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The Immediate Effects of Ischemic Compression Massage Applied to the Masseter Muscle in Individuals with Temporomandibular Joint Dysfunction: A Cross-Sectional Study

Temporomandibular Eklem Disfonksiyonu Olan Bireylerde Masseter Kasına Uygulanan İskemik Kompresyon Masajının Anlık Etkileri: Kesitsel Çalışma

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ABSTRACT Objective: The aim of this study is to examine the immediate effects of ischemic compression applied to the masseter muscle on pain, jaw and neck joint range of motion, and forward head posture in individuals with temporomandibular joint (TMJ) disorder. **Material and Methods:** This study was planned as a cross-sectional study with a total of 160 individuals. Ischemic compression was applied to the trigger points in masseter muscle for 90 seconds with a moderate tolerable pressure. Pain intensity was evaluated with Visual Analogue Scale, cervical range of motion was evaluated with a universal goniometer, jaw movements were evaluated with a rigid tape measure, and craniovertebral angle was evaluated with a modified universal goniometer. Dysfunction was classified according to the Helkimo Clinical Craniomandibular Dysfunction Index. **Results:** After the intervention, dysfunction score was decreased ($p<0.001$). There was no significant difference in resting pain scores ($p>0.05$); however pain scores of gum chewing, and TMJ and masseter muscle palpation decreased ($p<0.05$). Increase in TMJ movements was found; mouth opening, mouth forward protrusion, and mouth lateral deviation values all increased ($p<0.001$). Cervical joint movements and craniovertebral angle also increased ($p<0.01$). **Conclusion:** The present findings indicated that ischemic compression applied to the masseter muscle in individuals with TMJ disorder immediately reduced pain (except resting pain), improved jaw and neck range of motion, and forward head posture. Comparative studies are needed to examine the long-term effects of these results.

Keywords: Temporomandibular joint disorders; trigger points; massage; masseter muscle

ÖZET Amaç: Bu çalışmanın amacı, temporomandibular eklem [temporomandibular joint (TMJ)] bozukluğu olan bireylerde masseter kasına uygulanan iskemik kompresyonun ağrı, çene ve boyun eklem hareket açıklığı ve ileri baş postürü üzerindeki anlık etkilerini incelemektir. **Gereç ve Yöntemler:** Bu çalışma, toplam 160 bireyle kesitsel çalışma olarak planlandı. Masseter kasındaki tetik noktalara orta düzeyde tolere edilebilir bir basınçla 90 sn boyunca iskemik kompresyon uygulandı. Ağrı yoğunluğu görsel analog skala ile, servikal hareket açıklığı evrensel gonyometre ile, çene hareketleri rijit mezura ile ve kraniyovertebral açı modifiye evrensel gonyometre ile değerlendirildi. Disfonksiyon, Helkimo Klinik Kraniomandibular Disfonksiyon İndeksi'ne göre sınıflandırıldı. **Bulgular:** Müdahaleden sonra disfonksiyon skoru azaldı ($p<0,001$). İstirahat ağrısı skorlarında anlamlı bir fark yoktu ($p>0,05$); ancak sakız çiğneme, TMJ ve masseter kası palpasyonu ağrı skorları azaldı ($p<0,05$). TMJ hareketlerinde artış bulundu; ağız açma, ağzı ileri alma ve ağız lateral deviasyon değerlerinin hepsi arttı ($p<0,001$). Servikal eklem hareketlerinin ve kraniyovertebral açının arttığı belirlendi ($p<0,01$). **Sonuç:** Mevcut bulgular, TMJ bozukluğu olan bireylerde masseter kasına uygulanan iskemik kompresyonun anlık ağrıyı (istirahat ağrısı hariç) azalttığını, çene ve boyun hareket açıklığını ve ileri baş postürünü iyileştirdiğini gösterdi. Bu sonuçların uzun vadeli etkilerini incelemek için karşılaştırmalı çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: Temporomandibular eklem bozuklukları; tetik noktalar; masaj; masseter kası

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Temporomandibular joint (TMJ) is a complex structure that is an important part of the stomatognathic system, consisting of structures such as muscles, ligaments and teeth.[1] TMJ dysfunction (TMJD) is a condition that affects the TMJ, masticatory muscles and other related structures. It is known that TMJ dysfunction or disorders are the main causes of chronic pain in the orofacial region.[2] In TMJD; various symptoms are observed, such as tenderness and pain in the TMJ and the peripheral muscles, noise in the TMJ, limited mouth opening, deviation or deflection during opening and closing of the mouth, headache, earache, and malocclusion.[3,4]

