Research Paper: What Is the Acute Effect of Dry Needling on the Active Trigger Points of Upper Trapezius Muscle? The Effect of Eliciting Local Twitch Response on Clinical Outcomes

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ABSTRACT

Purpose: Dry needling has been introduced as an effective method to treat the upper trapezius myofascial pain. Muscle damage after receiving the local twitch response can increase the risk of tissue fibrosis in some cases. This study aimed to investigate how the clinical parameters change after dry needling without local twitch response.

Methods: This is a quasi-experimental study, with pretest and posttest. A total of 26 patients suffering from neck pain with an active trigger point in their upper trapezius muscles were recurited via the convenience sampling methods. In all patients, the needle was moved 15 times in the trigger point of the trapezius muscle and then remained in place for 5 minutes. Participants were assigned in the dry needling with local twitch response (experimental group) when a local twitch response was evoked from muscle and without receiving local twitch response or deqi (control group) when a local twitch response was not seen. Then, they were treated with one session of dry needling. Before the intervention and 24 hours after the treatment, pain, pain pressure threshold, and neck disability index were evaluated. The obtained data were analyzed by multivariate ANCOVA using SPSS version 20.

Results: After the treatment, no significant changes were seen in the experimental group compared to the control group (P>0.05) regarding the pain, the pain pressure threshold, and neck disability index.

Conclusion: Dry needling along with receiving local twitch response does not have a superiority over the dry needling without receiving the local twitch response while the treatment aimed to receive the immediate effects.

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1. Introduction

Myofascial trigger point is one of the main causes of acute and chronic pain and also one of the most commonly neglected musculoskeletal problems [1]. The trigger point is a highly sensitive point within a taut musculoskeletal band that gets very painful due to pressure, strain, contraction, and overloading, and often creates the referred pain at a faraway point [1]. Simon described the main conditions of the muscular trigger points as follows: 1. Presence of a taut band in the skeletal muscle, 2. Presence of a highly sensitive point along the taut band in the skeletal muscle, 3. Creation of Local Twitch Response (LTR) when touching and pressing the trigger point, 4. Producing the referred pain in response to pressure, and 5. Continuous presence of referred pain based on a specific pattern. The myofascial pain syndrome is a major challenge both for diagnosis and treatment [2, 3].

Recent studies indicate the role of active trigger points in creating and maintaining local pain such as headache, backache, temporomandibular joint disorders, chronic pelvic pain syndrome, and neck pain [4]. Among the neck muscles, the upper trapezius is the most susceptible muscle that creates trigger point syndrome in the entire body due to exposure to permanent pressure and small strikes [5]. That is why timely and effective treatment is very important. Treatment of the trigger points comprises invasive and non-invasive methods. Several non-invasive methods such as stretching, massage, ischemic pressure, laser therapy, heat, acupuncture, ultrasound, and medications are used to cure myofascial pain [6, 7]. Invasive methods include injections of Botox, corticosteroids, anesthetics as well as dry needles [7, 8].

In dry needling technique, an acupuncture needle is directed to the trigger point [9]. Many studies have proven the positive effects of dry needling [9-12]. In this method, the greatest effect occurs when a phenomenon called the LTR is created [9]. These are spinal reflexive contractions caused by stimulating sensitive sites within the trigger points, i.e. the superficial muscles such as upper trapezius [13]. In dry needling treatment associated with maximum LTR, the needle enters the local twitch response region repeatedly until the maximum responses are created. It usually takes one to two minutes for each trigger point [14]. The findings indicate that no more muscle twitch response is created in the same area after a large number of LTRs (7.4±3.9 needle entries on average). Thus, the sensitivity of the trigger point is reduced [14]. In dry needling therapies that the needle enters back and forth to the trigger point more than 15 times, the muscular fibers and neural axons of the end plates in the motor point region may get damaged. It may also disturb the complete restoration of muscular fibers, disconnect neural axons, and cause fibrosis (scar tissue) to some extent [15]. This method also has some complications, such as discomfort, local bleeding, and pain at the place of needling. About 6.8% of patients report at least one of these complications [9].

