ORIGINAL RESEARCH PAPER
Volume - 13 | Issue - 09 | September - 2024 | PRINT ISSN No. 2277 - 8179 | DOI : 10.36106/ijsr
INTERNATIONAL JOURNAL OF SCIENTIFIC RESEARCH

ASSESSMENT OF STRESS-INDUCED TEMPOROMANDIBULAR DISORDER AMONG STUDENTS USING ELECTROMYOGRAPHY BEFORE AND AFTER EXAMS – A COMPARATIVE OBSERVATIONAL STUDY

Maxillofacial Surgery

Avinash Baswaraju Post Graduate , Department of oral & Maxillofacial surgery,Faculty of dental sciences, Ramaiah university of Applied sciences, Bangalore.

Sejal K.M. Associate professor, Department of oral & Maxillofacial surgery,Faculty of dental sciences, Ramaiah university of Applied sciences, Bangalore.

Ramesh Debur Associate Professor Faculty Of Physiotherapy, Ramaiah University Of Applied Sciences, Bangalore.

Kavitha Prasad Professor and Head, Department of oral & Maxillofacial surgery,Faculty of dental sciences, Ramaiah university of Applied sciences, Bangalore.

ABSTRACT

Background: Temporomandibular joint disorders (TMD) encompass a group of conditions affecting the temporomandibular joint (TMJ), the jaw muscles, or both. Clinically, TMD manifests as pain and tenderness in the masticatory muscles or TMJ and limitations in mandibular movement, including restriction, deviation, or deflection. The aim of this study was to assess the stress induced TMD among students using electromyography before and after exams. **Materials & Methodology:** A sample of 48 students from the Faculty of Dental Sciences at Ramaiah University of Applied Sciences, aged 18 to 25, was studied. Anxiety levels were assessed using a questionnaire. A comprehensive clinical examination for TMD evaluation included muscle tenderness, clicking, and deviation. Electromyography recorded the electrical activity of the masticatory and trapezius muscles before and after exams. **Results:** Significant alterations of EMG activity in Trapezius and masseter muscles noted in the mean values of various study parameters, including the presence and absence of TMD, moderate anxiety before exams compared to after exams. **Conclusion:** In subjects with TMD and moderate anxiety , the trapezius and masseter muscles exhibited significantly higher EMG activity levels before exams compared to non-TMD subjects and after exams.

KEYWORDS

Electromyography, Stress, Students, Temporomandibular disorder.

INTRODUCTION

The temporomandibular joint (TMJ) constitutes a synovial compound joint of an ellipsoid variety, characterized by bilateral articulation. It involves the condyles of the mandible interacting with the glenoid fossa located on the inferior border of the temporal bone, which is separated by the meniscus or interarticular disc. Functionally, the TMJ comprises two bones along with an articular disc, which acts as a pivotal non-ossified component governing the intricate movements of the joint. The temporomandibular system encompasses two primary components: The TMJ itself and the associated neuromuscular system. Any disruption within this intricate network of muscles, bones, and joints can lead to the progression of temporomandibular disorder (TMD). The TMJ and the stomatognathic system are susceptible to a wide array of pathological conditions, each presenting with distinct prognosis.(1)

"The precise cause of temporomandibular disorders (TMDs) remains elusive but is believed to be multifaceted. Various etiological factors contributing to TMD have been documented in medical literature, including psychological aspects such as personality traits and behaviour, occlusal inconsistencies, inadequate dental interventions, joint laxity, repetitive microtrauma to the joints, excessive strain on joint structures, and parafunctional habits. Stress, behavioural patterns, social dynamics, and emotional states are also implicated. Among the array of etiological factors associated with TMD, psychosocial elements are most frequently linked to patients with TMD". Dental education is recognized as a demanding and stressful environment, with dental students facing significant pressure. Research indicates that 50%–75% of individuals with TMD experience heightened stress levels preceding the onset of TMD symptom.(2)

Electromyography (EMG) is a highly sophisticated and valuable diagnostic tool, offering clinical and research criteria for the objective assessment of stress-related temporomandibular disorders (TMD). Widely used as a non-invasive method, EMG is effective in evaluating patients with TMD and monitoring the electrophysiological behavior of muscles under various physiological conditions. Due to its simplicity, safety, and availability, EMG is also employed in studies involving children. "Assessing masticatory muscle function using EMG in TMD patients provides a robust foundation for diagnosing the disorder, tracking its progression, and evaluating the effectiveness of treatments. Numerous studies have demonstrated that individuals with TMD exhibit changes in masticatory muscle EMG activity, either as a direct result of the disorder or as a compensatory mechanism associated with the symptoms (3,4). Therefore, it is crucial to determine the electrical activity of the masticatory muscles in patients with stress-related TMD".

