Available online at **www.ijmrhs.com**

ISSN No: 2319-5886

International Journal of Medical Research & Health Sciences, 2021, 10(2): 1-7

Dry Needling in Combination with Muscular Inhibition Technique on Mouth Function and Health-Related Quality of Life in Patients with Temporomandibular Disorders: A Randomized Control trial

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ABSTRACT

Background: *Temporomandibular Disorders (TMD) is one of the most common and public health care concerns. The study was aimed to explore the effectiveness of dry needling and Muscular inhibition technique on mouth function and Health-related Quality of Life (QoL) in TMD patients.* ***Methods:*** *This was an experimental study with a randomized control trial design, conducted at the Lovely Professional University, India. We recruited 126 subjects of both gender, aged between 18 to 50 years, and who were clinically diagnosed with TMD. They were randomly divided through the lottery method into two groups: the control group and the experimental group. For outcome measurement mouth function and health-related QoL were measured through digital calipers and SF-36 questionnaire respectively, before and after 5 weeks of the treatment session. In this study, the control group received conventional physiotherapy treatment, while the experimental group received a physical therapy approach, which consisted of dry needling and muscular inhibition. Statistical analysis was carried out using Student's t-test via the Statistical Package for the Social Sciences software, version16. The level significant level was considered as $p<0.05$ for the analysis of data.* ***Results:*** *Both the group was found homogenous for baseline demographic characteristics. Between the group comparisons, it was observed there were differences in mouth function ($p<0.001$) and Health-related QoL ($p<0.001$).* ***Conclusion:*** *The results of this study indicate that the application of dry needling and Muscular inhibition technique could improve mouth function and Health-related Quality of Life (QoL) in patients with TMD.*

Keywords: Dry needling, Muscular inhibition, Temporomandibular disorders, Mouth function, Health-related QoL

INTRODUCTION

Temporomandibular Disorders (TMD) have turned into one of the most common problems among physical therapists and dentists [1]. TMD is a cervical-craniomandibular dysfunction that affects the temporomandibular joint and the central nervous system [2]. Its etiology can be "biomechanical, neuromuscular and biopsychosocial", and the condition can aggravate with emotional stress, bad posture, the bad position of teeth, tooth loss as well as various extrinsic and intrinsic changes of the structural components of the temporomandibular joint [3,4].

The main symptoms of TMD patients include orofacial pain, noise in the temporomandibular joint, decreased bite force, and reduced jaw mobility. Deviation of the jaw during jaw movements is also common and could impact mouth function [5,6]. Multi-factorial theology in TMD often requires a multidisciplinary approach to dealing with severe symptoms, including chronic pain. Current evidence has suggested that various conservative approaches such as massage, exercise, dry needling, electrotherapy, pharmacology, manipulation, etc. are effective against TMD-related symptoms [7-9].

As per the existing studies, TMD is a multidimensional condition that involves neural, muscular, and articular components. Therefore, its treatment strategies require a broad multidisciplinary approach. Physical therapy in conjunction with dry needling has a vital role in the rehabilitation of these patients since it provides pain relief, rehabilitates the neuromuscular system, and restores the mandibular rest position and muscle coordination.

The purpose of the therapeutic approach of this model is to reduce pain perception and improve motor behavior and cognitive and emotional factors related to the experience of pain [10]. Most authors have reported that dry needling

is one of the popular methods of a multidisciplinary approach to reduce pain [11,12]. Exercise programs were aimed to achieve improvement in motor performance and cognitive and emotional factors related to the experience of pain. However, to the best of our knowledge, there is still no research that proves the effectiveness of muscular inhibition technique and dry needling on mouth function and health-related QoL in patients with TMD. Therefore, this research aims to explore the effectiveness of dry needling and muscular inhibition technique on mouth function and health-related Quality of Life (QoL) in TMD patients.

MATERIALS AND METHODS

Study Design

This was an experimental study with a single-blind randomized control trial. The lottery method (sealed enveloped) was used to ensure the random concealment of allocation. The researchers were not involved in the recruitment or assessment of patients. All eligible subjects were randomly divided into two groups: the control group and the experimental group.

Study Setting and Participants

The data for the study was obtained from the Uni-Hospital, LSPPS (School of Physiotherapy and Paramedical Sciences), Lovely Professional University, India. The trial was conducted from June 2019 to March 2020 through UMS (University Management System) and social media announcements. The sampling method was simple randomized sampling. The sample size was calculated based on a 95% confidence interval, 80% power of the study, and 0.5 Cohen (d effect size). The calculated sample size was 63 per group. Due to 15% dropout chances, we included 73 subjects per group. All the participants were informed about the study and signed the consent form before the commencement of the study.

