Cover Page

Official Title:
Effect of Deep versus Superficial Dry Needling on Myofascial Trigger Points Characteristics in Patients with Neck Pain: An Ultrasound and Electromyography Evaluation

Short Title:
Comparing Deep and Superficial Dry Needling for Neck Pain: An Ultrasound and EMG Study

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Qatif Central Hospital, Eastern Province, Saudi Arabia

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Introduction:

The musculoskeletal system is the largest in the human body and is prone to various types of pain (Weller et al., 2018). Approximately 80% of the population experiences musculoskeletal pain (Bourgaize et al., 2018). Myofascial pain syndrome (MPS) is a particularly common musculoskeletal disorder, affecting around 85% of people at least once in their lifetime (Pal et al., 2014). Furthermore, the prevalence of symptoms and signs of MPS in Saudi Arabia is around 69% of the population. (Sabeh et al., 2020). The economic burden of myofascial pain is high as it was found that it costs 522 million dollars in Canada and around 57.51 million dollars in United State (Berger et al., 2007). MPS is characterized by regional pain associated with myofascial trigger points (MTrPs), typically caused by trauma or overuse leading to muscle contraction and local hypoxia that called local energy crisis (Barbero et al., 2019; Zhang et al., 2020). The upper back, particularly the levator scapulae and trapezius muscles, is the most common area for MTrPs, with 38.8% of people with neck pain exhibiting MTrPs in the upper trapezius muscle. (Cohen and Hooten, 2017).

The energy crisis hypothesis proposed by Simons and Travell, which links myofascial trigger points (MTrPs) to localized muscle contractions and hypoxia, has been supported by several studies. Needle and surface electromyography (EMG) studies revealed that motor unit potentials in MTrPs had greater amplitude and duration compared to normal muscles (Audette et al., 2004). Ultrasonography studies found that active MTrPs exhibited increased fiber alignment variability, band-like hypoechoic regions, and reduced entropy levels, indicating stiffer tissue compared to normal areas (Ballyns et al., 2012; Turo et al., 2013; Ball et al., 2022). The mechanical stiffness of active MTrPs was further confirmed by differences in shear wave speeds and phase plots. Additionally, both active and latent MTrPs were found to have higher retrograde diastolic blood flow, suggesting an impact on muscle blood circulation (Sikdar et al., 2010; Ballyns et al., 2011). Biochemical studies using microdialysis revealed that the environment surrounding active MTrPs is more acidic and contains higher levels of inflammatory and pain-related chemicals, such as substance P, compared to latent MTrPs and normal tissue (Shah et al., 2005; Shah et al., 2008; Gerdle et al., 2014). These elevated biochemical concentrations were also detected in distant pain-free areas in individuals with active MTrPs (Shah et al., 2005; Shah et al., 2008; Gerdle et al., 2014).

The most popular treatment for MTrPs is a form of injection therapy known as dry needling therapy, which was developed by Lewit in 1979 (Kalichman and Vulfsons, 2010). There are two main types of dry needling, based on the depth of insertion (Kalichman and Vulfsons, 2010; Moral, 2010; Legge, 2014). In superficial dry needling, the needle is inserted into the skin and does not reach the MTrP (Baldry, 2002). This type of dry

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needling was developed by Baldry in the early 1980s and provides good results (Baldry, 2002; Legge, 2014). In deep dry needling, the needle is inserted beyond the skin and into the muscle to access the MTrP (Griswold et al., 2019).

