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COMPARATIVE EFFECTIVENESS OF DRY NEEDLING AND MYOFASCIAL RELEASE TECHNIQUE IN INDIVIDUALS WITH ACTIVE UPPER TRAPEZIUS TRIGGER POINTS TO IMPROVE PAIN, FUNCTIONAL STATUS AND RANGE OF MOTION

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Abstract

Background:
Patients with active upper trapezius trigger points (most common complaint) may present with pain and decreased function. Many interventions are used to release trigger points, but the best is yet to be found.

Objective:
To compare the long-term effects of dry needling and myofascial release to relieve pain and improve ROM and functional status in active upper trapezius trigger point patients.

Methodology:
After approval of the synopsis, IRB No.895/RC/KEMU, research was conducted with 84 Patients who fulfilled the selection criteria were allocated into two group via the lottery method. Group A(42) received dry needling while Group B(42) received myofascial release for 2 weeks. The outcome tools for assessment were NPRS Scale, Goniometer and NDI questionnaire. Data was analyzed by SPSS-23, Kolmogorov-Smirnov test of normality, Man-Whitney U test, Friedman test and Wilcoxan-signed rank test.

Results:
Statistically, both techniques were equally effective in terms of reducing pain, improving functional status and cervical ROMs ($p<0.05$). The result showed that the Group 1's NPRS was 1(0,2), 8(4,9) NDI and 70(65,71.25) Cervical Flexion, 60(55,60) Extension, right side bending 25(25,30), left side bending 25(25,30), right rotation 60(58.75,65) and left rotation was 60(55,65) while the group 2's NPRS was 1(0,1), 7.5(4,9) NDI, 70(70,75) Cervical Flexion,

60(55,65) Extension, 30(25,35) right side bending, 30(28.75,35) left side bending, 62.5(60,66.25) right rotation and left rotation was 62.5(60,65).

Conclusion:

There was no significant difference between groups as p>0.05, but based on the median values, Group 2 was more effective in improving pain, ROM and functional status.

Introduction

The trapezius is a trapezoidal-shaped large superficial muscle in human anatomy that runs laterally to the scapula (shoulder blade) spine and longitudinally from the occipital bone to the lower thoracic vertebrae (1). Its purposes are to support the arm and move the scapulae. Trapezius has a range of effects since its fibers travel in diverse directions. The upper trapezius muscles are responsible for the scapula's elevation and upward rotation, as well as the neck's extension, lateral flexion, and contralateral rotation. The scapula is rotated upward, adducted, and depressed by the lower trapezius. The scapula is rotated upward and adducted by the middle trapezius. Another secondary breathing muscle is the upper trapezius(2, 3). The sensory functions of the trapezius are innervated via the ventral rami of C3 and C4. The trapezius's motor function is innervated by the spinal accessory nerve (cranial nerve XI)(4, 5). Myofascial trigger points, identified as hyperirritable sites inside a tense muscular band that are unpleasant to compress and stretch are frequently linked to myofascial pain syndrome, a prevalent cause of musculoskeletal pain (6-8). They could be the cause of muscular contraction deficiencies, range of motion (ROM) restrictions, and local or referred discomfort (9, 10). Disabling musculoskeletal pain can lead to secondary comorbidities and a reduction in working activity, income, sleep quality, and health status (11).

The two types of MTP are clinically categorized as **active and latent**, and spontaneous local or referral pain can be used to distinguish between the two (12). The term **"latent myofascial trigger point" (LMTP)** refers to the lack of pain. Muscle and joint overload, a disruption of the reciprocal inhibition process, and a lack of mobility are also linked to LMTP. Furthermore, LMTP raises the incidence of tension headaches, shoulder discomfort, mechanical neck pain, and patellofemoral pain syndrome (9). **Active MTrPs** replicate the pain symptoms that are experienced, which is how they vary from latent MTrPs (13). Within a tight ring of skeletal muscle, there is a palpable, distinct nodule that hurts on its own. This is known as an active trigger point, which is a nodule that hurts on its own. A latent myofascial trigger point is one that has to be palpated or moved in order to cause pain because it does not hurt on its own (14). Patients who have upper trapezius MTrPs may have knots around their neck, shoulder, or upper back, which, when handled, may cause excruciating pain and suffering that radiates beyond the area. Additionally, it may cause headaches, stiff necks, increased shoulders, restricted cervical rotation and lateral flexion, and neck pain (15). A thorough history and physical examination are necessary for the MTrP diagnosis to determine if the initial set of diagnostic criteria—such as taut band, spot tenderness, transferred pain, pain recognition, and local twitch response—are present or absent (16, 17).