In acupuncture, needling is done to create and strengthen a special sense called “deqi” Acupuncturists believe that creating the sense of “deqi” is very important for therapeutic effects [16]. The sense of “deqi” is, in fact, painful sensation, heaviness, swelling, numbness, tingle and itching, warmth and diffusion when the needle enters the tissue [17]. The sense of “deqi” involves a bunch of neural fibers from fast myelinated Aβ fibers with high thresholds to slow demyelinated fibers like C with a lower threshold. Thereby, it reduces the activity of the limbic system and pain [18, 19]. Considering the importance of treating trigger point syndrome of the upper trapezius muscle in patients with neck pain, and the risks of dry needling associated with receiving LTR in the creation of tissue fibrosis, bleeding and tissue adhesion, it is necessary to adopt a treatment with minimal tissue damage. Despite the positive physiological effects of dry needling without receiving LTR, no study has yet evaluated the effect of this method on the parameters of pain, pain pressure threshold and disability after a treatment session for upper trapezius muscle. Therefore, the present research aims to address this effect.

2. Materials and Methods

This study was a quasi-experimental research with pretest and posttest, in which 26 patients with active trigger points of upper trapezius muscle were selected by non-random and available sampling method out of those patients referred to the Physiotherapy Clinic of the Rehabilitation Sciences Faculty by orthopedic surgeons and neurosurgeons of the hospitals affiliated to Iran University of Medical Sciences. This research was conducted from November 1st to February 14th, 2016, at the physiotherapy clinic of Faculty of Rehabilitation Sciences of Iran University of Medical Sciences.

The inclusion criteria were as follows: aged 30-50 years, body mass index less than 30 kg/m^2, neck pain for the past 3 months, a numerical scale of more than 30 mm based on a 100-mm Visual Analogue Scale (VAS) of pain [20], and the presence of trigger points in the touch, based on the Travell and Simon [21] evaluation criteria. These criteria included the presence of taut band in the posterior-medial fibers of the upper trapezius muscle

Figure 1. Digital algometer PHYSICAL TREATMENTS

during the touch, presence of taut knot along the band, presence of at least one sensitive point in response to 25 N pressure, presence of referred pain and the pattern of pain associated with the trigger point of the upper trapezius muscle. The exclusion criteria included the diagnosis of fibromyalgia syndrome by taking medical history and clinical examinations based on the criteria stated by the American College of Rheumatology (1990) for not having bilateral symmetric pain in at least 11 points out of 18 (based on filling in the Fibromyalgia Impact Questionnaire), whiplash history, neck surgery in medical file and examinations, history of treatment for trigger points during past 3 months, severe postural disorders in examination, presence of prohibited conditions for dry needling including local infection, skin ulcers in the treatment area, local strike, receiving anticoagulants, or anything that may disrupt the correct assessment, such as alcohol and drug use, communication and cognitive impairment.

After entering the study, the eligible patients signed the consent forms. This study was approved by the Medical Ethics Committee of Iran University of Medical Sciences (IR.IUMS.REC.1395.0941134020). Before the evaluation and treatment, background information including participants' age, height, and weight was collected. Then, the Iranian version of the neck disability index was administrered to all patients for disability assessment. Validity and reliability of the questionnaire have been already approved [22]. The questionnaire consists of 10 questions, with a minimum score of 10 and a maximum disability score of 60. The severity of pain was also measured based on a 100-mm VAS. All patients were asked to mark their pain on this scale. The pressure pain threshold was measured by a digital algometer with an accuracy of 0.01 (Figure 1) [22]. First, the patient was asked to sleep on the back and place the hands under the forehead. Then, the probe of algometer was placed vertically on the point and applied at a speed of 1 kg/s to start the patient's pain and record it (3 repetitions were performed at an interval of 10 seconds, and then the average was calculated).

A digital scale was used to calibrate the instrument. After performing the evaluations, the patient was asked to sleep on the back as the hands are under the forehead. The active trigger point was detected based on the definition. In order to fix the position of the trigger points in the taut band of the posterior-medial fibers of the upper trapezius muscle, non-muscular points including spinous process of C7, vertebra, clavicle, and scapula process were used in the treatment session. In addition, the patients were treated with dry needling from the posterior region of the muscle to make the intervention similar for all of them (Figure 1).

Because the therapist was unaware of the creation of LTR in the muscle during the needling, the grouping was done after dry needling technique. Grouping in this study was done as follows: all patients were treated with dry needling in the first session, those with a LTR in the upper trapezius muscle were placed in the first group, and the others without LTR were placed in the second group (or the "deqi" group). The treatment method was as follows: first, the dry needling area was disinfected with the alcohol-impregnated cotton, and the examiner used sterile latex gloves. The needle used was 50 mm in length and 0.3 mm in diameter (made by Dong Bang Company in South Korea).