Since the cervical spine is directly connected to the cranium and chewing-related structures through muscles, joints and neurovascular structures, a change in either of the regions affects the other region.[1] Trigger points and chronic tensions can easily occur in the masseter muscle, thus causing TMJD symptoms.[1,2]

The aim of treatment in TMJD is to reduce pain and muscle spasm, increase jaw joint range of motion (ROM), ensure postural smoothness, and improve quality of life. This includes patient education, diet modification, electrophysical agents, exercises, postural correction, manual therapy, psychological support, splint therapy and pharmacological treatments.[5-7] Manual treatment method includes soft tissue and joint techniques such as classical massage, friction massage, myofascial release, trigger point therapy and soft tissue mobilization.[8-10]

Trigger points are localized and hyperirritable points in the palpable tense bands of skeletal muscle fibers and are frequently encountered in TMJD.[11-13] Many methods such as ischemic compression, massage, stretching and acupuncture are used in trigger point treatment.[11] Ischemic compression employs the application of tolerated pressure on the muscle with the thumb.[12] In using this application, tactile signals reduce pain by inhibiting pain signals.[9] A study by Espejo-Antunez et al. showed that ischemic compression had a healing effect on active mouth opening and the management of pain in TMJD.[14] Based on this, it is thought that ischemic compression applied to the masseter muscle, may affect jaw and neck ROM and pain.[12,13]

Therefore, the aim of this study is to examine the immediate effects of ischemic compression applied to the masseter muscle on pain, jaw and neck ROM, and forward head posture in individuals with TMJD. The hypothesis is that ischemic compression applied to the masseter muscle in individuals with TMJ will have immediate effects on pain reduction, increase in jaw and neck ROM, and forward head posture correction.

MATERIAL AND METHODS

RESEARCH DESIGN

This study was planned as a cross-sectional study, and was conducted in Ankara Yıldırım Beyazıt University Physiotherapy and Rehabilitation Department Applied Laboratories. The study was approved by Ankara Yıldırım Beyazıt University Health Sciences Ethics Committee (date: June 14, 2023, no: 06-276). The study was conducted in accordance to the Helsinki Principles. Participants were informed about the study and their written consents were obtained.

PARTICIPANTS

Participants were invited to the study by making announcements via social media. Participants included in the study were individuals aged 18 and older who voluntarily agreed to participate, had mild, moderate, or severe TMJD based on the Helkimo Clinical Craniomandibular Dysfunction Index (HCCDI), and had a trigger point identified through palpation of the masseter muscle. Exclusion criteria included individuals with underlying conditions that could cause TMJD symptoms (such as active dental treatment, cervical disc herniation, or scoliosis), neurological or rheumatological disorders, recent surgery on the jaw, neck, or shoulder within the past 6 months, a history of spine, head, or jaw fractures, or issues with cooperation and communication (Figure 1).

The sample size of the study was determined by taking into account the pre-post effect size difference (d=0.30) for visual analogue scale (VAS) measurements of the experimental group as seen in Espí-López et al.[15] G*Power 3.1.9.7 (Heinrich Heine University Düsseldorf, Germany) program was used to calculate the smallest sample size required for