Indeed, there are good reasons to pay more attention to this topic, given the high frequency of trigger point involvement and the amount of money spent annually on treating the condition's symptoms. Naturally, finding a treatment with high efficacy and long-lasting effects is the aim of this field of study (18). Trigger point inactivation can be treated with a variety of techniques these days, including dry needling, injections, pressure release, post isometric relaxation, acupuncture, physical modalities, and pharmaceutical therapy. More precisely, both invasive and noninvasive techniques are used to treat MPS. The manual therapy, heated packs, extracorporeal shock wave therapy, ultrasound, exercise, transcutaneous electrical stimulation, and medications are indicated for the treatment of MTrPs as invasive

treatments. Drug injection therapy and dry needle treatment are classified as invasive techniques. Studies comparing invasive and noninvasive techniques show that the former have the same pain-relieving efficacy while the latter have less severe side effects (19).

The most effective treatment methods among them have reportedly been found to be spray and stretch, dry needling, and injections for trigger point release (20). It is unknown; therefore, how dry needling lessens myofascial pain syndrome discomfort. By stimulating small-diameter nerve fibers, generating many neurotransmitters, and lowering trigger points, dry needling is believed to block pain signals (21).

Myofascial release is a type of soft tissue stretching in which gentle pressure is applied in a selected region and then consistently stretched to create a feeling of relaxation (22). Physiotherapists frequently employ myofascial release techniques in the therapy of trigger points with the goal of regaining the ideal length of the fascia tissue, reducing pain intensity, and optimizing functioning, despite the fact that the mechanisms of action and success are uncertain.

Methodology

This research work was a single blinded randomized controlled trial aimed at comparing the effectiveness of Dry Needling and Myofascial Release Technique in individuals with active upper trapezius trigger points to improve range of motion, functional status, and reduce pain. The data was collected from the Physiotherapy ward of Mayo Hospital, Lahore. Data collection was expected to begin within a six-month timeframe following the approval of the synopsis. Non-Probability convenience sampling method. A sample size of 76 patients was calculated with an expected 10% attrition sample size was 84, with 42 patients allocated to each group. Participants within the sample were selected based on eligibility criteria like Individuals between the ages of 18 and 50, both male and female, with the maximum NPRS on the activity score falling between 4 and 9. Individuals who have at least one active TrP in the cervical muscles linked to symptoms of neck pain. Patients had a tight band in the upper trapezius muscle with at least one trigger point present. Occurrence of a local twitch reaction upon abrupt palpation. Exclusion criteria was Patients who used analgesics within 48 hours before the first physiotherapy treatment and the Patients with a diagnosis of fibromyalgia, sensory disorders (sensory integration and Praxis test), disc disease (X-Ray, MRI), radiculopathy (X-Ray, spurling test, CT SCAN and MRI), torticollis (X-Ray CT SCAN and MRI), ankylosing spondylitis(HLA-B27), fracture or dislocation of the cervical vertebrae(X-Ray).

The researcher collected data after getting an approval letter After IRB No.895/RC/KEMU, from the ethical committee of King Edward Medical University, Lahore. Data was collected from Patients at Mayo Hospital, Lahore, after informed consent. Age, gender, employment, and level of pain were among the demographic and biographical details included in the data. This data was collected at three levels: the day a patient visits the therapist before the interventions (day 0), then immediately after the intervention (day 1, 10-minute follow-up), and after two weeks of intervention (day 14). Baselines were assessed and data were collected by:

i. NPRS (Numerical Pain Rating Scale): used to measure pain.

ii. NDI (Neck Disability Index); used to measure functional disability.

iii. Goniometer used to measure Cervical range of motion (ROM).

