow at the origin of the CET and often resolves by 6 months to 1 year after onset⁶; however, in some patients the pain can be persistent and can lead to considerable disability.

Despite the wide variety of medical and surgical therapies that have been used to treat chronic elbow tendinosis, no one therapy has gained universal acceptance.^{7,8} Various studies and meta-analyses have failed to show support for a definitive treatment option, with many studies producing inconsistent results.⁹⁻¹³ A review of the current literature fails to show long-term efficacy of corticosteroid injections in patients with chronic tennis elbow.¹⁴⁻¹⁹ Many of these studies have shown that corticosteroid injections can be useful in improving symptoms in the short term (generally 2-6 weeks). In assessing long-term (generally >6 months) benefits, most randomized trials do not show a benefit to treatment (and in some cases outcomes are worse²⁰) with steroids over physical therapy or rest alone.

Although the exact pathophysiologic mechanism of common extensor tendinosis is not clear, it is evident from surgical specimens that affected tendons have undergone a process of mucoid degeneration resulting from repetitive micro-trauma to collagen fibers, leading to interstitial

Table 3. Responses to Questionnaire Regarding the 52 Treated Elbows

Task	Difficulty Level, n (%)				
	None	Mild	Moderate	Unable	NA
Turning a doorknob	49 (94.2)	2 (3.8)	0 (0)	1 (1.9)	0 (0)
Carrying a bag of groceries	41 (78.8)	10 (19.2)	0 (0)	1 (1.9)	0 (0)
Lifting a cup or glass to mouth	49 (94.2)	1 (1.9)	0 (0)	1 (1.9)	1 (1.9)
Opening a jar	39 (75)	8 (15.4)	1 (1.9)	2 (3.8)	2 (3.8)
Wringing a washcloth	42 (80.8)	9 (17.3)	0 (0)	1 (1.9)	0 (0)
Vacuuming	39 (75)	6 (11.5)	0 (0)	2 (3.8)	5 (9.6)
Unloading a dishwasher	48 (92.3)	1 (1.9)	0 (0)	1 (1.9)	2 (3.8)
Performing a usual job	37 (71.2)	10 (19.2)	1 (1.9)	1 (1.9)	3 (5.8)
Recreation or sports activities	25 (48.1)	18 (34.6)	2 (3.8)	2 (3.8)	2 (3.8)

Patients were asked to rate the degree of difficulty in performing specific tasks over the past week. NA indicates not applicable.

Table 4. Overall Satisfaction (n = 52 Patients)

Perception of Overall Outcome	n (%)
Excellent	30 (57.7)
Good	18 (34.6)
Fair	1 (1.9)
Poor	3 (5.8)

tearing and a proliferation of ground substance. The collagen fibers lose their parallel orientation and instead are found to be in disorganized arrays.^{15,21-24} Histologic studies of chronic tendon lesions show that these degenerative changes occur without any cellular evidence of inflammation.^{21,25-27} Because there is no evidence to support an ongoing inflammatory process in chronic tendinosis, it is not surprising that corticosteroids (or nonsteroidal anti-inflammatory medications for that matter) provide only short-term symptom relief at best.

Given that the underlying process is one of mucoid degeneration of the tendon with infiltration of scar tissue, it may be that the structural changes in the tendon itself somehow lead to the production of pain. Pain may be due to irritation of mechanoreceptors by traction or shear forces²⁸⁻³¹ or activation of nociceptive receptors by neurotransmitters such as substance P.^{29,32} Reversing these structural changes and restoring more normal mechanical properties of the tendon may lead to resolution of the problem. We think that our PNT procedure not only breaks up the scar tissue that has formed in the tendon but also stimulates a healing response. This healing response, when guided by the appropriate physical therapy protocol, leads to remodeling of the tendon in a way that restores many of its normal mechanical properties. Perhaps the reason that many of the reported treatment strategies have failed to provide a definite therapeutic benefit is that they have not specifically addressed the underlying pathologic process or taken advantage of the remodeling process that occurs during healing.

In our previous study of 58 consecutive patients,¹ we injected 1 mL of a corticosteroid into the affected tendon at the end of the procedure. A retrospective analysis of our follow-up data in that series showed that 80% had good or

excellent results.¹ Even though we injected the corticosteroid after the needling, we were unsure of its exact role. We had thought that the corticosteroid might help in reducing the amount of thickened tendinotic tissue, much the same as injection of a steroid into a keloid will cause it to shrink.³³ However, we now think that inflammation is a desired outcome in tendons that have evidence of chronic degeneration.³⁴ It is possible that the needling procedure may achieve a healing response via local inflammation that may include blood vessel and collagen precursor recruitment.³⁵ This theory seems to be corroborated by the success of injections of autologous blood³⁶ or buffered platelet-rich plasma³⁷ into the CET. If inflammation is necessary for healing, then postprocedure corticosteroid injections may actually be detrimental to the potential therapeutic benefit provided by the needling. In addition, an intratendinous corticosteroid may adversely affect the biomechanical properties of the tendon by inhibiting formation of connective tissue and by decreasing the tendon mass.^{38,39}

In the series of 52 patients in this study, 48 (92.3%) reported excellent or good results. Although this percentage is higher than in the previous study in which we injected a corticosteroid after the PNT,¹ the data are not directly comparable because we did not perform randomized controlled trials to compare the steroid versus the nonsteroid group. There may also have been a learning effect for performance of the procedure because all of the patients in this study were treated at a later date than those in the previous study. Nevertheless, we think that these results are at least as encouraging as the results from our previous study. As did our previous cohort, these patients also participated in physical therapy after the procedure. Physical therapy may help prevent adhesions from reforming and may promote newly regenerated collagen to align along lines of stress in an organized, linear fashion.^{40,41}

There were several limitations to our study, mostly due to the fact that the data were retrospectively obtained. Owing to the length of the follow-up time (on average 22 months) at which data were gathered from patients, there was the potential for a recall bias. In addition, we did not assess specific functional abilities both before

and after the procedure. Another limitation of our study was the lack of a control group. Ideally, a prospective randomized trial would compare results of 4 groups: (1) PNT followed by corticosteroid injection, (2) PNT without corticosteroid injection, (3) surgical treatment, and (4) traditional supportive care. It would also be interesting to compare our results with those of needling followed by autologous blood injection.³⁶ We currently do not inject autologous blood after our procedure because we hypothesize that the degree of bleeding caused by our needle obviates the need for a separate blood injection.

In conclusion, sonographically guided PNT for lateral elbow tendinosis is a safe and effective treatment even without subsequent corticosteroid injection. On the basis of these results, we no longer use corticosteroids when we perform PNT.

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