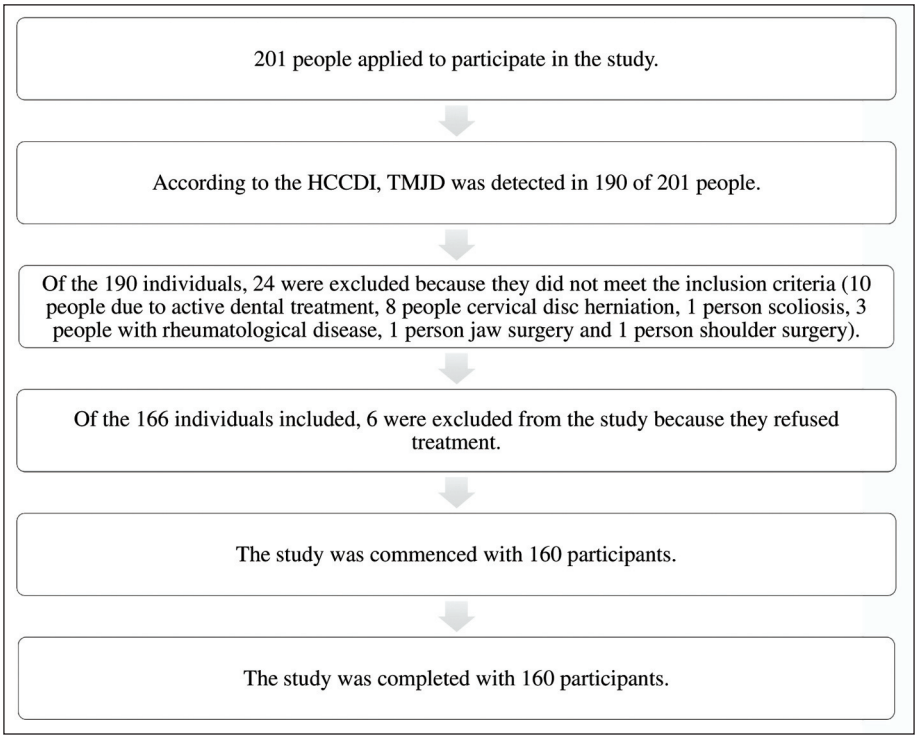

FIGURE 1: Flow chart
HCCDI: Helkimo Clinical Craniomandibular Dysfunction Index; TMJD: Temporomandibular joint dysfunction

analysis in groups. Since the difference between pre and post test measurements will be examined, the difference between 2 dependent means was used. The power of the test was taken as 80%, the margin of error was 5% and the effect size was at 0.30. In accordance to the results of this analysis, the total sample size was determined to have at least 90 participants.

EVALUATION METHODS

A demographic information form was filled out, in which information such as the individuals' age, gender, height, body weight, medications used, and presence of chronic diseases were recorded. HCCDI was used to evaluate TMJD signs and symptoms in detail. Pain intensity was evaluated with VAS, cervical ROM was evaluated with a universal goniometer, jaw movements were evaluated with a rigid tape measure, and craniovertebral angle for forward head posture was evaluated with a modified universal goniometer. All measurements were taken pre and post intervention.

EVALUATION OF TMJD SYMPTOMS AND FINDINGS

HCCDI was used to evaluate TMJ symptoms and findings in detail. HCCDI consists of 5 components, which includes; limited mandibular normal joint movement, pain during mandibular ROM, pain on TMJ palpation, pain on masticatory muscles palpation, and pain during mandibular function. For each component, 3 points can be given as 0, 1 or 5 points, and according to the scores received, individuals with 0 points are classified as having no TMD, 1-4 points as having mild TMD, 5-9 points as having moderate TMD, and those with 10-25 points are rated as advanced TMD.[16] The degree of dysfunction was taken into account when choosing participants in the study.

EVALUATION OF PAIN

Participants' right and left TMJ pain at rest and after chewing gum for 1 minute was taken, and pain upon the palpaltion of TMJ and masseter muscle was also taken. Pain was evaluated using VAS, which is presented as a 10cm horizontal line.[17] 0 means no pain,

10 means unbearable pain. After marking the participants' pain intensity of the on the line, it was then measured with a ruler and the pain intensity was presented in cm and was used in statistical analysis.[18]

EVALUATION OF CHIN AND NECK ROM

For jaw ROM, mouth opening, mouth right and left lateral deviation, and mouth forward movements were evaluated with the participant in sitting position, as well as for neck ROM, neck flexion/extension, right-left rotation and right-left lateral flexion movements. During goniometric measurements of chin and neck ROM, the pivot point, stationary and movable arms of the goniometer were placed in designated reference areas. Then, the patient was asked to perform the movement actively and the joint ROM was recorded in degrees and was used in statistical analysis.[19,20]

EVALUATION OF FORWARD HEAD POSTURE

Craniovertebral angle for forward head posture was evaluated with a modified universal goniometer. The participants were seated with their heads facing forward. The stationary arm of the goniometer was aligned to pass through the spinous process of C7, establishing the reference point. The angle between the line passing horizontally from the spinous process of C7 (the stationary arm of the goniometer) and the line connecting the tragus of the ear (the movable arm of the goniometer) was measured in degrees.

INTERVENTION

At the end of the first evaluation, while the individuals were lying on their back in a comfortable position, ischemic compression was performed by applying a continuous and gradually increasing pressure at a tolerable level that they could tolerate for approximately 90 seconds to the masseter muscle of the side (right) with the trigger point.[21]

STATISTICAL ANALYSIS

The data obtained from the study were evaluated with the SPSS 23 program (IBM, Armonk, NY, ABD). Mean, standard deviation, median, minimum and maximum values were taken for quantitative variables. Frequency (n) and relative frequency (%) were taken for qualitative variables. Normal distribution analysis was performed with the Kolmogorov-Smirnov test and it was concluded that the data did not show a normal distribution ($p<0.05$). Pre and post test comparisons for all measurements were examined using the Wilcoxon rank number test. The mean rank numbers obtained from the Wilcoxon rank number test were summarized. The results were evaluated at 0.05 significance level.

