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Original Article

The Effect of Dry Needling of Trigger Points in Forearm's Extensor Muscles on the Grip Force, Pain and Function of Athletes with Chronic Tennis Elbow

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ABSTRACT

Background: Tennis elbow syndrome (TES) is mainly known by having pain in the external side of the elbow. Physiotherapy plays an effective role in the treatment of this syndrome. Dry needling is a less invasive, novel, and inexpensive method that shows its therapeutic effects in a shorter time in comparison with the other physiotherapy methods. Effect on tough bands, circulation, and environmental and central neurophysiological effects are some mechanisms by which dry needling poses its effects. The aim of this study was to study the effect of adding dry needling to routine physiotherapy methods in order to improve grip strength and function and reduce pain, as well as to decrease costs and treatment duration for treating tennis elbow syndrome.

Methods: Forty four athletes aged 18 to 40 years old who had exercise or match for at least 3 sessions per week (for a sum of 6 hours per week), and were detected to have tennis elbow syndrome lasting more than 3 months were recognized and classified into two groups. The first group received physiotherapy including ultrasound, deep friction massage, and muscle stretching and strengthening exercises. The second group received dry needling in addition to physiotherapy treatment. Therapeutic duration was 3 weeks in each group and 3 sessions in each week. The patient rate elbow evaluation questionnaire (PREE) was completed at the beginning of treatment and the beginning of the second and third weeks, as well as at the end of the third week; grip strength was measured at the mentioned times as well. One week after the end of the therapeutic period, patients were re-evaluated for the reliability rate of the treatment outcomes. For analysis of data obtained for the study, repeated measure test, Mixed ANOVA, and Paired T-test statistical tests were used.

Results: Results showed that all evaluated variables (including pain, function, and grip strength) were improved in the patients of both groups after completion of the therapeutic period (P<0.0001). Comparison of the two groups showed a significant difference in the pain variable at the seventh session with P<0.0001, the ninth session with P=0.006, and one week after the end of treatment with P<0.001, and the performance variable at seventh sessions with P<0.0001, ninth sessions with P=0.006, and one week after the end of treatment with P<0.0001, respectively. The pain reduction and function increase rates were higher in the group that received dry needling in addition to physiotherapy in comparison with the group that received physiotherapy after the seventh session. Regarding

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grip strength variable, the mean of groups was different, though the effect of these two methods in the enhancement of grip strength was not statistically significant (P=0.09). Moreover, regarding the results obtained for the group that received physiotherapy in addition to dry needling, the pain variable reduced in a shorter time in comparison with the other group.

Conclusion: With regard to the results mentioned above, both therapeutic methods resulted in an improvement in the studied variables in a comparison that was performed before and after treatment. Moreover, in comparison with the single physiotherapy, using dry needling in addition to physiotherapy had a more powerful effect in improving the studied variables. Therefore, it could be said that using dry needling in addition to other therapeutic methods results in the facilitation of treatment process in the patients, and can reduce their therapeutic costs.

Introduction

Tennis elbow syndrome is known by a pain in the external side of the elbow, and when the patient tries to perform wrist supination and extension against resistance, its pain increases [1]. Annual frequency of this syndrome is 4 to 7 patients per 1000 persons, and it often occurs during ages 35 to 55 years old [2]. Although the pain is known to be centered on the lateral epicondyle, and it is called tennis elbow syndrome, tennis players are only 10% of the patient population. Half of the tennis players have a pain around their elbows and only 75% of them have this syndrome [3]. It seems that tennis elbow syndrome is caused by continuous and repeated usage of the extensor carpi radialis brevis with or without involvement of the common digitrom extensor muscle [4]; so, the prominent role of the extensor muscles of the wrist in all strokes of tennis could be the cause of high frequency of tennis elbow syndrome among athlete group. Moreover, in many sports that have upper head movements (such as tennis, volleyball, basketball,…), external rotation of the shoulder increases. During service and forehand strokes, internal rotation of the shoulder is needed; this increases internal rotating forces through the elbow of the patient and results in tennis elbow syndrome [5].