After detecting the location of the trigger point by touching, the thumb and index fingers of the therapist's non-dominant hand held the trigger point and then, the needle entered the skin from the side of the point by the dominant hand of the therapist. From this moment, the needle was reciprocated into the trigger point for 15 times with 1 Hz frequency and 1-2 cm along the vertical direction of the tissue [23] (without taking out the needle from the skin area). After the 15th shot, the needle was remained in place for 5 minutes [15, 17]. The patients were divided into two groups on the basis of the presence or absence of LTR during the reciprocating motion of the needle. In the second group (dry needling treatment group without LTR), after the evaluation and detection of

the trigger point location by the therapist, the needle was inserted into the skin and then the trigger point. During the maneuver, the sensation of needling and the sense of "deqi" were asked from the patient. The patient's reports of "deqi" sensation were recorded [24, 25]. The needle then remained in place for 5 minutes [15, 17]. After 5 minutes, the needles were removed and the treatment site was disinfected again by alcohol-impregnated cotton. All patients were treated for 1 session and re-evaluated 24 hours after the treatment.

Data analysis

SPSS version 20 was used for statistical analysis. After the completion of treatment and re-evaluation of all patients, the normal distribution of data was assessed by Kolmogorov-Smirnov test. Multivariate analysis of covariance (MANCOVA) was used to compare the effect of local twitch intervention on variables and the effect of associated variables.

3. Results

All variables of age, weight, and height had a normal distribution (P>0.05). Demographic information of patients is presented in Table 1. In addition, all patients participated in the treatment session and in both stages of evaluation. In this study, the subjects were divided into two groups based on the presence or absence of LTR, as described in the previous section (13 patients in the group of dry needling with LTR and 13 patients in the group of dry needling without LTR). In other words, 13 participants indicated no LTR when undergoing needling the upper trapezius muscle, and they were placed in the "deqi" group. In contrast, 13 patients indicated this response during dry needling in the muscle. In the following, we will discuss the changes in the parameters of these two groups.

Kolmogorov-Smirnov and Shapiro-Wilk test were used to test the normality of data and dependent variables, which is the first condition of multivariate covariance analysis (Table 2). The Levene's test was conducted to study the equality of the variables in the posttest stage, which is another condition of the multivariate covariance test. The results showed a significant level of more than 0.05 for all variables, denoting the equality of the variables (Table 3). In the next step, another condition of the multivariate covariance test was the equality of variance-covariance matrices that was performed by the Box test. The results showed no significant difference in the results of the Box test for the dependent variables ($F_{21,2,119}$=0.824 and Sig.=0.69; Box's M=23.854). Therefore, the assumption of equality was also confirmed.

Table 1. Demographic information of study samples

Variable	Group	Number	Mean±SD	Significance
Age (y)	With twitch response	13	41.16±10.83	0.1
	Without twitch response	13	46.92±9.97	
Weight (kg)	With twitch response	13	77.25±14.82	0.7
	Without twitch response	13	75±14.05	
Height (cm)	With twitch response	13	168.5±12.96	0.6
	Without twitch response	13	166.54±8.42	

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Table 2. Kolmogorov-Smirnov and Shapiro-Wilk test results for the normality of pretest data

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Pain	0.118	26	0.2	0.946	26	0.188
Pressure pain threshold	0.179	26	0.07	0.872	26	0.062
Neck disability index	0.091	26	0.2	0.977	26	0.801

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Table 3. Levene's test results of the equality of the variables

	F	df1	df2	Sig.
Pain	0.006	1	24	0.93
Pressure pain threshold	0.202	1	24	0.65
Neck disability index	0.124	1	24	0.72

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Another important assumption of the multivariate covariance test was the equality of regression coefficients. The regression coefficient equality test was investigated by the interaction of the pretest pain, pain threshold, and disability index with independent variable (treatment method) in the pretest stage. This assumption is true in relation to the posttest stage (P=0.64, $F_{2,2441,69}$=0.446). The interaction between these pretests and the independent variable was not significant, suggesting the equality of regression coefficients. Therefore, considering the confirmation of MANCOVA assumptions, we are allowed to do this test.