RESULTS

A total of 160 people who met the criteria and had TMJD were selected for this study. 75.6% of the participants were women and 24.4% were men. The age, weight, height and body mass index (BMI) information of the participants are summarized (Table 1). The ages of the participants ranged from 18 to 65. Their average weight is 66.02±14.65 kg, their average height is 166.57±8.90 cm, and their average BMI is 23.75±4.86 kg/m^2.

The power of the test was taken as 80% confidence interval, the margin of error was 5% and the effect size at 0.30. The pre and post intervention results for the comparison of TMJ dysfunction score, VAS, jaw and neck joint ROM, and forward head posture of the participants are summarized (Table 2). A significant difference was found between the pre and post intervention measurements in terms of dysfunction score, a decrease was seen ($p<0.001$; Table 2).

There was no significant difference between pre and post intervention values in of resting VAS score ($p=0.068$). The VAS scores after chewing gum, and upon TMJ and masseter muscle palpation decreased after the intervention ($p<0.001$; Table 2).

After the intervention, an increase in TMJ movements was observed. As mouth opening, mouth for-

TABLE 1: Participants' age, weight, height and BMI scores

Variables	X̄±SD	Median	Interval (minimum-maximum)
Age (years)	29.86±12.62	23.00	47 (18-65)
Weight (kg)	66.02±14.65	62.00	83 (37-120)
Height (cm)	166.57±8.90	165.00	43 (149-192)
BMI (kg/m^2)	23.75±4.86	22.86	30.91 (15.97-46.88)

SD: Standard deviation; BMI: Body mass index

TABLE 2: Pre and post intervention comparison of the participants' dysfunction score, VAS, jaw and neck joint range of motion, and forward head posture scores

	X̄±SD		
Parameters	**Pre**	**Post**	**p value[a]**
Dysfunction score	5.27±3.88	3.73±3.12	**<0.001**
VAS (cm)			
Resting	0.74±1.29	0.61±1.11	0.068
Chewing	1.76±1.87	0.95±1.24	**<0.001**
TMJ	1.65±1.77	1.24±1.74	**<0.001**
Masseter	1.22±1.61	0.81±1.26	**<0.001**
Chin movements (cm)			
Mouth opening	3.94±0.71	4.13±0.71	**<0.001**
Mouth right lateral	0.76±0.29	0.84±0.31	**<0.001**
Mouth left lateral	0.79±0.32	0.90±0.37	**<0.001**
Mouth forward	0.78±0.33	0.87±0.32	**<0.001**
Cervical joint movements (°)			
Cervical flexion	40.87±6.04	42.43±5.71	**<0.001**
Cervical extension	37.73±7.70	39.06±7.61	**<0.001**
Right rotation	55.96±9.97	56.74±9.65	**0.034**
Left rotation	56.41±10.37	57.30±10.22	**0.003**
Right lateral rotation	40.41±6.18	41.46±6.05	**<0.001**
Left lateral rotation	39.79±6.40	40.86±6.11	**<0.001**
Forward head posture			
Cranio horizontal angle	54.35±32.52	54.91±31.75	**0.013**

[a]Wilcoxon rank number test result, (o): degree. SD: Standard deviation; VAS: Visual analogue scale; TMJ: Temporomandibular joint

ward protrusion, and mouth right and left lateral deviation values all increased (p<0.001). The same result was seen in cervical flexion, cervical extension, right/left rotation, and right/left lateral flexion values, they all increased after the intervention. Also, an increase in cranio horizontal angle was seen after the intervention (p<0.005; Table 2).

DISCUSSION

This study aimed to investigate the immediate effects of ischemic compression massage applied to the masseter muscle on pain, jaw and neck joint range of motion, and forward head posture in individuals with TMJD. The results revealed that ischemic compression massage on the masseter muscle reduced activity and palpation pain, improved cervical mobility and TMJ movements, and reduced forward head posture and TMJ dysfunction.

In our findings there was no immediate changes seen in TMJ resting pain, after applying ischemic compression massage to the masseter muscle. We think that this may be because of the resulting pain from sustained pressure during the ischemic compression. After the intervention, pain after chewing gum was decreased. The same decrease was seen in TMJ pain and masseter muscle pain scores. Here, our results are in consistent with the current literature, in as many studies have found that ischemic compression of masticatory muscles is effective in relieving TMJ pain.[14,22] However, there is no comparable data in the literature for pain after chewing gum. This result suggests that application of ischemic compression reduces functional pain and increases performance in the masseter muscle. However, further studies on this subject are much needed.