Tendon alterations due to the tennis elbow syndrome include an increase in the number of fibroblasts, an increase in vascular volume, and collusion of collagens. The beginning of tendon of common extensor muscles tends to be thickened in people with tennis elbow syndrome [6]. When the tendon alteration occurs, tissue restorations could be formed in a small space in the depth of the extensor carpi radialis brevis tendon, and under its joints to the arm bone prominence; in this space, free and painful ends of nerves are placed and that can explain the cause of pain and elbow sensitivity in the patients with this syndrome. This injury is completely out of joint, but its repeat could involve upper synovial joint membrane of Ulna and Radius bones, as well as annular ligament [7].

A sensory-motor and biomechanical defect may occur during tennis elbow syndrome that could be effective on the performance of upper limb. These functional defects could have interferences in the occupational duties and daily activities of the patients and can impose heavy costs on the patient [6-11].

Corticosteroid injections, acupuncture, surgery, and physiotherapy can be mentioned as the treatments for tennis elbow syndrome. Physiotherapy is a common treatment that is usually recommended to these patients. Physiotherapy methods that are recommended for the treatment of this syndrome include exercise therapy, soft tissue manipulation, manual techniques, and dry needling [12]. Despite the difference of action between these methods, the aim of all of them is to improve the performance of the patient and to reduce its pain; though, it seems that there is no ideal treatment for tennis elbow syndrome yet [13]. Results of a review and meta-analysis study that is performed to review physical interventions in the lateral epicondyle showed that there are not sufficient documents about the effectiveness of a single physiotherapy method in the treatment of tennis elbow syndrome [14].

Among all methods mentioned for treatment, dry needling is a new method that is performed by physiotherapists worldwide [7]. The effect on formed tough bands, by creating contractions and twitch responses, and reducing spontaneous activity, the effect on blood circulation and increased oxygenation, and environmental neurophysiological effects including secretion of opioids and beta-endorphins were used to control pain transfer, and central physiological effects including segmental inhibition (gait theory), opioids secretion, and effect on secretion of serotonin and noradrenalin neurotransmitters are mechanisms by which dry needling makes an action [14, 15]. This less-invasive, low-cost, easy-to-learn and low-risk method has proved to be promising in numerous studies. Dry needling can be used as part of a therapeutic program for chronic musculoskeletal pains in the patients [7]. A group of researchers inferred that the use of dry needling along with eccentric exercises has a more significant effect on decreasing active trigger points of tennis elbow syndrome than common physiotherapy methods [16]. Moreover, the comparison between dry needling, drug treatments, and breis showed that dry needling group has a better improvement after 6 months follow-up [17]. In another study performed to compare dry needling and plasma autologous blood injection, it was shown that there is a better clinical improvement in the plasma autologous blood injection method; however, the difference between these two groups was not significant [18].

Regarding the expansion of using dry needling as a therapeutic modality of physiotherapy, and the lack of adequate studies on the effect of using dry needling in patients with tennis elbow syndrome, if this method is proven to be effective, this can be considered as a less invasive method that can reduce the costs and the time taken for treatment of these patients.

Methods

This study was a randomized clinical trial (IRCT2016040827284N1) performed on 44 athletes aged 18 to 40 years old that carried out exercises that often involve upper limbs (such as tennis, badminton, volleyball, and basketball), and were doing their sport activities in gyms of Shiraz, Iran. These athletes minimally were in exercise or match for 3 sessions (6 hours) per week. Those who were detected to have tennis elbow syndrome for more than 3 months entered the study. Cozen's test was used to ensure that syndrome detection is correct. In this case, the person will sit and put his/her elbow on the table (with a 90 degrees flexion). Therapist puts a hand on the lateral epicondyle, and using the other hand gives resistance to extension, pronation, and radial deviation in the patient's wrist. If the pain occurred in the external side of the elbow, the result of the test is positive [19, 20].