The methodology followed a consort flow chart. A total 90 patients were assessed for eligibility. 6 participants were excluded. 4 of them were not meeting the inclusion criteria, and one of them declined to participate, while the other one had some other reason. Thus, a total of 84 participants who fulfilled eligibility criteria were selected by non-probability convenience sampling. 2 groups of participants were made; each of the groups had 42 participants. Each participant was randomly allocated to the group by lottery method. This study was a randomized clinical trial with single blinding. The interventions were administered over two weeks, two days apart total of 4 sessions and three evaluations were carried out, one at the start of treatment then 10minute after the

treatment, and the other after two weeks of intervention. Group A had received dry needling once a day while Group B had received myofascial release. Both groups also performed neck isometric and stretching exercises and ROM. The patient was instructed to perform these exercises with 10 repetitions at least three times a day. A patient had also received guidance about posture correction.

	Frequency	Percent
Male	17	40.5
Female	25	59.5
Total	42	100.0

Results

Table 1: Age in Group 1 and group 2:

Table 2: Gender in Group 1 (Dry Needling)

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Age of Group 1	42	18.00	45.00	29.2381	6.78164
Age of Group 2	42	18.00	47.00	31.4286	8.94739

WITHIN GROUP ANALYSIS

Table 3: Friedman Test for NPRS Scale in Group 1 (Dry Needling)

Descriptive Statistics

	N	Percentiles		
		25th	50th (Median)	75th
Pre Intervention Numeric Pain Rating Scale of Group 1	42	7.0000	8.0000	8.0000
After 1 session Numeric Pain Rating Scale of Group 1	42	4.0000	4.0000	5.0000
Post Intervention Numeric Pain Rating Scale of Group 1	42	.0000	1.0000	2.0000

Table 4: Friedman Test for NDI Scale in Group 1 (Dry Needling

Descriptive Statistics

	N	Percentiles		
		25th	50th (Median)	75th
Pre Intervention Neck Disability Index of Group 1 (Percentage)	42	20.0000	24.0000	31.2500
After 1 Session Neck Disability Index of Group 1(Percentage)	42	12.0000	16.0000	18.0000
Post Intervention Neck Disability Index of Group 1(Percentage)	42	4.0000	8.0000	9.0000

Table 5: Friedman Test for Cervical ROM in Group 1 (Dry Needling)
Descriptive Statistics

	N	Percentiles		
		25th	50th (Median)	75th
Pre Intervention Cervical Flexion of Group 1 (Degree)	42	48.7500	50.0000	60.0000
After 1 Session Cervical Flexion of Group 1 (Degree)	42	55.0000	60.0000	65.0000
Post Intervention Cervical Flexion of Group 1 (Degree)	42	65.0000	70.0000	71.2500
Pre Intervention Cervical Extension of Group 1 (Degree)	42	40.0000	40.0000	45.0000
After 1 Session Cervical Extension of Group 1 (Degree)	42	50.0000	50.0000	55.0000
Post Intervention Cervical Extension of Group 1 (Degree)	42	55.0000	60.0000	60.0000
Pre Intervention Cervical Right Side Bending of Group 1 (Degree)	42	10.0000	15.0000	20.0000
After 1 Session Cervical Right Side Bending of Group 1 (Degree)	42	15.0000	20.0000	25.0000
Post Intervention Cervical Right Side Bending of Group 1 (Degree)	42	25.0000	25.0000	30.0000
Pre Intervention Cervical Left Side Bending of Group 1 (Degree)	42	10.0000	15.0000	16.2500
After 1 Session Cervical Left Side Bending of Group 1 (Degree)	42	18.7500	20.0000	25.0000
Post Intervention Cervical Left Side Bending of Group 1 (Degree)	42	25.0000	25.0000	30.0000
Pre Intervention Cervical Right Rotation of Group 1 (Degree)	42	40.0000	42.5000	46.2500
After 1 Session Cervical Right Rotation of Group 1 (Degree)	42	48.7500	50.0000	55.0000
Post Intervention Cervical Right Rotation of Group 1 (Degree)	42	58.7500	60.0000	65.0000
Pre Intervention Cervical Left Rotation of Group 1 (Degree)	42	40.0000	45.0000	50.0000
After 1 Session Cervical Left Rotation of Group 1 (Degree)	42	50.0000	55.0000	60.0000
Post Intervention Cervical Left Rotation of Group 1 (Degree)	42	55.0000	60.0000	65.0000