Sampling Criteria

The following participants were included in the study: age between 18 and 50 years, having pain for at least 3 months, minimum score in Numerical Pain Rating Scale (NPRS) ≥ 3, and positive three-finger test with a limited maximum mouth opening of less than 30 mm. Those participants were excluded who met any of the following criteria: suffering from any dental problem, headache, hypertension, diabetes, asthma, epilepsy, and trauma, and surgery to the maxillofacial area.

The control group received conventional physiotherapy with normal home-based exercise, and the experimental group received a physical therapy approach consisting of dry needling and home-based exercise.

Outcome Measure

A pre-test reading of mouth function was measured through a digital metallic caliper wherein the distance from the edges of upper and lower central incisors was measured. SF-36 was used for the measurement of health-related QoL. Outcome measures of all participants were recorded before commencing the study and then after 5 weeks of treatment protocol post evaluation.

Intervention

The intervention protocol followed the TIDieR checklist [13]. The experimental group received 10 sessions of physiotherapy over 5 weeks, 2 sessions per week; the minimum treatment gap was 48 hours. Physical therapist-1, who carried outpatient screening, was responsible for dry needling technique, and Physical therapist-2 was responsible for muscular inhibition technique and exercise supervision. The control group was advised to do a range of motion exercise for the neck and jaw. Both the group was advised to do home exercise [14].

Dry needling: Before using dry needling, the skin surfaces were cleaned with saline water; the plastic guided (0.22 mm × 30 mm) acupuncture needle was inserted into the tender point of the muscle. Dry needling was performed on masseter, temporalis, and sub-occipital muscles in 8 sessions with a 4-day interval. Before applying the needling, the participant was advised to sign the consent form for the dry needling application [15].

Muscular inhibition: For the muscle inhibition technique, ischemic-sustained pressure was applied on the muscle for 5-10 seconds. This was performed on masseter, temporalis, medial and lateral pterygoid muscles, and sub-occipital muscles on alternative days of dry needling session. The patient was in a relaxed position (supine lying), and then

the tender point was palpated through fingertip palpation. The sustained pressure was applied on the muscle for 5-10 seconds by the therapist's finger digits to reinforce the pressure and emphasize different digits.

Data Analysis

A summary of the study protocol is shown in Figure 1. Kolmogorov-Smirnov test was used to identify the normal distribution of the data. Baseline, a characteristic of categorical variables, was evaluated through Chi-square test, the quantitative variable was evaluated through Student's t-test, and quantitative variable without normal distribution was measured through Mann-Whitney U test. The intra- and intragroup outcome measures were evaluated through a pair t-test. Data were analyzed using SPSS version 16. The level of significance for this study was fixed at 5% ($p<0.05$).