Patients that has inclusion criteria filled the informed consent form and entered the study. Exclusion criteria were a positive history for shoulder or elbow fracture or dislocation during the previous year, the history of shoulder or elbow surgery during the last 6 months, and needle phobia. At the beginning of the study, the grip strength rate was evaluated through the hand dynamometer and the pain rate and function of the patient were evaluated through patient rate elbow evaluation questionnaire (PREE) (the validity and reliability of it was previously evaluated) [21], and the data were measured and recorded. To measure the grip strength, the person sat and placed his hand in the position of 90 degrees of elbow flexion on the bed, and then the dynamometer was placed in his/her hand and was loaded one time with the maximum strength that the patient could bear. The number that was shown by the dynamometer was recorded (in kilograms).

Then, the participants were divided into two groups (A, B) using simple randomization method and picking up a draw from a box. The first group received physiotherapy (continuous therapeutic ultrasound, one watt, for a period of five minutes at the site of the tendon of muscles of the forearm and the fingers), deep friction massage for five minutes [21], and muscle stretching and strengthening exercise [22].

The second group received dry needling in addition to the physiotherapy. To do this, the patient slept in the supine position, and placed his/her forearm in the pronation position. The needle entered the tendon parallel to skin position and toward the radius bone at the origin of common extensor muscles, and was kept for 15 minutes [16, 18, 23].

The treatment duration was three weeks and patients of both groups received physiotherapy at a three sessions per week period. At the beginning of the second and the third weeks, the PREE was filled by the patient and the grip strength test was performed. At the end of the third week of treatment, patients were eventually evaluated. Moreover, patients were assessed one week after the end of treatment to reevaluate the reliability rate of results.

Statistical analysis of data was performed using Mixed-Design ANOVA, Repeated measure t-test, Independent sample test, and Contrast test, as well as SPSS16 software.

Results

Table 1 shows the demographic data of participants. Regarding this table, mean age and BMI of patients in both groups are approximately equal. Additionally, the number of females was more than males in both groups.

Regarding significance level ($P<0.05$) for all variables, the differences between the two groups based on pain, performance, and grip strength in the 4th, 7th, and 9th weeks, as well as a week after intervention were statistically significant ($P<0.0001$) so that, the pain was decreased and the performance and grip strength were increased in them. Moreover, regarding the insignificant difference between the means of the 9th session and one week after intervention, it was shown that the intervention effect was persistent for one week in both groups and for all variables ($P<0.0001$).

Clinically, the pain of the patients decreased in both groups, at the time interval to the 4th session, and their performance increased as well. There was no significant difference in the pain and performance variables between the two groups, before intervention and the 4th session. However, the comparison of the two groups in 7th, 9th, and one week after intervention showed a significant increase in the performance of the group that received physiotherapy along with dry needling (Tables 2 and 3).

Regarding grip strength variable, though clinically both groups had an increased rate, the enhancement rate was more in the group that received physiotherapy along with dry needling; however, no significant difference was seen in the grip strength variable among the two groups in all time intervals ($P=0.09$).

Moreover, to have a better comparison of the obtained

Table 1: The demographic data of participants

Group	Mean±SD of age (year)	Mean±SD of height (meter)	Mean±SD of weight (kilogram)	Mean BMI	Number of women	Number of men
PT	34.54±6.36	1.65±3.43	63.86±7.06	23.40	21	1
PT & DN	35.31±7.1	1.68±5.62	66.09±8.87	23.34	16	6
Significance level	0.7	0.04	0.36	*	*	*

Table 2: The comparison of mean and SD of the pain, performance, and grip strength rates, before and after treatment in both groups

Group-Time	Variable	Pain		Performance		Grip strength	
		Mean±SD	Significance level	Mean±SD	Significance level	Mean±SD	Significance level
Before intervention with the 4th session	PT	8.72±3.91	<0.0001	21.22±10.35	<0.0001	1.50±1.3	<0.0001
	PT&DN	8.19±16.09	<0.0001	43.86±29.62	<0.0001	2.53±3.63	<0.0001
Before intervention with the 7th session	PT	15.50±5.8	<0.0001	37.18±18.68	<0.0001	2.63±1.09	<0.0001
	PT&DN	11.30±27.50	<0.0001	69.22±32.77	<0.0001	2.41±5.31	<0.0001
Before intervention with the 9th session	PT	23.86±8.23	<0.0001	55.04±22.42	<0.0001	2.63±1.09	<0.0001
	PT&DN	11.08±32.00	<0.0001	77.72±31.84	<0.0001	2.80±6.04	<0.0001
Before intervention with one week after intervention	PT	23.72±8.49	<0.0001	54.54±22.58	<0.0001	2.44±3.40	<0.0001
	PT&DN	10.28±30.63	<0.0001	75.72±31.39	<0.0001	3.64±6.54	<0.0001

