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ORIGINAL ARTICLE

The role of ultrasound guided peri-tendinous injection in the treatment of non-calcific tendinopathy

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KEYWORDS

Tendinopathy;
Corticosteroid injection;
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Abstract *Purpose:* To evaluate the effectiveness of the percutaneous ultrasound guided peri-tendinous injection in improving or treating non-calcific tendinopathy.
Patients and methods: Between January 2012 and March 2014, 25 patients with non calcific tendinosis were treated by ultrasound guided corticosteroid injection. All patients underwent pre-treatment diagnostic ultrasound, as well as assessment of the pain and disability of the affected area through a self-answered questionnaire. Reevaluation of the ultrasound changes and clinical response as regard the pain and disability score on regular follow up visits, were done at the 1st, 3rd and 6th month posttreatment.
Results: According to the results of this study, there was statistically marked reduction in patients pain and disability score, with reduction of the mean pain score from maximum 3 points pre-treatment to 0.5 post-treatment, and mean disability score form 1.5 point pre-treatment to 0 point at the 6th month follow up visit. The clinical success rate was 87%, with a technical success rate of 100%.
Conclusion: Ultrasound is a non invasive imaging technique that allows real time guidance for interventional therapy of non-calcific tendinopathy improving the result of peri-tendinous corticosteroid injection.

1. Introduction

Tendinopathy (often called tendinitis or tendinosis) is the most common tendon disorder. It is characterized by activity related pain, focal tenderness, and decreased range of movement in the affected area. Tendinopathy can occur in almost any tendon, common examples include supraspinatus tendinitis, Achilles tendinitis, patellar tendinitis and tennis elbow (1).

Tendinopathy is not characterized by an inflammatory response, but rather infiltration of fibroblasts and vessels, with an ensuing chronic cycle of tendon degeneration and repair resulting in a weakened tendon. These changes have been shown to appear as hypoechoic areas on ultrasonography (2).

Conventional non-surgical treatment options include relative rest, cryotherapy, non-steroidal anti-inflammatory medications, physical therapy, and biomechanical devices.

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Surgical intervention has been reported as an additional treatment option in those cases in which conservative treatment had failed (3).

Reported surgical success rates have been variable, with undesirable complication rates and prolonged recovery. In an effort to shorten recovery and reduce morbidity, less invasive approaches to the treatment of chronic tendon injuries have been studied and shown to be effective (4).

With its associated technological improvements and associated lack of ionizing radiation, ultrasound (US) imaging is ideal for guiding most musculoskeletal interventional procedures. Unlike other imaging modalities, US has a unique advantage in that it can visualize soft tissues, bony landmarks, and the needle using real-time scanning, allowing dynamic visualization. In addition, there are no known contraindications to US (5).

Peri-tendinous injection of anesthetic and short acting corticosteroid is an effective means to treat tenosynovitis. Ultrasound guided injections have been shown to be an effective mean to ensure correct localization of therapeutic agents (6).

The aim of this study is to evaluate the effectiveness of percutaneous ultrasound guided injection in improving or treating non calcific tendinopathy.

2. Patients and methods

2.1. Patients

From January 2012 to March 2014, twenty-five patients with non-calcific tendinopathies identified based on clinical and radiological evaluation, were prospectively treated with ultrasound guided peri-tendinous injections.

Patients were 12 males, 13 females, with age ranging from 20 to 55 years old (mean = 37.5).

Lesions were located in the biceps tendon (n = 9) (36%), supra-spinatus tendon (n = 5) (20%), patellar tendon (n = 3) (12%), Achilles tendon (n = 3) (12%), extensor tendon of the fingers (n = 2) (8%), De Quervain tenosynovitis (n = 2) (8%), and common extensor tendon of the elbow (tennis elbow) (n = 1) (4%).