Regarding the mechanism of these two techniques of needling, in superficial dry needling, the MTrPs can be deactivated by stimulation of Aδ nerve fibers, which in turn release of opioid peptides from encephalin producing inhibitory interneurons in the dorsal horn. These peptides then block the transmission of pain signals within the dorsal horn, which are carried to the spinal cord by group IV sensory afferents from the MTrPs (Karavis, 1997; Baldry, 2002). While in the deep dry needling, is believed to be related to its ability to reach the trigger point, where it reduces end plate noise, spikes, acetylcholine levels, and neuromuscular junction responsiveness (Fernández-de-Las-Peñas and Nijs, 2019). This reduction in end plate noise is thought to sufficiently disrupt defective end plates within the MTrP area. Additionally, the observed decrease in acetylcholine levels may lead to increased muscle blood flow and oxygenation, as well as reduced sarcomere contracture (Fernández-de-Las-Peñas and Nijs, 2019).

The distinction between superficial and deep dry needling was highlighted in early 1980s by Baldry when patient with arm pain from a MTrP in the scalene anterior muscle was referred to him. Instead of needling deeply into the MTrP due to its proximity to the lung apex, he prudently inserted the needle into the subcutaneous tissues overlying the area of the MTrP. Surprisingly, this superficial dry needling technique effectively deactivated the MTrP, alleviating the tenderness at the site and spontaneously reduced the arm pain (Baldry, 2002). However, in recent years, it has been observed some studies in the impacts of both needling techniques. Many studies found that no significant difference between deep and superficial dry needling techniques both were beneficial in reducing pain intensity and functional disability (Sedighi et al., 2017; Sarrafzadeh et al., 2018; Ezzati et al., 201; Griswold et al., 2019; Hoseininejad et al., 2023). Although the subjective outcome measures like pain intensity and functional disability are valid measures, they may be providing biased assessment because they are affected by individual opinions, beliefs, or expectations (Linton and Show, 2011). However, objective outcome measures like ultrasound and electromyography provide an unbiased assessment of treatment outcomes and are not influenced by individual opinions, beliefs, or expectations. This objectivity enhances the validity of the findings and reduces the potential for placebo effects or other sources of bias (Vollert et al., 2020; Mobbs, 2021). There are no studies have compared the effect that these two dry needling techniques have on the ultrasonic and electromyographic properties MTrPs. Therefore, the purpose of this study is to investigate the

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effect that these two dry needling techniques have on the structural level of the MTrP by using the ultrasonic and electromyographic properties of MTrPs.

Objectives:

To investigate impact of deep and superficial dry needling on the ultrasound properties and electromyography muscle activity of trapezius muscle points in patients with neck pain by conducting randomized clinical trial.

Research Question (PICO)

Condition	intervention	Control or comparison	Outcome
Myofascial trigger points in patients with neck pain	Deep dry needling	Superficial dry needling	ultrasound properties and electromyography muscle activity

Time of the study: 1 year

Hypothesis: In this study, deep dry needling will be more affective to make change in the ultrasound properties of the myofascial trigger points and electromygraphic activity than superficial dry needling and there will be no correlations between primary outcomes (ultrasonographic and EMG findings) and secondary outcomes (pain intensity and neck disability).

Method:

Study type:◯ Descriptive
■ Analytical □ Cross sectional □ Case control □Cohort

Study design :◯ Retrospective ■ Prospective ■ Intervention

Estimated sample size: ◯ Depending on the prevalence ■ Power of the stud
Study start date: 01/10/2025
Study completion date: 01/10/2026

Research proposal
Detailed Description:
Eligibility:
Genders eligible for study: male and female
Recruitment: at physical therapy department - Qatif central hospital
Sampling method: convenience sampling
Age: between 18 and 65 years

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Criteria:

◯ **Inclusion criteria:**

aged 18–65 years, have neck pain, and have at least one active MTrP in the upper trapezius muscle.

◯ **Exclusion criteria:**

Whiplash injury, prior cervical surgery, cervical radiculopathy, fibromyalgia, analgesic treatment (e.g., physiotherapy or medication) within the week preceding participation, psychiatric disorders, or any contraindication to dry needling (e.g., needle phobia and/or anticoagulant use).