Table 3: The comparison of mean and SD of the pain, performance, and grip strength rates, before and after treatment in both groups and comparison of the two groups

Time-Group	Variable	Pain			Performance			Grip strength		
		Mean±SD	Mean differences	Significance level of the difference between the two groups	Mean±SD	Mean differences	Significance level of the difference between the two groups	Mean±SD	Mean differences	Significance level of the difference between the two groups
Before intervention	PT	3.90±11.173	0.73	0.59	27.33±77.04	5.27	0.53	1.31±5.887	1.46	0.52
	PT & DN	34.62±9.39			28.23±82.31			1.77±8.798		
The 4th session	PT	25.18±9.65	-6.64	0.42	23.64±55.81	17.36	0.03	1.81±6.388	3.59	0.12
	PT & DN	18.54±12.11			27.37±38.45			2.40±8.602		
The 7th session	PT	18.40±9.21	11.27	<0.0001	25.27±39.86	26.77	<0.0001	1.95±6.439	4.14	0.07
	PT & DN	9.00±7.13			17.78±13.09			2.09±8.254		
The 9th session	PT	10.04±10.55	-7.41	0.006	2. 00±26.582	-17.41	0.008	2.00±6.271	3.81	0.09
	PT & DN	2.63±5.58			4.59±9.57			2.81±8.434		
One week later	PT	10.18±9.55	-6.18	0.001	2.50±25.832	15.91	<0.0001	2.72±5.920	4.59	0.46
	PT & DN	4.00±5.28			6.59±8.56			2.31±7.525		

results, the interaction between time and studied variables was evaluated. Results showed that in both groups, the pain is reduced and the function and grip strength are increased, and the interaction is significant; it means that during the time, the pain reduction, and the function and grip strength enhancement is more in the group that received physiotherapy along with dry needling than the group that received physiotherapy (Figures 1, 2, and 3).

A considerable result was the number of therapeutic sessions in which patients reported that their pain is completely relieved (Table 4). Regarding Table 4 and Chart 1 that assess the pain rate reduction rate during the time, it could be concluded that patients in the group that received physiotherapy along with dry needling had a shorter pain relieving time compared to the other patients.

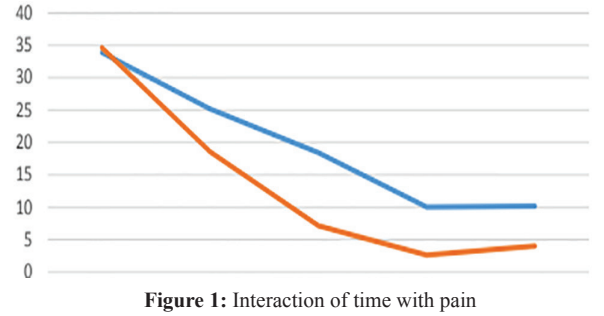

Figure 1: Interaction of time with pain

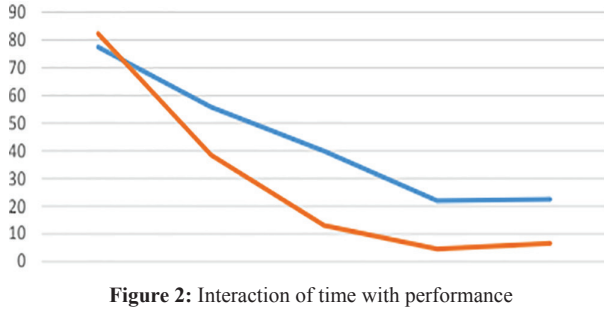

Figure 2: Interaction of time with performance

Discussion

The rates of pain, function, and the grip strength of the patients were measured before the intervention, and in the 4th, 7th, and 9th sessions, and one week after the end