The patients included in our study were selected with the following *inclusion criteria*:

1) Patients complaining of clinical manifestations suggestive of tendinopathy as pain, focal tenderness, and reduced range of movement of the affected muscle.
2) Symptoms of more than 6 months duration.
3) Failed conservative treatment over 6 months.

Patients excluded from our study, were those showing the following *exclusion criteria:*

1) Radiological findings of tendon tear.
2) Patients with symptoms less than 6 months.
3) Patients who showed successful response to conservative treatment.

2.2. Pretreatment patient assessment

A prospective evaluation was performed by using a pain and disability score (PADS) questionnaire modified from the Shoulder Pain and Disability Index (SPADI) questionnaire (7). It is a self-administered score designed to measure the response to treatment in time. It consists of 11 items divided into two subcategories reflecting the pain (6 items) and disability (5 items) associated with tendinopathy (Table 1). The questionnaire required 1 min to complete. This questionnaire was filled out by the patient before the procedure and at regular follow up at 1, 3 and 6 month after treatment.

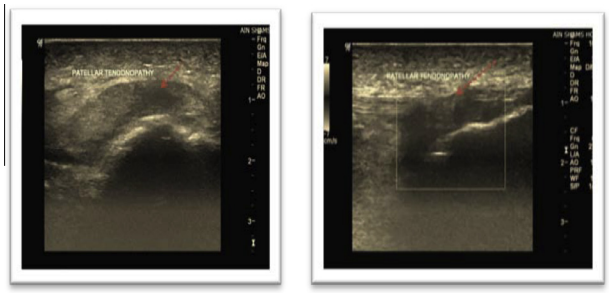
The range of movement of the joint affected by the tendon pathology is also evaluated, pre-treatment and on the follow up visits, this helps to assess the degree of improvement in the disability. It varies according to the affected joint e.g. biceps tenosynovitis affects the shoulder flexion, supraspinatus tendinosis affects the full (150°) shoulder abduction and Achilles tendinosis affects the ankle planter flexion.

The time of consultation from the onset of symptoms varied between 6 months to as long as 1.5 year (the mean time was 12 months). For patients with multiple joint related pains, only the most symptomatic site was percutaneously treated and included in our study.

A diagnostic preliminary US examination of each patient was performed. The tendon was examined first in a neutral position and then during activity. All tendons were assessed for presence of focal tendinosis, tendon effusion, increased vascularity by power Doppler evaluation, and presence or absence of tendon tear (Fig. 1).

Table 1 Pain and disability score questionnaire.

Pain and disability score	
Pain score	0 = no pain 1 = pain with forced active movement 2 = pain with simple active movement 3 = pain with passive movement 4 = pain at rest 5 = pain at rest and during sleep
Disability score	0 = intact full movement range 1 = near full movement range 2 = partial movement 3 = slight movement 4 = no movement



(A) **(B)**

Fig. 1 Ultrasound evaluation of distal patellar tendon in transverse (A) and longitudinal (B) view, revealed focal tendinosis (arrow) appearing as a focal area of loss of fibrillar pattern.

2.3. Ultrasound guided peri-tendinous injection technique

The procedure was explained to the patients in detail, then a written consent was obtained, and after that the patient was prepared for the percutaneous procedure.

During the procedure in general, the patient was seated with the affected tendon best visualized, for most shoulder cases, the patients were sitting on a rotating stool, for wrist and elbow, the patients were sitting with the joint resting on a straight table and for Achilles tendon, the patients were laying on the table in prone position (Figs. 2–4). A supine position was favored for patients with history of vagal reaction during any previous injections.

The procedure was performed by using sterile technique and surgical gloves, where a pencil mark was placed on the skin for localization. Then the skin was cleaned and antiseptically draped using betadine. Also the transducer head was cleaned and antiseptically draped.