The relevant multivariate statistics, Wilks's lambda, were not statistically significant at 99% confidence level (α=0.01) (P=0.6) for pain, (P=0.06) for sensitivity threshold and (P=0.43) for disability index, respectively (Table 4). Therefore, the null hypothesis was not rejected, indicating that the linear combination of the three dependent variables of posttests of pain, pressure pain threshold and neck disability index had not been affected by the independent variable (LTR of muscle) (posttest stage) after adjusting the differences between the three covariance variables (pretests of pain, pressure pain threshold and neck disability index). As a result, MANCOVA was not significant in general. In other words, the analyses show that adding LTR to dry needling of the upper trapezius muscle was not effective on the linear combination of the three variables of pain, pressure pain threshold and neck disability index.

Although the linear combination of the dependent variables was not affected by the independent variable (treatment method), to complete the covariance analysis test, this section addressed whether each dependent variable was affected by the independent variable. The comparison of the mean posttest scores is shown in Table 5. The analysis of all variables indicates that they are not individually affected by the treatment method as the independent variable.

Table 4. Results of MANCOVA, i.e. the effect of the independent variable of the treatment on the three variables after adjusting the three covariance variables at the posttest stage

	Dependent Variable	Type III Sum of Squares	df	Sum of Squares	F	Sig.
Corrected Model	Pain	483.395[a]	2	241.698	0.446	0.645
	Pressure pain threshold	2503.440[c]	2	1251.720	3.062	0.066
	Neck disability index	241.999[d]	2	120.999	0.874	0.431
Intercept	Pain	6974.539	1	6974.539	12.879	0.002
	Pressure pain threshold	4207.710	1	4207.710	10.295	0.004
	Neck disability index	3352.089	1	3352.089	24.210	0.000
Pain Pressure pain threshold Neck disability index	Pain	483.395	2	241.698	0.446	0.64
	Pressure pain threshold	2503.440	2	1251.720	3.062	0.06
	Neck disability index	241.999	2	120.999	0.874	0.43
Error	Pain	12455.066	23	541.525		
	Pressure pain threshold	9400.714	23	408.727		
	Neck disability index	3184.501	23	138.457		

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Table 5. Results of multivariate analysis of covariance to compare the pretest and posttest results of dependent variables in both groups

	Dependent Variable	Sum of Squares	df	Mean of Squares	F	Sig.	Observed Power[b]
Pain	Pretest	541.337	1	541.337	0.986	0.332	0.158
	Group	215.222	1	215.222	0.392	0.538	0.092
	Error	11529.081	21	549.004			
Pressure pain threshold	Pretest	184.444	1	184.444	0.336	0.568	0.086
	Group	892.089	1	892.089	2.173	0.155	0.291
	Error	8619.737	21	410.464			
Disability index	Pretest	21.238	1	21.238	0.039	0.846	0.054
	Group	101.313	1	101.313	0.975	0.335	0.156
	Error	2182.623	21	103.934			

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To determine if the difference between the means was so large that the results of the present study could be used to compare the two groups, the effect size was calculated by Cohen's d test [26]. The results of this test showed that the present sample size (26 people) had an effect size of 0.83. Therefore, the sample size had high capacity in this study. In addition, according to the minimum detectable changes (MDC 95%) in the variables, the following values were obtained in all variables using the formula [27]:

$$MDC\ 95\% = 2.96 \times 2.25 \times SEM$$

With the help of a 100-mm VAS for the pain variables, pressure pain threshold and neck disability index in the present study, as well as the above formula and the SEM (Standard Error of Mean) values in patients, the MDC values were 12.27, 5.23, and 5.43 for pain, pressure pain threshold and the disability index, respectively. Therefore, with respect to these values, the mean changes of the variables studied in two groups did not reach the desired level for a clinically significant difference.

4. Discussion

The present study aimed to examine the effect of LTR intervention in dry needling on the clinical parameters of pain, pressure pain threshold and disability in patients with active trigger points in upper trapezius muscle. As discussed in the problem statement section, considering the risks and the probability of fibrosis and bleeding in the dry needling method associated with LTR [9, 15], this study compared the effect of dry needling treatment associated with and without receiving LTR. The results indicated that the LTR did not affect pain, disability and pressure threshold of the upper trapezius myofascial. Therefore, the conventional method of dry needling associated with receiving LTR does not have a superiority over the case without receiving LTR. So, when the immediate effects of dry needling are intended, the dry needling method without receiving the LTR is the choice. The lack of significant improvement in the pressure pain threshold in the present study is consistent with previous studies in the dry needling group with LTR [28, 29]. Although pain and disability in this group showed significant improvement after 24 hours, it is similar to other studies [28, 30]. However, the results of the present study are not consistent with the results of some other researchers who did not obtain immediate effects after the dry needling method [20, 31].