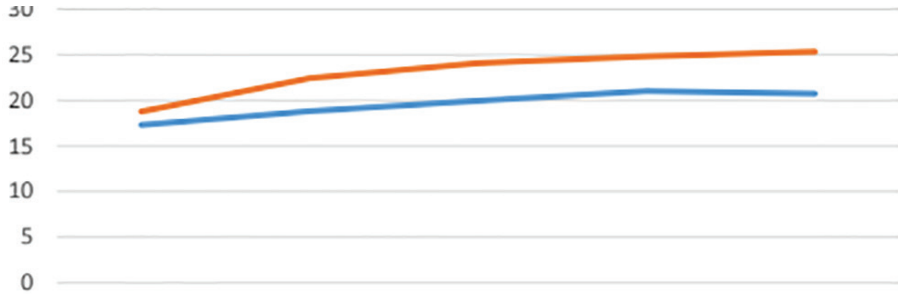

Figure 3: Interaction of time with grip strength

Table 4: Number of complete pain relieving during treatment sessions in each group

Session / Group	4th (person)	7th (person)	9th (person)	One week after intervention (person)
Physiotherapy	0	0	9	6
Physiotherapy along with dry needling	5	11	12	7

of the intervention in the physiotherapy group. Results showed that at all times of measurement, the pain rate decreased in comparison with the before interventions situation, and the rates of performance and grip strength increased as well; these alterations were significant. This finding is consistent with the results of studies that have already been published, including the study of Deniz et al. (2015). These researchers said that persons with tendinopathy in the elbow area would be relieved with resting and physiotherapy (especially strengthening and stretching exercises). Moreover, the use of friction massage can also be effective in the treatment of these patients [11].

In another study conducted in 2016, Marcollino et al. studied 8 volunteers with chronic tennis elbow syndrome which were receiving mobilization with movement, massage, and stretching and strengthening exercise. At the end of the study, the pain rate was significantly reduced in the patients and the rates of function and grip strength of these patients were significantly increased. In order to justify these results, Marcollino et al. suggested that eccentric exercises for the extensor muscles of the wrist and fingers can reduce pain and improve function in this area [24]. Moreover, the study of Mahmood Hassan et al. (2016) compared the effects of deep friction massage and stretching exercises for the extensor muscles of the wrist in 40 patients with tennis elbow syndrome. The first group received a deep friction massage, ultrasound along with using splint wrist, and the second group received stretching exercises for the wrists along with the use of splint of the wrists. At the end of the study, the pain was significantly decreased in both groups. Mahmood Hassan et al. also mentioned that stretching exercises lead to a decrease in muscle cramps and an improvement in blood circulation, which reduce the concentration of metabolites in the area. They believe that the tension developed by stretching exercises leads to a new arrangement in muscle tendon units. This results in an increase in the resistance of the tendon to the injury, a reduction in the stress on the tendon while moving, and an increase in the tendon tensile strength, which consequently lead to bulk muscular hypertrophy. Moreover, deep massage results in the regulation of pain impulses through the spinal cord (via the gateway control theory), which leads to inhibition of the A-delta and C fibers [25]. They also mentioned that the ultrasound through the micro-massage will result in an increase in flexibility of hard tissues, and using this way reduces the pain [25]. It seems that an improvement in the performance will also occur as a result of pain reduction in the patients [16, 26, 27].

The rates of pain, function and strength were measured before intervention, in the fourth, seventh, and ninth sessions, and one week after the end of the intervention in the group that received dry needling along with physiotherapy, and it was shown that at all times of measurement, the rate of pain was reduced in comparison with the before intervention status, and the rates of performance and grip strength increased as well; these changes were statistically significant. This result is also consistent with the results of the studies published so far. In a study by Sokmäar et al. (2014), 36 patients with unilateral chronic tennis elbow syndrome were divided into two groups that received low-power laser therapy or dry needling treatment. In the end, it was concluded that laser and dry needling can be used to develop immediate therapeutic effects in patients with this syndrome [28].