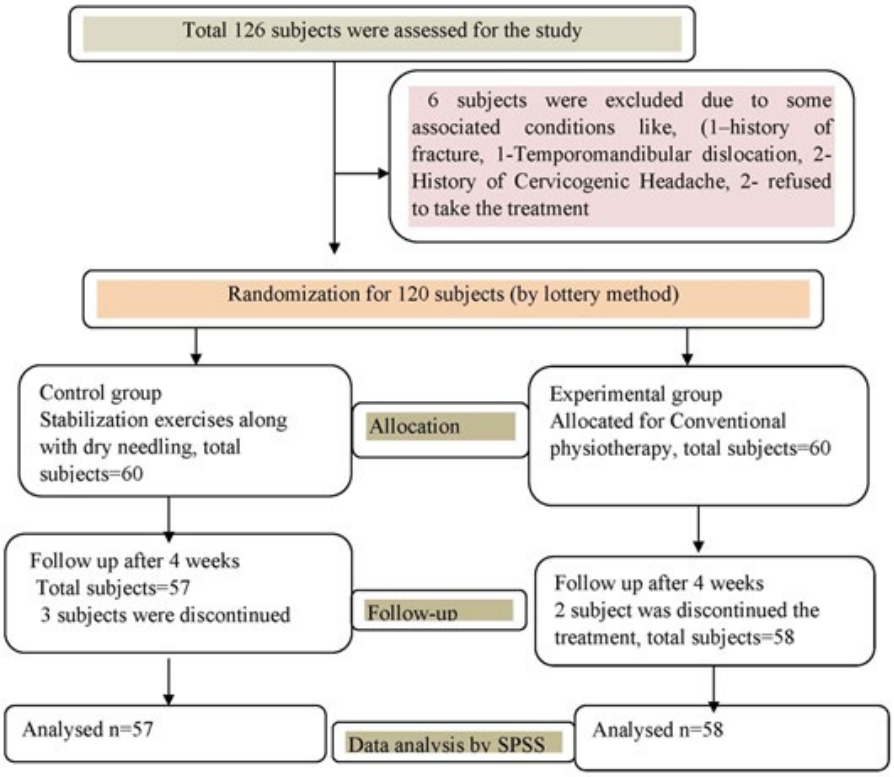

Figure 1 A summary of the study protocol

RESULTS

We recruited 126 subjects of both genders who were aged between 18 to 50 years. Six subjects were excluded from the study, as they did not meet the inclusion criteria. A total of 120 subjects were randomly allocated into two groups: 60 subjects to the control group and 60 subjects to the experimental group. In the control group, 3 subjects did not receive the treatment, and in the experimental group, 2 subjects discontinued their treatment due to personal issues and non-adherence to the treatment. Finally, 115 subjects (78 women and 37 men) were included in the final analysis. No adverse effects were observed due to the treatment approach in the experimental group. In the descriptive demographic data, no significant difference was found between the two groups (Table 1). There was a significant change in the experimental group for all the parameters of pain pressure pain threshold and mouth after the intervention (Table 2). In the control group, significant changes were not found (Table 3). In the control group, a comparison of pre and post outcome measures of mouth function and health-related QoL revealed no statistically significant change ($p>0.05$). In the experimental group, a comparison of pre and post outcome measures of mouth function and health-related QoL and mouth function revealed statistically significant change ($p<0.05$). When the post-treatment data were compared between the groups, it was found that the experimental group parameters were significantly different from the control group ($p<0.05$).

Table 1 Baseline demographic characteristics of data for control and experimental groups

Variables	Control group Mean ± SD	Experimental Group Mean ± SD	p-value
Age (y)	35 ± 10.11	36 ± 12.12	0.232
BMI (kg/m^2)	22.55 ± 3.65	23.32 ± 3.15	0.441
Gender	Female (n=38)	Female (n=40)	0.116
	Male (n=19)	Male (n=18)	0.228
Smoking history	No=82% Yes=18%	No=75% Yes=25%	0.354
Marital status	Married 90%, Unmarried 10%	Married 85%, Unmarried 15%	0.397
Education history	School level 20%, UG 60% and PG 20%	School level 10%, UG 40% and PG 50%	0.257
Socio-economical history	Poor 0%, Average 60%, Well established 40%	Poor 0%, Average 50%, Well established 50%	0.459
Note: y: year; kg: kilogram; cm: centimeter; m: meter; BMI: Body Mass Index; UG: Undergraduate; PG: Postgraduate			

Table 2 Comparison of Mouth function and health-related quality of life within the control and experimental group

Group	Outcome	Pre (Mean ± SD)	Post (Mean ± SD)	Differences	p-value
Control Group	Mouth Function	32.50 ± 3.70	33.23 ± 2.90	0.73	0.212
	PF	59.67 ± 9.00	58.86 ± 8.53	1.19	0.341
	RL-PH	35.49 ± 19.18	31.62 ± 16.83	1.13	0.441
	RL-EH	36.07 ± 24.31	32.07 ± 22.23	1	0.487
	EN	52.89 ± 8.27	50.37 ± 7.72	1.38	0.342
	EWB	62.91 ± 6.50	64.49 ± 8.76	1.58	0.233
	SF	61.73 ± 9.77	63.37 ± 11.56	2.64	0.435
	BP	44.29 ± 9.01	62.62 ± 9.37	18.33	0.001
	GH	54.59 ± 7.67	53.45 ± 9.49	1.86	0.543
Experimental Group	Mouth Function	31.50 ± 3.70	41.55 ± 4.90	8.73	0.001
	PF	58.91 ± 9.87	87.83 ± 6.81	28.92	0.001
	RL-PH	35.81 ± 16.18	86.48 ± 13.93	50.67	0.001
	RL-EH	32.37 ± 25.56	83.94 ± 16.72	51.57	0.001
	EN	48.94 ± 12.03	84.00 ± 8.91	35.06	0.001
	EWB	60.97 ± 7.95	83.62 ± 5.88	22.65	0.001
	SF	60.89 ± 8.23	83.95 ± 10.56	23.06	0.001
	BP	43.59 ± 12.06	83.32 ± 12.58	39.37	0.001
	GH	55.81 ± 8.54	86.62 ± 9.72	30.81	0.001
Note: PF: Physical Functioning; RL-PH: Role of Limitation Physical Health; RL-EH: Role of Limitation Emotional Health; EN: Energy; EWB: Emotional Well-Being; SF: Social Life; BP: Body Pain; GH: General Health					