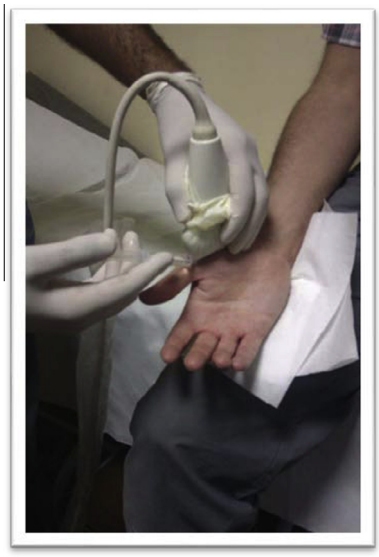


Fig. 2 Peri-tendinous injection of a case of De Quervain's tenosynovitis.

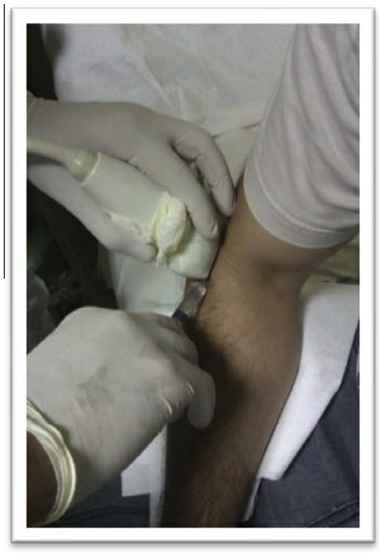


Fig. 3 Peri-tendinous injection of a case of tennis elbow.

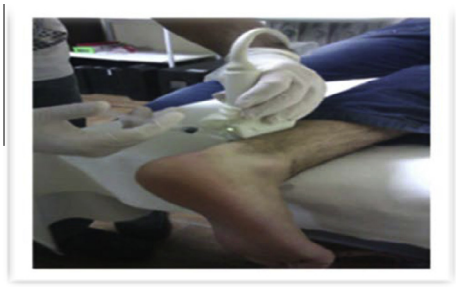


Fig. 4 US guided peri-tendinous injection of Achilles tendinitis with the patient lying in a prone position.

After identifying and localizing the focal tendinosis by US, and with relation to the clinical pain. Injection of the mixture into the peritendinous area was done under constant US monitoring, by using a 1.5-inch (3 cm) 25-gauge needle (Fig. 5).

The mixture used in all cases was short acting corticosteroid (40 mg methylprednisolone acetate (Depo-Medrol) mixed with Local anesthesia (2% Lidocaine hydrochloride (Dibucaine) in a ratio of 1:2 or sometimes 1:3.

The average dose used was ranging from 2 ml in cases of De Quervain's and extensor digitorum tenosynovitis, up to 3 ml as in cases of patellar and Achilles tendinosis.

In all cases, 2 sessions of injection with 2 weeks interval was done and the clinical response as regard the pain was the main parameter of continuation for the 2nd session and follow up. In 3 cases a 3rd session of injection was done (2 cases showed relapse of increasing pain score on the follow up visit at the 3rd month, and one case who showed pre-treatment pain score of 4 (pain at rest) interfering with his daily activity, showed mild pain reduction on the 1st month follow up.

In all cases, care was done to avoid intra-tendinous injection to avoid complicated tendon rupture, as after introducing the needle, slow withdrawal was done with gentile injection, till sudden release of resistance occurred.

Repeated insertion and withdrawal were done until coverage of the lesion with the injected material was accomplished.

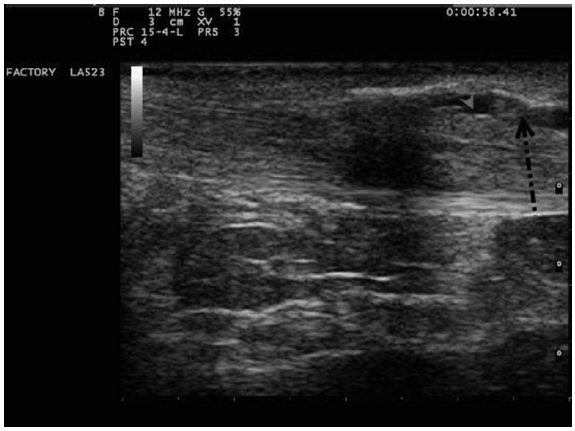


Fig. 5 The needle tip is seen in paratendinon (black arrow) with injected therapy in paratendinon (white arrow head).