In a study performed in 2015, a 41-year-old woman suffering from pain and stiffness of the elbow was treated with dry needling in the wrist extensor muscle tendons and myofascial trigger points. At the end of the treatment, the pain of the patient decreased and her ROM increased. This study suggests that dry needling can turn off the myofascial trigger points, and when entered into the tendon, causes more muscle relaxation; thus, it appears that needle can be used as a better and faster therapeutic tool to relieve the pain and dysfunctions of the joints due to pain and immobility in the elbow and other joints [10]. In another study performed by Medvit et al. (2016), 10 patients with chronic tendinopathy in the long head of biceps muscle received dry needling along with eccentric exercises. Dry needling was performed on

the tendon of the long head of biceps muscle and the area in which the patients reported to have the most severe pain. In the end, it was observed that the pain of the patients significantly decreased and their performance significantly increased [29, 30]. In a study conducted by Sokumar et al. (2014), the effect of static dry needling and inactivating the associated trigger points along with eccentric exercises were evaluated on women with unilateral tennis elbow syndrome. It was concluded that the use of dry needling prior to the exercise of the eccentric exercises could result in muscle relaxation and muscle strength improvement to eccentric exercises [16]. In a case report in 2018, a woman suffering from tennis elbow syndrome received 6 sessions treatment with dry needling along with the alteration in activities and stretching exercises. At the end of the sessions, the patient's pain completely disappeared and her grip strength was increased. The results of this study showed that the use of dry needling can be effective in treating the problems of upper limb tissues and improve the daily activities of the patient [31].

In the present study, after comparing the two groups, in the seventh and ninth sessions, and one week after the end of the intervention, a significant decrease in pain and a significant increase in performance was observed in the group that received physiotherapy along with dry needling. So far, no study has been done to compare physiotherapy treatments with physiotherapy treatments along with dry needling. It seems that the greater rate of pain relief and increased function in the group that received physiotherapy along with dry needling can be due to the fact that the use of dry needling affects both tendon and muscle simultaneously, though techniques that are employed in routine physiotherapy (such as deep massage) only affect the tendon [32]. The use of dry needling can also result in relaxation in the muscle by deactivating the trigger points at the origin of the extensor muscle. As a result, the strength of the muscles in performing eccentric exercises will be improved [26]. It seems that dry needling can be considered as a better and faster therapeutic tool for recovery of joint pain and dysfunctions due to pain and immobility in the elbow and other joints [33]. On the other hand, P substances and calcitonin released in the area the needles are entered have a significant role in the reduction of activated trigger points that result in an immediate reduction in trigger point and tenderness in the area. Moreover, it seems that entering the needle in the trigger point will result in reduction of pain in the patients with tennis elbow syndrome via its effect on sensitivity process in that area [34]. It is shown that stimulations induced by high pressure using dry needling or mechanical stimulation of needle on a high number of sensory strings or neurotransmitters in the pain area can cause the production of powerful neural impulses in the trigger point that breaks the pain cycle and mitigates it [35].

In the case of grip strength, although there was a clinically increased rate in both groups, this increase was higher with respect to means in the group that received physiotherapy along with dry needling; however, comparing the grip strength rate between the two groups in all time intervals showed no significant difference. Thus far, no published study compared this variable in different physiotherapy treatments. It appears that the number of treatment sessions should be increased to see a significant difference in the grip strength variable between before and after physiotherapy treatment intervals.

Furthermore, a slight difference between the studied variables in the intervals of one week after the treatment or before it could be due to the more persistent effects of the treatments on the injured tissue. In fact, the newly developed tissue arrangement due to the therapeutic interventions is more stable.

Conclusion

Regarding the results of the present study, it could be concluded that using dry needling along with different elements of physiotherapy therapeutic protocols could be effective in the improvement of patients with tennis elbow syndrome, and can result in a faster relieving in patients, which reduces therapeutic costs in them.

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