Table 3 Comparison of post-treatment outcome measures of mouth function and quality of life for control and experimental group

Variables	Control Group Post (Mean ± SD)	Experimental Group Post (Mean ± SD)	Differences	p-value
Mouth Function	33.23 ± 2.90	41.55 ± 4.90	9.32	0.01
PF	57.86 ± 8.53	87.83 ± 6.81	29.93	0.001
RL-PH	32.62 ± 16.83	86.48 ± 13.93	53.86	0.001
RL-EH	33.07 ± 22.23	83.94 ± 16.72	50.87	0.001
EN	50.27 ± 7.72	84.00 ± 8.91	33.73	0.001
EWB	64.49 ± 8.76	83.62 ± 5.88	19.13	0.001
SF	63.37 ± 11.56	83.95 ± 10.56	20.58	0.001
BP	62.62 ± 9.37	83.32 ± 12.58	20.7	0.001
GH	53.45 ± 9.49	86.62 ± 9.72	33.17	0.001
Note: PF: Physical Functioning; RL-PH: Role of Limitation Physical Health; RL-EH: Role of Limitation Emotional Health; EN: Energy; EWB: Emotional Well-Being; SF: Social Life; BP: Body Pain; GH: General Health				

DISCUSSION

This study's main purpose was to evaluate the effectiveness of manual physical therapy in conjunction with dry needling to improve mouth function and health-related Quality of Life (QoL) in patients with TMD. In this study, the experimental group showed a significant improvement in all parameters of health-related QoL and mouth function compared with the control group.

A recent study by Gil-Martínez, et al. reported that a multidisciplinary approach is compulsory to treat TMD patients [10]. They also suggested that physical modalities can only reduce the symptoms, but promoting a better quality of outcome interdisciplinary approach is required. Felício, et al. did another similar study using the SF-36 questionnaire in 2008 and reported that the physical therapy approach is capable of improving the health-related Quality of Life (QoL) in patients with TMD [16].

Previous studies have shown that exercise, combined with the physical therapy approach, was a positive treatment approach for managing TMD patients [17-19]. These studies have also concluded that supervised exercise is required for a better prognosis for TMD patients. In our study, we proposed supervised exercise, and all exercises were supervised by physical therapists with 10 years of experience. Exercises involved the cervical as well as mandibular areas. Many studies proved that there is a direct connection between the cervical area and jaw and that, during jaw movement, the neck muscles co-activate [20,21]. Therefore, any pain in the jaw region could be the cause of neck and shoulder muscle weakness [22].

Dry needling was added because myofascial in the masseter and suboccipital muscles are widespread in patients with TMD. Dry needling is the best option to treat myofascial trigger points [23]. It is observed that the multidimensional treatment approach for multifactorial disease still lacks in physical therapy practice for TMD management [24-26]. Also, the muscle inhibition technique stimulates the mechanoreceptor, which creates the balance of the autonomic nervous system mechanoreceptors [21]. A study has shown that stretching of the deep fascia surrounding the internal organs causes a release of neurotransmitters, which can affect the cardiovascular system [22].

The present study was a multidimensional approach where improvement was shown in all the parameters. This study has some potential limitations. Firstly, participants were recruited in one area of India. Secondly, follow-up was not taken for the study. In the future, prolonged follow-ups with more outcome measures should be carried out with multidisciplinary interventions like dental, pharmacological, physical, and psychological therapies for gold standard treatment method establishment of TMD patients.

CONCLUSION

The study results showed that the application of combined physical therapy is beneficial for improving a patient's mouth function and Health-related Quality of Life (QoL). It was concluded that the multimodal physical therapy protocol could be a part of a physical therapy managing protocol for better management of patients with TMD.

DECLARATIONS

Ethical Clearance and Institutional Review Board Statement

Institutional research and institutional ethical committee approval were obtained before recruiting the patients (LPU/IEC/2019/01/05) for the proposed study, and the clinical trial registration number was CTRI/2019/06/019858. In the study, all human ethical principles, as per the World Medical Association's Declaration of Helsinki (2013) and the guidelines of Good Clinical Practice (Indian Council of Medical Research), were observed.

Conflict of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Source of Funding

Self-funding

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