All patients experienced total disappearance of pain immediately within few minutes after injection.

Following the maneuver, patients were discharged with a hand-written prescription for total rest of injected site for at least 24 h before regaining normal activity, with no oral non steroidal anti-inflammatory drugs prescribed along the course of the treatment.

No technical failures occurred from the inability to localize the symptomatic tendinopathy.

All interventions performed were free of any immediate complications, except for 1 case who showed vasovagal syncopal attack during needle insertion; this was treated by laying down the patient and elevating her legs. It lasted for few seconds, after which the procedure continued with no problems.

2.4. Aftercare and follow up

Patients were reevaluated at regular follow-up visits (1, 3 and 6 month after the procedure). At each visit, they refilled the pain and disability score questionnaire. Also underwent a standard US examination which depicted the changes in echogenicity, tendon thickness and calcification if present.

Statistical analysis was performed, that analyzed the difference in the pain and disability scores during the follow up visit.

3. Results

One patient (a woman of age, 33 years old with right biceps tenosynovitis) had to be excluded from the study because follow-up was missing and so medical records were incomplete. Therefore, the clinical success and outcome was evaluated in 24 cases.

In our study, we considered the ability to enter the tendon sheath and deliver the injected material in the peri-tendinous area as a technical success.

Also we considered that complete or marked relief of patients' symptoms without the use of oral anti-inflammatory drugs or physical therapy within the first 6 months after the procedure as a clinical success.

3.1. Pre and post treatment pain and disability score changes

The Mean pre-treatment pain score was 3 in 13 cases (54.2%) with a maximum score of 4 seen in one case (4.2%) and a minimum score of 2 seen in 10 cases (41.6%).

The mean pre-treatment disability score was 1.5 with a score of 2 seen in 13 cases (54.2), a maximum score of 3 seen in one case (4.2%) and a minimum score of 0 seen in 10 cases (41.6%) (Table 2).

15 patients out of 24 (62.5%) showed total disappearance of their pain over 6 months post injection.

6 patients out of 24 (25%) showed marked reduction in their pain scores with the most significant reduction noted at the end of the 6th month.

1 patient (4.2%) had not responded well regarding the pain score. This patient (female, 44 years old) had right biceps tenosynovitis; she was a known case of uncontrolled SLE.

2 patients (8.3%) showed an increase in their pain score mainly after 1 month of injection, these patients developed complicated intra-substance tendon tear diagnosed on the follow up US examination (Table 3 and Fig. 6).

Table 2 Individual pre-treatment pain and disability score.

Patients	Pre-treatment pain score	Pre-treatment disability score
1	3	2
2	2	0
3	3	2
4	3	1
5	3	1
6	3	2
7	2	1
8	3	2
9	3	2
10	2	1
11	2	1
12	3	2
13	3	2
14	2	1
15	2	1
16	3	2
17	2	1
18	4	3
19	2	1
20	3	2
21	2	1
22	3	2
23	2	1
24	3	3

The mean pain score for the patients has been reduced during the first 6 month post injections from 3 pre-treatment to 2.5 at the end of the 1st month, 1.5 at the end of the 3rd month, and 0.5 at the end of 6th month with a mean value of 2.5 points pain reduction (Fig. 7).

20 patients out of 24 (83.3%) showed total regain of full joint movement over 6 months post injection, with 6 cases (25%) showing full movement after 1st month, 9 cases (37.5%) showing full movement after 3rd month and 5 cases (20.8%) showing full movement after 6th month.

1 patient out of 24 (4.2%) showed no disability from the start with full joint movement.