◯ **Study population:**

The study sample will consist of patients with neck pain and at least one active MTrP in the upper trapezius muscle that meets the following qualifying criteria: tender point, presence of a palpable taut band, presence of familiar pain during compression on the tender point and/or referred pain recognized by the patient as a "familiar" sensation and/or restricted range of motion of the neck (Fernández-de-Las-Peñas and Dommerholt, 2018). The identification of MTrPs by both different raters and the same rater has been observed to be moderately to highly reliable (Mayoral del Moral et a., 2018; Gerwin et al., 1997). Identified MTrPs must directly induce pain in the specific region and generate a localized twitch response on palpation (Gerwin et al., 1997; Myburgh et al., 2011). These diagnostic criteria were developed by Simons and Travell, and an international consensus was reached on their use in a Delphi study published in 2018 (Simons et al., 1999; Fernández-de-Las-Peñas and Dommerholt, 2018).

Method of assigning subjects to study groups

The participants will be randomly assigned to one of two groups: deep dry needling group or superficial dry needling group. An independent researcher will use the Research Randomizer platform (version 4.0) to generate a randomized series of numbers, which will be written on individual cards. The card will be then folded and placed in sealed opaque envelopes to ensure that the contents are concealed. The participants will then select an envelope to determine their intervention allocation. Consequently, each participant will be assigned to the relevant intervention group. The assessors and participants will be unaware of the group assignment, and the therapist will be unaware of the outcome measures.

Data Collection

■ **Dependent variables (the presumed effect)**

◯ **Independent or predictor variables (the presumed cause)**

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◯ **Confounding variables**

Data Analysis:

Statistical Package for the Social Sciences (SPSS) statistics software version 29.0 (IBM Corporation, Armonk, New York, USA) will be used to analyze all data. Normality will be tested using the Shapiro–Wilk test. In addition, mean and standard deviation values will be used for descriptive analysis. Linear Mixed Model (LMM) will be used to analyze the outcome measures at different time points (baseline, post-needling, and one week later), and post hoc tests will be used if significant differences are found. To determine whether there are relationships between the primary and secondary outcomes, Pearson or Spearman correlation will be used. 95% confidence interval and Cohen's d will be used to indicate the magnitude of treatment effects between groups. The significance of the results will be determined at P value < 0.05.

Research proposal

Ethical considerations

Although dry needling is a commonly used, safe, and approved technique, a few mild and transitory adverse events have been associated with deep dry needling, such as fatigue, drowsiness, and soreness, bruising, and bleeding at the needling site during or after treatment. There are specific procedures will be followed during dry needling procedure to prevent or reduce these adverse events. To minimize patient fatigue and discomfort, the dry needling procedure will be performed with the patient in a supine position. Following needle insertion, a sterile compression pad will be applied to the insertion site for 2-3 minutes to control potential bleeding or bruising. Moreover, to control soreness at the MTrP site, cold spray will be applied and the needled muscle will be stretched immediately after needling. The patients will be advised to rest for 48 hours between the sessions because post-needling soreness is very common and often lasts for 48 hours. Given the frequency of this adverse event, the dry needling intervention will be performed over 4 sessions, spaced 48 hours apart (Gattie et al., 2020).

Time line

The timeline helps the researchers and the reviewers ensure that the target is feasible, and helps the researcher think through the steps in implantation of the study.

Activity	Responsible investigator		Months or quarters; add columns as needed											
	investigator	investigator	1	2	3	4	5	6	7	8	9	10	11	12

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Study proposal	Anas Alhakami												
Literature review	Anas Alhakami												
Add rows as needed													

Investigators

Investigator(s)	**Name**	**Position and institute**
Principal Investigator	Anas Mohammed Alhakami **Saudi ID No.:** 1078500004	PhD candidate of Rehabilitation Sciences Program at Imam Abdulrhman Bin Faisal University
Co- Investigator	Dr. Ali Muteb Alshami	Supervisor - Imam Abdulrhman Bin Faisal University
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