With the aforementioned considerations, a study was formulated to explore the perceived stressors and pinpoint the stress sources among dental students enrolled at Ramaiah University of Applied Sciences, Faculty of Dental Sciences, India. The primary objectives were to probe into stress levels associated with academic years and gender and prevalance of TMJ disorders encountered by dental students. Additionally, the study aimed to assess the stress induced TMD among students using electromyography before and after exams.

MATERIALS AND METHODS

A sample of 48 students of Faculty of Dental Sciences, Ramaiah University of Applied Sciences age ranged from 18 to 25 years. The Undergraduate students from the 1st, 2nd, 3rd, and 4th years were included, along with a clinical evaluation of the temporomandibular joint (TMJ) and an anxiety questionnaire.TMJ evaluation comprises TMJ tenderness, clicking, deviation, medically compromised students, severe malocclusion, trauma, TMJ Surgery and Students with anti- psychotic drugs were excluded.

The anxiety levels in the enrolled participants were assessed using a questionnaire where responses are recorded based on the values (≥12 = anxiety) but this questionnaire was utilized, and their validation was completed prior to use it in the subjects. The comprehensive clinical examination includes assessments of muscle tenderness, clicking, and deviation. Individuals exhibiting more than two symptoms of temporomandibular joint disorder (TMD) are considered to have TMD issues.

The Electrical activity of the muscles of enrolled participants were recorded using Electromyography before and after exams with the help of surface electrodes placed on Masticatory and Trapezius muscle region for about 1 – 2 minutes. The Electromyography assess the parameters like EMG (muscle activity), SD (Average mean value of EMG), Area (Amount of change from the baseline), Variability (Area under the curve).

RESULTS

The present study evaluates the relationship of the muscle activity among TMD, no TMD, Mild and Moderate anxiety subjects in UG

dental students before and after exams using electromyography.

All the subjects were clinical examined and evaluated for TMJ tenderness (60.4%), clicking (33.3%) and deviation (12.5%).

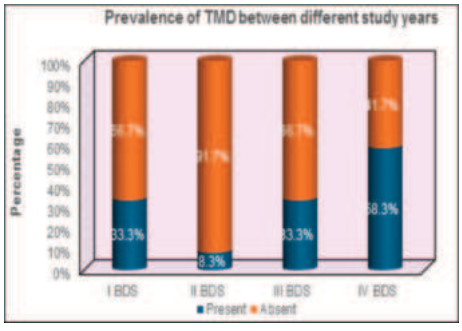
Table :1 Illustrates that Distribution of Clinical Examination findings among study subjects

Distribution of Clinical Examination findings among study subjects			
Variables	Category	N	%
Tenderness	Present	29	60.4%
	Absent	19	39.6%
Clicking	Present	16	33.3%
	Absent	32	66.7%
Deviation	Present	6	12.5%
	Absent	42	87.5%

Based on the clinical assessment they were categorized into TMD (33.3%) and Non-TMD(66.7%) groups.

Table:2 Prevalence of TMD is noted higher in IV BDS (58.3%) followed by I & III BDS (33.3%) and II BDS (8.3%).

Prevalence of TMD among study subjects			
Variables	Category	N	%
TMD	Present	16	33.3%
	Absent	32	66.7%



Graph :1

Based on the questionnaire the results were tabulated and inferred as follows:

A significant portion of the study subjects exhibit moderate levels of anxiety.

Table:3

Distribution of Anxiety levels among study subjects			
Variables	Category	N	%
Anxiety	Mild	19	39.6%
	Moderate	29	60.4%

The IV BDS cohort demonstrates notably higher levels of moderate anxiety in comparison to subjects in the other groups. However, comparison of Anxiety levels between different study years did not show statistically significant difference(Table:4)

Table :4

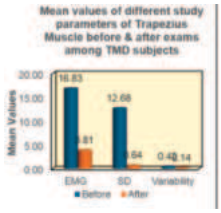
Comparison of Anxiety levels between different study years using Chi Square Test						
Variable	Year of Study	Mild		Moderate		p-value
		n	%	n	%	
Anxiety levels	I BDS	5	41.7%	7	58.3%	0.22
	II BDS	7	58.3%	5	41.7%	
	III BDS	5	41.7%	7	58.3%	
	IV BDS	2	16.7%	10	83.3%	

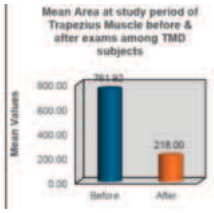
The majority of TMD displayed students exhibited moderate levels of anxiety. However, the correlation between anxiety levels and the prevalence of TMD among study subjects does not exhibit a statistically significant difference(Table :5)