Table 6 : Friedman Test for NPRS Scale in Group 2 (Dry Needling)
Descriptive Statistics

	N	Percentiles		
		25th	50th (Median)	75th
Pre Intervention Numeric Pain Rating Scale of Group 2	42	6.0000	7.0000	8.0000
After 1 session Numeric Pain Rating Scale of Group 2	42	4.0000	4.0000	5.0000
Post Intervention Numeric Pain Rating Scale of Group 2	42	.0000	1.0000	1.0000

Table 7: Friedman Test for NDI Scale in Group 2 (Myofascial Release technique)
Descriptive Statistics

	N	Percentiles		
		25th	50th (Median)	75th
Pre Intervention Neck Disability Index of Group 2	42	16.0000	24.0000	32.0000
After 1 Session Neck Disability Index of Group 2	42	12.7500	16.0000	18.0000
Post Intervention Neck Disability Index of Group 2	42	4.0000	7.5000	9.0000

Table 8*: Friedman Test for Cervical ROM in Group 2(Myofascial Release)*
Descriptive Statistics

	N	Percentiles		
		25th	50th (Median)	75th
Pre Intervention Cervical Flexion of Group 2 (Degree)	42	50.0000	50.0000	55.0000
After 1 Session Cervical Flexion of Group 2 (Degree)	42	60.0000	65.0000	70.0000
Post Intervention Cervical Flexion of Group 2 (Degree)	42	70.0000	70.0000	75.0000
Pre Intervention Cervical Extension of Group 2(Degree)	42	40.0000	42.5000	50.0000
After 1 Session Cervical Extension of Group 2 (Degree)	42	48.7500	55.0000	60.0000
Post Intervention Cervical Extension of Group 2 (Degree)	42	55.0000	60.0000	65.0000
Pre Intervention Cervical Right Side Bending of Group 2 (Degree)	42	13.7500	15.0000	20.0000
After 1 Session Cervical Right Side Bending of Group 2 (Degree)	42	20.0000	25.0000	30.0000

Post Intervention Cervical Right Side Bending of Group 2 (Degree)	42	25.0000	30.0000	35.0000
Pre Intervention Cervical Left Side Bending of Group 2(Degree)	42	13.7500	15.0000	20.0000
After 1 Session Cervical Left Side Bending of Group 2 (Degree)	42	20.0000	25.0000	30.0000
Post Intervention Cervical Left Side Bending of Group 2 (Degree)	42	28.7500	30.0000	35.0000
Pre Intervention Cervical Right Rotation of Group 2 (Degree)	42	40.0000	45.0000	46.2500
After 1 Session Cervical Right Rotation of Group 2 (Degree)	42	50.0000	50.0000	55.0000
Post Intervention Cervical Right Rotation of Group 2 (Degree)	42	60.0000	62.5000	66.2500
Pre Intervention Cervical Left Rotation of Group 2 (Degree)	42	40.0000	45.0000	50.0000
After 1 Session Cervical Left Rotation of Group 2 (Degree)	42	50.0000	50.0000	60.0000
Post Intervention Cervical Left Rotation of Group 2 (Degree)	42	60.0000	62.2500	65.0000

Discussion:

Myofascial trigger points are hypersensitive or painful areas found in the skeletal muscles' tight bands, which are stretched or compressed and can result in local or transferred pain. Myofascial pain syndrome is linked to myofascial trigger points(51).