In Irnich et al. study, a group of 36 patients with neck pain and motor deficits in the neck were treated for three sessions. Treatment sessions included a treatment session in far points, a needling session in the neck area, and a control laser session. The measurement criteria comprised pain and neck motor range. In the end, the results indicated that the needling method in the points far from the cervical myofascial involvement region was superior to the needling of the local neck area and the laser off [32]. In this study, pain and motor range did not change significantly after three sessions of dry needling. The present study indicated different results due to a different number of sessions and the second evaluation time. To explain the results, the study researchers pointed out the role of the severe muscular soreness created in dry needling technique in

the treated muscle and the time it takes to improve the local injury. Therefore, the cause for the insignificant change in the neck's motor range seems logical in this regard. Similar results can be found in other studies.

Among other studies published in 2016, Ziaeifar et al. divided 31 patients with neck pain into two groups and treated them with one session of dry needling and spot ischemic pressure. The results showed improvement in both groups, but the difference was that the ischemic pressure treatment group showed a decrease in pressure threshold immediately after the treatment session. However, the dry needling treatment group showed pain reduction and increased pressure threshold two days after the treatment. The researchers noted the creation of muscular soreness after the dry needling as the cause of this delayed recovery. In this study method, receiving LTR was a part of the dry needling which continued until there was no more LTR [30]. The results of the present study were similar in terms of the positive effect of the needling. Despite the improvement of the patient's symptoms, the method of dry needling without LTR does not have a superiority to the other method.

In another study, Martín-Pintado-Zugasti et al. investigated the correlation between the amount of muscular soreness and gender, as well as the factors such as the number of reciprocating movements of needles in the tissue and having or lacking pain during the dry needling treatment. The evaluation included pain and pressure pain threshold three days after the treatment session. Dry needling technique was applied to upper trapezius muscle. The researchers reported that muscle soreness, pain, and pressure pain threshold was higher in women than in men. In addition, there was a strong logical correlation between the number of needles in the muscle to receive LTR and the muscle soreness, as well as pain relief and pressure pain threshold.

Therefore, the results suggest a delay effect after the dry needling technique with twitch response. There is also a relationship between the patient's gender and pain relief as well as the frequency needed to receive LTR until the end of the treatment so that there is no more LTR [33]. The study results are consistent with our study, especially in the group of dry needling without LTR. However, some results are inconsistent because the pain relief in our study was observed immediately after the dry needling technique with LTR. It can be said that the frequency of needling in this study was one of the possible causes of the difference in results. In other words, the needle entered the tissue for 15 times in the present study to complete the treatment session, while those researchers continued the needling until there was no other LTR.

There are two factors in the treatment of trigger points pain syndrome with dry needling. The first mechanism is to increase the blood flow in the surrounding area and chemical changes after the needling. The second mechanism is mechanical stimulation, which leads to the correction of the length of the sarcomeres in the affected area [34-37]. In contrast, the dry needling technique without LTR that creates the "deqi" sensation in the needle region is slightly different. In this regard, Japanese researchers have used animal studies as well as MRI imaging of the brain during needling, along with the sense of "deqi", and observed circulatory changes in the limbic system, as well as the amygdala, hippocampus, thalamus and cerebellum insula. In other words, this method of needling stimulates a batch of pain receptors from Type II to Aβ and C and Aβ and thereby reduces pain [18, 19, 38, 39]. Nevertheless, research into the mechanisms of dry needling effect is still ongoing in the "deqi" method.

The present study has some limitations. For example, there are no follow-up courses to examine the long-term effects of these two methods. However, no more treatment sessions were possible due to time constraints. Therefore, further research with more treatment sessions and longer follow-up is recommended. According to the study results, dry needling has a positive effect on the alleviation of pain in patients with trigger point pain syndrome of the upper trapezius muscle. Nevertheless, the needling method associated with receiving LTR does not have a superiority over the dry needling without receiving LTR. Therefore, when the immediate effects of dry needling are intended, the dry needling method without receiving the LTR can be used to treat patients due to the lower risks of bleeding and tissue fibrosis.

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Conflict of Interest

The authors declared no conflicts of interest.

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