Table:5

Correlation of Anxiety levels and Prevalence of TMD among study subjects using Chi Square Test						
Variable	Category	Present		Absent		p-value
		N	%	n	%	
Anxiety Levels	Mild	4	21.1%	15	78.9%	0.14
	Moderate	12	41.4%	17	58.6%	

The mean values of different study parameters of Trapezius muscle before and after exams among TMD subjects showed statistically significant difference.(Graph 2& 3)

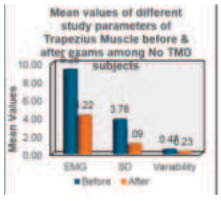


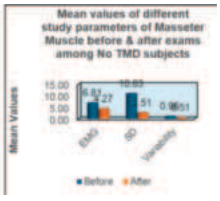


The mean values of different study parameters of Masseter muscle before and after exams among TMD subjects showed statistically significant difference.(Table:6)

Comparison of mean values of different study parameters of Masseter Muscle before & after exams among TMD subjects using Wilcoxon Signed Rank Test						
Parameters	Exams	N	Mean	SD	Mean Diff	p-value
EMG	Before	16	13.62	16.55	9.16	0.02*
	After	16	4.46	2.97		
SD	Before	16	36.91	71.77	35.61	0.002*
	After	16	1.30	1.15		
Variability	Before	16	1.49	1.28	1.15	0.001*
	After	16	0.34	0.45		
Area	Before	16	702.83	884.43	450.14	0.02*
	After	16	252.69	155.98		

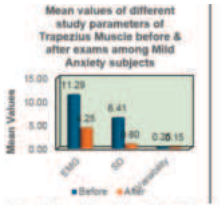
The mean values of different study parameters of Trapezius and Masseter muscle before and after exams among no TMD subjects showed statistically significant difference. (Graph 4 & 5)

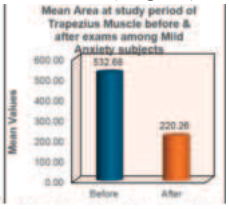


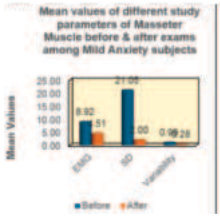


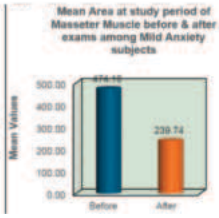
The trapezius and masseter muscles show significantly higher activity before exams in TMD subjects when compared to non-TMD subjects, also the percentage reduction in the muscle activity after exams (in both muscles) is greater in the TMD subjects. It can therefore be inferred that stress and anxiety cause more muscle activity/tension in TMD subjects when compared to non- TMD subjects.

In Subjects With Mild Anxiety: -
Trapezius Muscle: There was an increase in EMG activity before exams and a reduction after exams; however, this difference is statistically insignificant. - Masseter Muscle: There is a statistically significant reduction in EMG activity after exams. Anxiety appears to influence muscle activity, with subjects experiencing mild anxiety showing an insignificant reduction in Trapezius muscle activity but a significant reduction in Masseter muscle activity after exams. (Graph: 6)





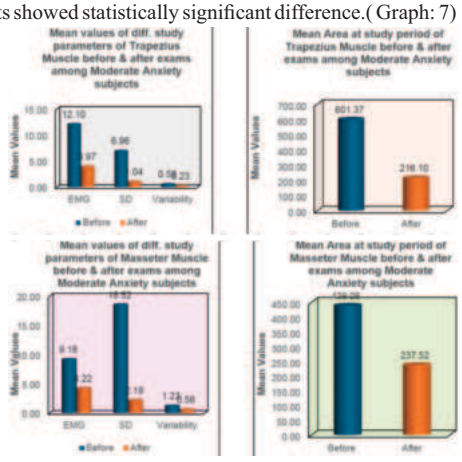




Graph:6

In subjects with moderate anxiety, there was a statistically significant reduction in muscle activity after exams. This suggests that moderate anxiety related to exams increases muscle tension in both the Trapezius and Masseter muscles, with a significant reduction in muscle tension post-exam.

The mean values of different study parameters of Trapezius Muscle & Masseter Muscle before & after exams among Moderate Anxiety subjects showed statistically significant difference.(Graph: 7)



Graph:7

The physiological effects of exam-related stress on muscle activity, along with the influence of anxiety on this relationship, are significant. Consequently, anxiety and muscle tension have a more pronounced impact on individuals with temporomandibular disorders (TMD) both before and after exams compared to those without TMD. Thus, individuals with TMD will require not only anxiety management but also long-term, comprehensive treatment for stress and TMD symptoms.