1 patient (4.2%) had no reduction in his disability score which showed no change on follow up. It was the same female patient with right biceps tenosynovitis.

2 patients (8.3%) showed complicated intra-substance tear with no change in their disability score after 1st month (Table 4 and Fig. 8).

The mean disability score for the patients had been reduced during the first 6 month post injection from 1.5 pre-treatment to 1 at the end of the 1st month, 0.5 at the end of the 3rd month, and 0 at the end of 6th month with a mean value of 1.5 points disability reduction (Fig. 9).

3.2. Post treatment ultrasound changes

This was assessed by US examination performed regularly on the follow up visits at 1st, 3rd and 6th month post-procedure. We considered the ultrasound finding at the 6th month as the net result finding. These results varied between total disappearance of tendinopathy in 14 cases out of 24 (58.3%), partial regaining of the normal fibrillar pattern of the tendon in 4 cases out of 24 (16.7%) and no changes at all in 6 cases out

Table 3 Individual post-treatment pain score.

Patients	Pre-treatment pain score	Pain score at 1 month post-treatment	Pain score at 3 months post-treatment	Pain score at 6 months post-treatment
1	3	1	0	0
2	2	1	0	0
3	3	1	0	0
4	3	2	1	0
5	3	2	1	0
6	3	2	3	3
7	2	1	0	0
8	3	2	1	1
9	3	2	1	0
10	2	1	0	0
11	2	1	0	0
12	3	4	Complicated tear	
13	3	2	1	1
14	2	1	1	1
15	2	1	0	0
16	3	2	3	1
17	2	1	1	0
18	4	3	2	1
19	2	1	0	0
20	3	2	1	0
21	2	1	0	0
22	3	2	1	1
23	2	1	0	0
24	3	3	Complicated tear	

of 24 (25%), among them 3cases showed complete pain and disability absence, and 2 cases developed complicated intra-substance tendon tear (Fig. 10).

3.3. Clinical success rate (Table 5)

15 patients out of 24 (62%), showed total disappearance of their pain and disability over the first 6 month post-treatment.

6 patients out of 24 (25%), showed marked reduction in their pain and disability.

Therefore, the clinical success rate was estimated to be 87%.

With technical success rate 100%, the total success rate was 87%.

The previous table shows that there was no statistically significant difference between the clinical and sonographic results with p-value >0.05 (Fig. 11).

3.4. Complications

One minor complication occurred which was a vasovagal syncope with needle insertion. That attack remained for few seconds, after it the procedure continued with no problems.

Two major complications occurred, two patients (a male patient with right supra-spinatus tendinosis and a female patient with right biceps tenosynovitis) developed partial

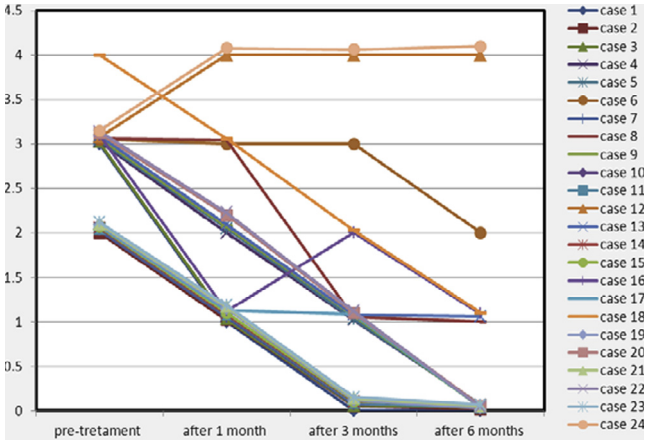


Fig. 6 Individual post-treatment pain score compared to pre-treatment pain score.

