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Original Article

The effectiveness of neck strengthening exercises on jaw mobility and clicking in anterior disc displacement with reduction of temporomandibular joint: A randomized controlled trial

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Abstract

Background: The studies in the literature have focused on the biomechanical and neurophysiological aspects of cervical and temporomandibular joint (TMJ) function. Addressing the cervical spine correlation with the TMJ may lead to long-term improvement in the derangement. This study desired to deduce the effectiveness of deep neck muscle strengthening exercises on jaw motion and clicking sounds in anterior disc displacement with reduction of the TMJ.

Methods: This controlled clinical trial was conducted using a single-blinded design in a tertiary care teaching hospital affiliated with The University of Lahore- from March 2020 to January 2021. A count of 68 patients were enrolled each with 34 patients. The inclusion criteria were being 18–50 years old, suffering from TMJ pain and disc displacement with reduction, medical referral for temporomandibular disorders by a dentist or a maxillofacial surgeon, and having symptoms for more than one month before the first treatment. The exclusion criteria were having a tumor, fracture, or trauma in recent medical history, systemic, rheumatic diseases, degenerative changes, and history of surgery of the cervical spine or TMJ. The control group (group A) was only given TMJ mobilization and soft tissue release. The Intervention group (group B) did neck strengthening exercises in addition to the TMJ mobilization. The subjects were assessed twice.

Results: To analyze the data, SPSS version.21 was used. To assess the frequency of qualitative factors like clicking, the chi-square test was employed. The mean scores of quantitative factors such as mandibular lateral deviation and maximal mouth opening were approximated between the two categories of subjects using the Mann-Whitney test. The findings demonstrated that there was no change between the groups' pre- and post-treatment means for jaw mobility and clicking sounds. Nonetheless, the Intervention group's mandibular lateral deviation significantly improved ($P \leq 0.037$).

Conclusion: The findings revealed that neck strengthening exercises in addition to routine physical therapy of the TMJ do not affect clicks and mobility between the two groups. The exercises were found out to be effective only in improving the lateral deviation of the mandible.

Keywords: Temporomandibular joint disorders, Temporomandibular joint disc, Temporomandibular disorders, Therapy, Exercise

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Introduction

The term "temporomandibular joint disorder" (TMD) refers to a group of illnesses that are characterized by clicking sounds in the temporomandibular joint (TMJ), discomfort in the joint and its surrounding tissues, or functional limitations of the jaw during motion.[1] The most prevalent and frequent self-limiting musculoskeletal conditions affecting adults are TMJ problems. According to epidemiological research, one-third of individuals exhibited at least one symptom and up to 75% of adults displayed at least one indicator of the joint dysfunction.[2,3] Upon clinical examination, limited mouth opening and joint snapping were noticed. Anterior disc displacement with reduction (ADDR) in the TMJ is often seen

occasionally in younger population, and it is correlated with biomechanical and anatomical factors.[4]

Disc displacement with reduction is common, reported in about 27.6% in the left and 28.6% in the right TMJ. However, American and Asian groups have reported lower incidences.[5]

The females are more frequently affected by TMJ disorder.[6] This might be due to the impact of some female features such as more lax joints[7] and higher intra-articular pressure.[8] The interrelationship between age and disc displacement with reduction has been confirmed by statistics.[9]

Patients with TMD symptoms may exhibit significant compensatory variations, which include hyperextension of the upper cervical spinal segments, decreased curvature of the lower neck vertebra, protraction and elevation of the shoulders, and increased kyphosis of the thoracic spine.[10]

MJ dysfunction's ideal course of treatment is still up in the air. Patients who experience clicking as a result of decreased anterior disc displacement now have a new approach to treatment thanks to therapeutic exercises. In order to reduce clicking sounds, these exercises are far more common and economical than splint therapy or surgery.[11]

Studies have indicated that the treatment of disc displacement with reduction is difficult, particularly when the popping sound in the joint is the key complaint for many patients.[12,13]

In another study, neck vertebral interventions based on joint mobilization, segmental stabilization, and cranio-cervical flexor stabilization exercise promoted the activation of deep neck flexors with negligible neck bending in one group, and muscle stretching brought about statistically significant improvements in TMD patients. The intervention resulted in reduced self-narrated pain, enhanced ache less mobility of jaw and mandibular function. There was also a significant increase in the sensitivity of the chewing muscle on the left side. After intervention, maximum mouth opening increased by 5.7 mm, equal to 17.5% of the initial value with modest impact size. The improvement has been confirmed by studies that used cervical spine manual therapy for TMD patients.[14,15]

In order to assess the usefulness of cervical strengthening exercises, empirical evaluation of cervical spine treatment in correlation to disc displacement with reduction of the TMJ is necessary. To date, the question of whether or not cervical strengthening exercises are effective in the control of disc displacement has been left unanswered. The results of the study will help dentists and physical therapists to manage the disorder, reduce its recurrence, and predict treatment outcomes.