This study aimed to figure out if myofascial release and dry needling may help patients with active upper trapezius trigger points with their pain, functional status, and cervical range of motion. As a null hypothesis, it was proposed that there would be no difference between the effects of Myofascial Release and Dry Needling on pain reduction, functional status, and cervical range of motion in patients with active upper trapezius trigger points. Alternatively, it was proposed that there would be a significant difference between the effects of Myofascial Release and Dry Needling on pain reduction, functional status, and cervical range of motion in patients with active upper trapezius trigger points.

A total of 84 people who met the eligibility requirements and were chosen by non-probability convenience sampling were included in this study. There were 42 people in each of the two participant groups. By use of a lottery, each participant was assigned to the group at random. Dry needling combined with conventional physical therapy treatment was part of Group A, while myofascial release combined with conventional physical therapy treatment was part of Group B.

It is always crucial to choose outcome measurements that are both valid and dependable. NPRS, NDI, and a goniometer were employed in this study to directly address the goal of the research. It is crucial to remember that the outcome measures under study have distinct constructs. In certain outcome measures, lower scores indicate higher performance, whereas in others, the opposite is true. For instance, a lower NPRS and NDI score indicates a better result, but a higher goniometer score indicates an improvement in cervical ranges of motion. According to this study's findings, myofascial release and dry needling, when combined with conventional physiotherapy treatment, significantly increase cervical range of motion, functional status, and pain reduction. Comparing the two groups revealed that both methods are similarly successful in lowering pain, enhancing functional status, and increasing cervical range of motion, group 2, that is Myofascial Release is somewhat more successful than group 1, which is Dry Needling, based on the median value.

The **mechanism of Dry Needling** involves both peripheral and central nervous system effects, aimed at restoring homeostasis in myofascial trigger points and alleviating pain. It works by eliciting a **local twitch response** in which the involuntary contraction of the affected muscle alters muscle fiber length and tension. This stimulates mechanoreceptors, like A-beta fibers, which can lead to a decrease in peripheral and central sensitization to pain, **increasing blood flow** and oxygenation in the affected area by vasodilation. This improved circulation helps deliver nutrients, remove waste, and reduce inflammation, and influences **neurophysiological responses** by stimulating sensory receptors, promoting the release of endogenous opioids (natural pain relievers). It may also alter neurotransmitter balance, influencing pain signals and perception (52).

The **mechanism of Myofascial Release** is stimulating fascial tissue, leading to changes in the structure and function of the fascia, which surrounds muscles and other tissues. This stimulation can improve blood flow, reduce inflammation, and increase fascial hydration, ultimately improving movement and reducing pain. Myofascial release techniques apply pressure to the fascia, which stimulates **fibroblasts,** the cells responsible for producing collagen and elastin fibers. This stimulation can lead to changes in the fibroblasts' shape and function, encouraging them to produce more connective tissue fibers. The sustained pressure applied during myofascial release can cause the **fascia to lengthen and become more elastic**. This can help to release restrictions and improve movement. The pressure and manipulation of the fascia can also **increase hydration** within the fascial layers, which is essential for maintaining its elasticity and ability to glide smoothly over muscles and bones. Myofascial release can **enhance blood flow** to the affected areas, delivering more oxygen and nutrients to the cells. The therapy can also **reduce levels of inflammatory cytokines**, which can contribute to pain and stiffness. Myofascial release can **alter sensory input** and affect the nervous system, leading to changes in muscle tone and pain perception. By releasing restrictions and reducing inflammation, myofascial release can help to relieve pain associated with myofascial pain syndrome. Myofascial release can help to **release tension** in myofascial trigger points, which are hyperirritable areas in the fascia that can cause pain and restricted movement.

Conclusion

Statistically, both techniques were equally effective in terms of reducing pain, improving functional status and cervical ranges of motion as $p<0.05$.