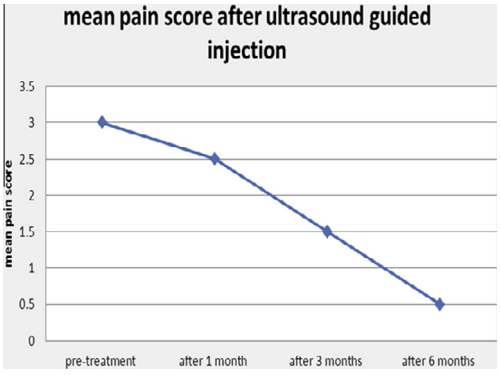


Fig. 7 Post-treatment mean pain score compared to pre-treatment pain score.

Table 4 Individual post-treatment disability score.

Patients	Pre-treatment disability score	Disability score at 1 month post-treatment	Disability score at 3 months post-treatment	Disability score at 6 months post-treatment
1	2	1	0	0
2	0	0	0	0
3	2	1	0	0
4	1	1	0	0
5	1	1	1	0
6	2	2	2	2
7	1	0	0	0
8	2	2	1	0
9	2	1	0	0
10	1	1	0	0
11	1	1	0	0
12	2	2	Complicated tear	
13	2	1	1	0
14	1	0	0	0
15	1	1	0	0
16	2	2	1	0
17	1	1	0	0
18	3	2	1	0
19	1	0	0	0
20	2	1	0	0
21	1	0	0	0
22	2	1	1	0
23	1	0	0	0
24	3	3	Complicated tear	

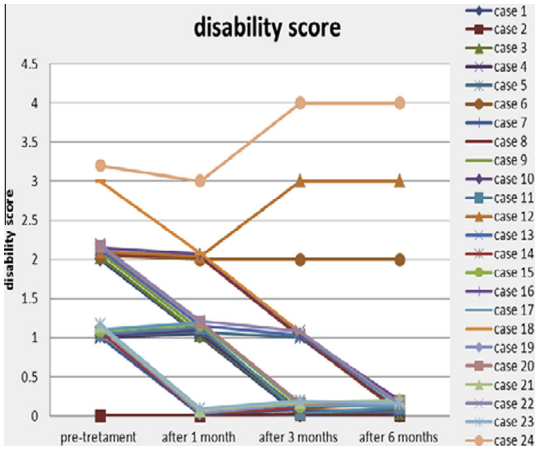


Fig. 8 Individual post-treatment disability score compared to pre-treatment disability score.

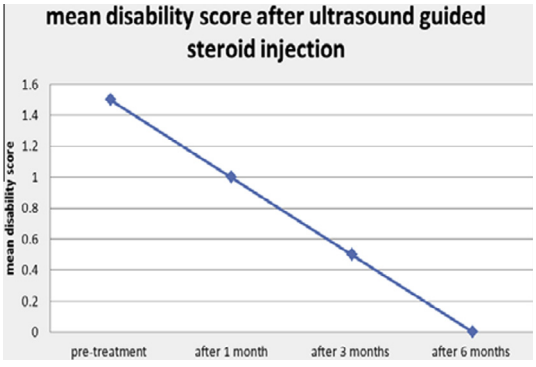


Fig. 9 Post-treatment mean disability score compared to pre-treatment disability score.

tendon tear after the injection. This was diagnosed by US examination in the first follow up visit after the patient complained of worsened pain. They were treated conservatively with oral medications.

4. Discussion

Ultrasound is a technique that has gained widespread acceptance for musculoskeletal imaging and guiding interventions. This noninvasive, non ionizing imaging technique allows continuous monitoring of the needle position, which facilitates the performance of safe and precise interventions (8).

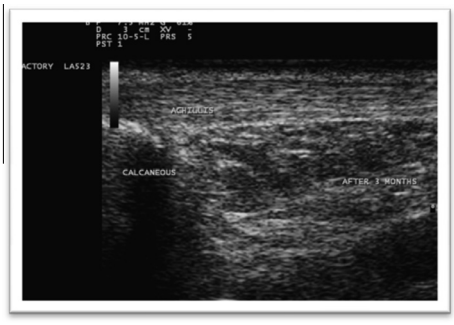


Fig. 10 Follow up ultrasound examination revealed disappearance of the focal Achilles tendinos.