Furthermore, our results demonstrated an increase in jaw movement after the intervention. This finding is also compatible with the literature. Ginszt et al. found that ischemic compression was effective in improving active maximum mouth opening.[23] In a study by Espejo-Antúnez et al. on athletes with temporomandibular dysfunction it was found to increase mouth opening.[14] The same was seen in Şahin et al. where it improves painless mouth opening.[24] The improvement in pain could be the reason for the increase in range of motion.

Our findings also showed an increase in neck joint ROM and a decrease in cranio horizontal angle. We could not find any studies in the literature examining the effect of ischemic compression massage applied to the masseter muscle on neck movements, and head/neck posture. However, there are studies in the literature examining the effect of ischemic compression on the trapezius muscle on neck movements.[25,26] In a metaanalysis conducted by Xu et al. ischemic compression of the trapezius muscle was found have an instant benefit, short-term pain relief, and increase in range of motion.[26] Kisilewicz et al. stated that it has a positive effect on the cervical lateral flexion movement of the ipsilateral and contralateral sides.[25] Aguilera et al. also found that it improved cervical active range of motion, especially lateral flexion.[27] Oliveira-Campelo et al. stated in their study that neck lateral flexion movement after ischemic compression is significantly greater 24 hours and 1 week after treatment.[28] We stated that neck joint ROM increased and cranio horizontal angle decreased after the inter-

vention. The reason why ischemic compression of the masseter muscle positively affects neck joint movements and head and neck posture may be due to the complex muscular, neural and biomechanical connections of the jaw, head and neck regions. Another reason could be because the pressure from the hold can elicit a local ischemia and further blood reperfusion, which results in the increase of muscle metabolism.[29] However, we recommend that further studies be conducted on this subject.

In the present study, ischemic compression massage applied to the masseter muscle reduced the dysfunction score in individuals with TMJD. We could not find any study in the literature that looked at the effects of ischemic compression on TMJD directly. However, many studies have investigated the effects of ischemic compression with other manual trigger point treatments.[14,22,30] It was mentioned by Espejo-Antúnez et al. in their study on athletes with temporomandibular dysfunction that it showed decrease in pain intensity, in addition to increase in active mouth opening and pressure pain threshold.[14] Ginszt et al. also found compression techniques to be effective in reducing resting electrical activity and increasing the pain pressure threshold of the masseter muscle.[23] Kisilewicz et al. concluded that a single treatment session resulted in a decreased muscle stiffness.[25] In another study by Ginszt et al. it was found to be effective in improving active maximal mouth opening and that it provided significant acute effects on bioelectric masseter muscle activity.[31] In our study, we think that ischemic compression massage reduces the dysfunction index because it positively affects factors such as mouth range of motion, muscle imbalance and pain.

Our study is subject to certain limitations. Firstly, there was no comparison or control group in the study. Secondly, the immediate effects of the application were examined after a single session was performed. However, the increase in TMJ ROM and the decrease in pain with a single session from this study reveal the immediate effect of ischemic compression in acute situations. Also, the nature of our sample group could implicate the generalization of the study's results. Therefore to address this, there is a need for studies to investigate long-term effects with less biased sample groups, including control and comparison groups and with a higher number of sessions.

CONCLUSION

In conclusion, ischemic compression massage applied to the masseter muscle in individuals with TMJD can immediately reduce functional pain, increase jaw and neck joint range of motion, and improve jaw dysfunction. In cases where a rapid effect is desired to reduce pain and increase jaw and neck joint movement in TMJD where trigger points are present, ischemic compression massage to the masseter muscle should be considered as a treatment option.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Bihter Akınoğlu, Arife Akbulut Bayrak;* ***Design:*** *Bihter Akınoğlu, Arife Akbulut Bayrak;* ***Control/Supervision:*** *Bihter Akınoğlu, Şeyda Toprak Çelenay;* ***Data Collection and/or Processing:*** *Bihter Akınoğlu, Arife Akbulut Bayrak, Bayram Bilgi;* ***Analysis and/or Interpretation:*** *Ayfer Ezgi Yılmaz, Bihter Akınoğlu;* ***Literature Review:*** *Salman Usman Shehu, Arife Akbulut Bayrak;* ***Writing the Article:*** *Bihter Akınoğlu, Salman Usman Shehu;* ***Critical Review:*** *Bihter Akınoğlu, Şeyda Toprak Çelenay;* ***References and Fundings:*** *Bihter Akınoğlu;* ***Materials:*** *Arife Akbulut Bayrak.*

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