REFERENCES:

Gupta M. An immediate effect of myofascial release therapy and combined approach on myofascial trigger points in upper fibers of trapezius: A comparative stu. 2021.

Physiotherapy KKS. A Comparative Study Between Muscle Energy Technique and Myofascial Release Therapy on Myofascial Trigger Points in Upper Fibres of Trapezius.

Jensen C, Westgaard RH. Functional subdivision of the upper trapezius muscle during low-level activation. Eur J Appl Physiol Occup Physiol. 1997;76(4):335-9. doi: 10.1007/s004210050257. PMID: 9349648.

Ourieff J, Scheckel B, Agarwal A. Anatomy, Back, Trapezius. StatPearls. Treasure Island (FL): StatPearls Publishing Copyright © 2025, StatPearls Publishing LLC.; 2025.

Johnson G, Bogduk N, Nowitzke A, House D. Anatomy and actions of the trapezius muscle. Clinical biomechanics. 1994;9(1):44-50. .

Immediate Effects of Dry Needling and Myofascial Release on Local and Widespread

Pressure Pain Threshold in Individuals With Active Upper Trapezius Trigger Points: ARandomized Clinical Trial. 2020.

Guzman-Pavon MJ. Effect of Manual Therapy Interventions on Range of Motion Among Individuals with Myofascial Trigger Points: A Systematic Review and Meta-Analysis. 2022.

Guzmán Pavón MJP.

Comparative Effectiveness of Manual Therapy Interventions on Pain and Pressure Pain Threshold in Patients With Myofascial Trigger Points

A Network Meta-analysis. 2022.

tabatabaiee a. Comparison of pressure release, phonophoresis and dry needling in treatment of latent myofascial trigger point of upper trapezius muscle. 2018.

Bethers AH. Positional release therapy and therapeutic massage reduce muscle trigger and tender points. 2021.

martin dp. Immediate effects of variable durations of pressure release technique on latent myofascial trigger points of the levator scapulae: a double-blinded randomised clinical trial. 2019.

Das R. Myofascial Trigger Points and its Influence on Athletic performance- A Review. 2022.

yan-tao-ma. dry needling on latent and active mtrp vs oral diclofenac. 2023.

Gerber LH. Dry Needling Alters Trigger Points in the Upper Trapezius Muscle

and Reduces Pain in Subjects With Chronic Myofascial Pain. 2015.

lew j. Comparison of dry needling and trigger point manual therapy in patients with neck and upper back myofascial pain syndrome: a systematic review and meta-analysis. 2020.

Rubi Yadav SS. Efficacy of Myofascial Release Therapy and Positional Release Therapy in Patients with Upper Trapezius Trigger Points: Study Protocol of a Double-blinded Randomized Clinical Trial. 2024.

Bagheri R, Taghizadeh Delkhoush C, Mirmohammadkhani M, Safavi Farokhi Z, Bakhshi S. Comparison of Dry Needling and Inhibitory Kinesio Taping in Treatment of Myofascial Pain Syndrome of the Upper Trapezius Muscle: A Randomized Controlled Trial. J Chiropr Med. 2022;21(1):23-31.

Junaid M. Effects of post-isometric relaxation, myofascial trigger point release and routine physical therapy in management of acute mechanical neck pain: a randomized controlled trial. 2020.

Asad Ullah 1 ZM, Zubair Ahmad3, Rabia Kanwal4. Effects of positional release technique on myofascial trigger points of the upper trapezius in computer users having forward head posture. 2023.

Pattnaik S. Effect of Positional Release Technique in Improving Range of Motion and Pain Pressure Threshold in Patients with Myofascial Trigger Points in Upper Trapezius Muscle: A Systematic R... 2024.

Zutshi1 K, PV, AH. Effectiveness of Myofascial Release in Improving Pain, Pain

Pressure Threshold and Disability as Compared with StandardCare in Upper Trapezius Myofascial Trigger Points. 2021.

ÖBn. The effectiveness of deep tissue massage on pain, trigger point, disability, range of motion and quality of life in individuals with myofascial pain syndrome. 2023.