Methods

This study was a controlled clinical trial conducted by way of single-blinded design in a tertiary care teaching hospital affiliated with The University of Lahore- from March 2020 to January 2021.

Sample size

The sample size was calculated using the following formula (see Figure 1):

$$n = \frac{Z_{(1-\beta+Z_{1-\alpha/2})})^2 + \left(\delta_1^2 + \delta_2^2\right)}{(\mu_1 - \mu_2)^2}$$

Z1-α/2 Level of significance: 90%
μ1 = Expected mean pain score in the Intervention group: 2.12
μ2 = Expected mean pain score in the control group: 2.87
δ1 = Expected standard deviation in the Intervention group: 0.83
δ2 = Expected standard deviation in the control group: 1.12
Z1-β = Test power: 80%
N = Expected sample size in each group: 28

Considering 20% drop out, the sample size was estimated as 68 (34 in each group).[14] The participants were selected using the non-probability convenience sampling technique. The inclusion criteria were age ranged between 18–40 years, suffering from TMJ pain and disc displacement with reduction, being referred for temporomandibular disorders by a dentist or maxillofacial surgeon, and having symptoms for more than one month before the first treatment. The exclusion criteria were having a tumor, fracture, or trauma in recent medical history, systemic/rheumatic diseases, degenerative changes, and history of surgery of the cervical spine or TMJ.

The sensitivity of Helkimo Index was calculated as 86.67%, the specificity was 68.09%, and Cronbach alpha was 0.826.

Random allocation was done using sealed opaque envelopes. The random numbers were generated by a computer software and written on the opaque envelopes. All the odd numbers were assigned to group A (control) and the even numbers were assigned to Group B (intervention). After assessment, the assessor handed over

Sample Size for Comparing Two Means			
Input Data			
Confidence Interval (2-Sided)	90%		
Power	80%		
Ratio Of Sample Size (Group 2/Group 1)	1		
	Group1	**Group2**	**Difference**
Mean	2.12	2.87	-0.75
Standard Deviation	0.83	1.12	
Variance	0.6889	1.2544	
Sample Size for Group 1	22		
Sample Size for Group 2	22		
Total	44		

Figure 1. Sample size calculation on Open Epi

the envelope to the patient and then the patient handed over the envelope to the therapist. This was a single-blind study in which the assessor was blinded simply by not being told the group assignments.

Data collection

The data was collected using a measuring tape, a stethoscope, and the Helkimo index questionnaire. The participants who met the inclusion criteria and gave consent were recruited in the study. An initial assessment was done by a trained physical therapist before allocation to the groups. The pre-treatment Helkimo index questionnaire was completed, and jaw mobility was measured. A stethoscope was used to listen to the clicking sounds. The treatment plan was executed by the researcher for both groups. Both groups received routine physical therapy of the TMJ but neck strengthening exercises were only performed by the Intervention group. The post-trial assessment was done by the same physical therapist who had done the initial assessment. The Helkimo index questionnaire was completed once more, and jaw mobility was measured again.

Data collection methods

Control group

Manual mobilization of the TMJ was performed in all sessions with 3–5 repetitions in 1 to 3 sets once a day. Besides, soft tissue release of chewing muscles, including the masseter, lateral/medial pterygoid, and temporalis, was performed for 2 minutes on each muscle once a day. Furthermore, therapeutic exercises of the TMJ, including protrusion and lateral shifting were done at home 2 times a day with 5–6 repetitions and a 10-second hold.

Intervention group

All of the above-mentioned treatment protocols were performed for the patients in the Intervention group. In addition, the patients did strengthening exercises of deep neck bending muscles, including the longus capitis and longus colli muscles, at home three times a day with 10 repetitions and a 10-second hold. To ensure patient compliance with the neck strengthening exercises, the patients' diaries were checked each session.

Data analysis

Statistical Package for the Social Sciences (SPSS) 21 version was used, chi-square and cross tabulation for qualitative variables. The non-parametric test was used to evaluate the difference in the mean scores of quantitative variables within the groups. The Mann-Whitney test was also used to find the differences in the average score of quantitative variables between the groups. The level of significance was set at ≤ 0.05*.

Patients were well informed potential threats and benefits of the exercise and it was ensured to them that their data was kept in confidential. Pain may increase after the treatment, the only risks associated with this research. There may be decrease in pain, improvement in mouth opening and may be reduced lateral deviation and clicking sounds

Results

In this study, the average age of the patients was 32.07 ± 10.64 in the Intervention group and 31.73 ± 9.09 in the control group as shown in Table 1. Moreover, there were 50 females and 3 males in this study. A count of 27 females were in the Intervention group and 23 were in the control group. There were only 3 males in the control group and none in the Intervention group as represented in Table 2.