Table 5 Comparison between the results of clinical and sonographic findings.

Chi-square test		Sonographic		Clinically		
P-value	X^2	%	No.	%	No.	
0.459	0.547	75	18	87.5	21	Improved
		25	6	12.5	3	Not improved
		100	24	100	24	Total

$P > 0.05$: non significant; $P < 0.05$: significant; $P < 0.01$: highly significant.

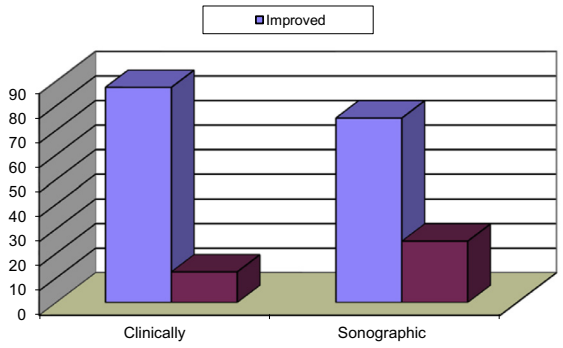


Fig. 11 Comparison between the results of clinical and sonographic findings.

Although soft tissue injections are very popular there is remarkable paucity of controlled data to support their efficacy. That is because the randomized controlled trials were scarce and their interpretation was frequently hindered by methodological issues, such as poor definition of cases, inclusion of heterogeneous study populations, small sample sizes, unsuitable outcome measures, short term follow up, inadequate blinding and lack of true placebo (9).

Most of the studies regarding the role of steroid injection in tendinopathy showed that they are well tolerated and more effective for tendinosis in the short-term than other injection treatment, with lack of benefit at long term therapy (10,11). In a relative recent meta-analysis study, by Coombes et al., a trial to compare data from many other studies to determine the best use of injections for tendon problems. They showed that corticosteroid injections reduced pain in the short term compared with other interventions, but this effect was reversed at intermediate and long terms (10).

During our study, 21out of 24 patients showed either total or marked reduction of their pain and disability, 2 of them showed recurrence of their pain and disability in less than 3 month post-injections. This clinical improvement was achieved and continued for the 6 months follow up period. So we suggest that steroid injection is effective in both short and intermediate term of treatment, rather than short-term only. It's effect as long-term therapy (more than 6 months) was beyond the scope of the study goal.

Evaluation of its efficacy may be also hampered by the accuracy of injection, as even in a specialist's hands, up to 70% of injections may be misplaced. That is why the use of ultrasonography as guidance for injection improves the efficacy (9).

Up till now few non sufficient studies have been applied to verify the role of ultrasound as image guidance in improving the result of the injection therapy, however all these studies recommended its use, as they proved that it is more accurate than the blind method. Till our update knowledge, very few studies compared the efficacy of cortisone injection in tendinopathy by both blind and ultrasound guided methods (8,12).

Lee et al. reported that ultrasound guided injection method in trigger finger disease is more accurate and safer than the blind method, they injected dye in 40 fingers from 5 cadaveric hands, then determined the dye location through dissection. They reported that the dye was seen in the tendon sheath (optimal site) in 70% of the 20 fingers injected by ultrasound guidance with 0% dye detection in tendon proper, compared to only 15% in optimal site using blind methods with 30% dye detection in the tendon proper (13).

In our study, we unfortunately did not make a comparative study, comparing the result of injection under ultrasound guidance vs. the blind method; however we depended on the clinical response of the patients as indicator of effectiveness of ultrasound guidance, and compared the clinical success to other studies that involved injection by the blind method.