There was a significant difference between the two groups after treatment in the clicking sounds of the TMJ tabulated in Table 3. Besides, TMJ mobility increased in both groups, but the Intervention group showed more improvement than the control group. The mean difference in the Intervention group was 32.59 ± 9.48 before the treatment and 41.9 ± 5.86 after the treatment. In the control group, the mean difference was 38.07 ± 9.320 before the treatment and 43.26 ± 7.164 after the treatment tabularized in Table 4.

As depicted in Table 5, the mean difference of the lateral deviation of TMJ in the Intervention group was 0.62 ± 0.49 pre-treatment and 0.22 ± 0.42 after the treatment. The

Table 1. The results of descriptive statistics according to age

	Intervention group	Control group
n	34	34
Mean age	32.07	31.73
SD	10.64	9.09
Minimum	20	20
Maximum	50	48

Table 2. Descriptive statistics according to gender

		Frequency	Percent
Intervention group	Female	34	100.0
	Male	3	11.5
Control group	Female	31	88.5
	Total	68	100.0

Table 3. Chi-square test for clicking sounds before and after treatment

Clicking sounds	Pre-Intervention		Post-Intervention	
	Intervention group	Control group	Intervention group	Control group
Yes	77.8%	88.5%	22.2%	69.2%
No	22.2%	11.5%	77.8%	30.8%
Total	100.0%	100.0%	100.0%	100.0%
P value	0.300*		0.001*	

corresponding value for the control group was 0.42 ± 0.50 before treatment and 0.50 ± 0.50 after treatment.

Discussion

The mean assessments of pain, mobility, and clicking sounds varied significantly both among and between the groups, according to the study's findings. The mandibular lateral shift and general TMJ dysfunction were found to be better with the additional workouts performed by the Intervention group.

A study by Calixtre et al in 2016 used cervical muscle-conditioning techniques and evaluated maximum mouth opening was measured, the results showed an improvement from 31.5 ± 9.17 before the treatment to 38.0 ± 8.82 after the treatment (*$P \leq 0.002$).[14] In the present study, maximum mouth opening was 32.59 ± 9.48 before the treatment, and the intervention improved it to 41.9 ± 5.86 after the treatment (*$P \leq 0.012$).

Further investigation assessed the efficacy of isokinetic activities in the management of TMJ clicking. Upon completion of a 6-month testing period, 18 of the 22 people (or roughly 82%) were free of clicking, whereas 4 (or roughly 18%) of those who had bilateral reciprocal clicking remained free of it. This study showed that 6 (22.2%) patients in the Intervention group had no clicking noises at all, while 21 (77.8%) patients had clicking sounds prior to treatment.[16]

Furthermore, a study in 2021 in which maximum mouth opening was estimated in the stabilizing splint group (36.9 ± 3.44 mm), the anterior repositioning splint group (37.5 ± 3.69 mm), and the lingual ring splint group (36.4 ± 3.62 mm).[17]

This study was conducted with some limitations. Patients with traumatic injury and adolescent patients with ADDR of the TMJ were not included in the study. The geriatric population was also not incorporated in the study.

Table 4. The results of Mann-Whitney test for maximum mouth opening before and after treatment

	Before treatment		After treatment	
	Intervention group	Control group	Intervention group	Control group
Mean	32.59	38.07	41.9	43.26
SD	9.48	9.320	5.86	7.164
Min	23.0	23.00	32.0	32.00
Max	55.00	55.00	55.00	55.00
Mean ranks	21.85	32.35	26.33	27.69
Sum of ranks	590.0	841.00	711.0	720.00
P value	0.012		0.747	

Table 5. The results of Mann-Whitney test for mandibular lateral deviation before and after treatment

	Intervention Group		Control Group	
	Pre	Post	Pre	Post
n	34	34	34	34
Mean	0.62	0.22	0.42	0.50
SD	0.49	0.42	0.50	0.50
Minimum	0.00	0.00	0.00	0.00
Maximum	1.00	1.00	1.00	1.00
Wilcoxon signed-rank test	0.001*		0.317	

Conclusion

The study results indicated that both groups exhibited a significant decrease in clicking sounds but an increase in joint mobility (maximum mouth opening and lateral deviation of the mandible).

The following are recommended for further studies:

1. To evaluate the effectiveness of neck strengthening exercises in comparison to joint mobilization, particularly without the conventional therapies.
2. To conduct more follow-ups for further review of new developments
3. To carry out studies on the adolescent population separately

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Competing Interests

There was no conflict of interest exists between authors in this study.

Ethical Approval

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