In our study, the technical success rate was 100%, and with the clinical success rate of 87%, gave a 87% total success rate, which is considered higher than reported by previous studies that concerned the cortisone injection. This can be explained by the fact that all these studies used blind method of injection, which has proven to be less effective than image guided methods (14,15).

In our study, regarding the post-treatment sonographic findings, about 58% showed total disappearance of tendinopathy within 6 months post-injection, and only 17% showed partial improvement, giving an overall sonographic improvement of about 75% of cases with only 25% showing no sonographic changes. In correlation with our clinical success rate of 87%, there was no significant difference between the clinical improvement and sonographic sign of improvement according to chi-square test with *P* value of 0.459, which increased the value of the success of injection.

It is believed that the patient's response to previous injection is important in deciding whether and when to precede with reinjection, as according to Cardone and Tallia, most patients, if they are going to respond, will respond after the first injection. They also recommended that if therapeutic effect is achieved, a maximum of four injections per year is recommended, fearing of that repeated use of corticosteroid preparations may accelerate tendon weakness (16). In our study the number of injections used for our patients ranged from 2 to maximum 3 injections, depending on the degree of the clinical improvement (according to self-answered questionnaire) and recurrence of the pain in the follow up visits.

In spite of manufacturers of corticosteroid advising against mixing it with Lidocaine, because of the risk of clumping and precipitation of steroid crystals, most rheumatologist and

physiotherapists mix it with local anesthesia. They believe that this mixing, provides temporary analgesia, confirms the delivery of medication to the appropriate target, and dilutes the crystalline suspension, so that it is better diffused within the injected region. We have never experienced this mixing as a major problem.

Many studies (10,11,16,17), suggested adequate time between injections, generally a minimum of four to six weeks, however in our study the time interval was about 2 weeks. In all previous studies, blind method of injection was done that carries the risk of tendon injury, mainly due to lack of direct visualization of needle position, that is avoided in ultrasound guided methods. So waiting time to re-analyze possible complications is minimized in our study. Also in our study, we found that this time interval is appropriate for maintaining a relative adequate amount of the therapy for a relative longer period to achieve more improvement and healing of the affected tendon.

In our study, 2 patients developed tendon tear. However, in these patients, the tear occurred within the first 2 weeks after first injection. We believe that it is not a result of corticosteroid injection, but from a pre-treatment misdiagnosis, as the incidence of tendon ruptures with steroid injection is rare, with overall adverse effect incidence of about 5.8% as reported in a relative recent study by Brinks et al. (18).

Also tendon tear as a complication of steroid injection was categorized by the WHO, as a dose dependant side effect.

Several other injection therapies have been described to treat tendinosis other than cortisone injections, and they carry the future for more effective and safer treatment. Further studies for their efficacy are recommended. The injection of autologous blood, which contains fibroblast growth factors, has been used successfully in treatment of refractory medial and lateral epicondylitis of the elbow (19).

Prolotherapy is another treatment option that has shown promising results. It is a technique in which injection of an irritant solution incites a local inflammatory response, which, in turn, induces fibroblast proliferation and collagen synthesis. Hyper-osmolar dextrose is considered the best substance, as it has an excellent safety profile and is inexpensive. In a recent study by Carayannopoulos et al., which compared the efficacy of prolotherapy versus corticosteroid injection for the treatment of chronic lateral epicondylitis, there was a significant higher success rate for prolotherapy than for corticosteroid (20).

A newer injection treatment for tendinosis is gaining popularity, the platelet rich plasma (PRP) injections. While this treatment offers exciting hope, it is still relatively a newer technique with little evidence reviewed studies to back up its use and efficacy. However it is believed that platelet rich plasma injection was superior to corticosteroid injection in relieving pain for lateral epicondylalgia in the long term (10).

In conclusion, Corticosteroid injection is a relatively safe and effective therapy in cases of non-calcific tendinopathy for short and intermediate term treatment. It is more effective and safer by ultrasound guidance rather than the blind method that depends on doctor expertise.

5. Conflicts of interest

None declared.

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