DISCUSSION

Temporomandibular disorders (TMJ disorders), TMJ dysfunction, and TMJ syndrome are synonymous terms describing issues affecting the jaw, the temporomandibular joint (TMJ), and the surrounding facial muscles. These problems typically manifest more frequently in individuals aged between their second and fourth decades, with a higher incidence among females.(5,6,7)

Clinical manifestations of TMJ disorders encompass various symptoms such as clicking, popping or grating sounds within the jaw joint, tenderness of the TMJ, limited mouth opening, stiffness or tenderness in the neck and shoulder region, pain in the ears and preauricular region during jaw movement or chewing(8,9). Additional symptoms may include facial fatigue, chewing difficulties, facial swelling, toothache, headaches, dizziness, hearing impairment, and tinnitus (ringing in the ears) (10,11).

TMJ disorders are multifactorial and unclear in their exact cause. There is no doubt that behavioural and psychological factors are among the most significant etiologies of TMD among all potential causes(12-14). The aim of the present study to assess the stress induced TMD among students using electromyography before and after exams.

In the present study, the most prevalent TMD signs among the groups was tenderness, with a prevalence of 58.3%, followed by clicking at 33.3% and deviation at 12.5% and common subtypes of TMDs in clinical populations observed are myofascial pain, arthralgia, and disc displacements with reduction, in that order.

The prevalence of TMDs was found to be higher IV BDS (58.3%) followed by I and III BDS (33.3%), II BDS (8.3%).

The age group of 18 to 25 years exhibited the highest prevalence of temporomandibular disorders (TMDs) among dental students, with a prevalence rate of 58.3%. This finding aligns with the research conducted by Manfredini et al.,(15-17) which indicates a peak prevalence of TMDs in the age range of 20 to 40 years, with lower rates observed in younger and older individuals. Additionally, Maydana et al.(18) demonstrated the typically restrictive nature of TMD symptoms and concluded that the majority of cases occur in young adults aged between 20 and 40 years.

The highest levels of stress related to personal factors were observed among fourth-year BDS students. This heightened stress experienced by BDS fourth-year students may stem from their limited opportunities for relaxation, owing to the demanding academic, preclinical, and clinical workload they face. This finding correlates with the findings of a study conducted by Kumar et al.(19)

In the current study, Based on the provided study data, the findings regarding EMG (electromyography) activity of the Trapezius and Masseter muscles among TMD (temporomandibular disorder) subjects, non-TMD subjects, and varying anxiety levels before and after exams can be summarized as follows:

Summary of Findings:
All the subjects were clinical examined and evaluated for TMJ tenderness (60.4%), clicking (33.3%) and deviation (12.5%) Based on the clinical assessment they were categorized into TMD (33.3%) and Non-TMD(66.7%) groups.

1. TMD Subjects:
Before Exams: The EMG activity of the Trapezius muscle was significantly higher compared to the Masseter muscle.
After Exams: There was a statistically significant reduction in the EMG activity of both the Trapezius and Masseter muscles.

2. Non-TMD Subjects:
Before Exams: The EMG activity of the Trapezius muscle was also significantly higher compared to the Masseter muscle.
After Exams: Similar to TMD subjects, there was a statistically significant reduction in the EMG activity of both the Trapezius and Masseter muscles.

The trapezius and masseter muscles show significantly higher activity before exams in TMD subjects when compared to non-TMD subjects, also the percentage reduction in the muscle activity after exams (in both muscles) is greater in the TMD subjects. It can therefore be inferred that stress and anxiety cause more muscle activity/tension in TMD subjects when compared to non- TMD subjects.

3. Anxiety Levels:
Anxiety Assessment: Anxiety levels were assessed using a questionnaire with the following scoring:
- Score ≥12 indicates anxiety.
- Mild Anxiety: Score 1-6.
- Moderate Anxiety: Score 7-11.

Based on the questionnaire assessment subjects were categorized into mild and moderate anxiety groups

Mild Anxiety Subjects
Trapezius Muscle: There was an increase in EMG activity before exams and reduction after exams, but this difference is statistically insignificant.
Masseter Muscle: There is a statistically significant reduction in EMG activity after exams.

Anxiety appears to influence muscle activity, with mild anxiety subjects showing an insignificant reduction in Trapezius activity but a significant reduction in Masseter activity after exams.

Moderate Anxiety Subjects:
Trapezius Muscle: There was an increase in EMG activity before exams followed by reduction in the activity after exams which was statistically significant.
Masseter Muscle: There is a statistically significant reduction in EMG activity after exams.

The study indicates that moderate anxiety related to exams increases muscle tension of both the Trapezius and Masseter muscles with significant reduction in muscle tension post exams.

This study highlights the physiological impact of exam-related stress on muscle activity and the potential influence of anxiety on this relationship. Therefore, it can be understood that anxiety and muscle tension have a greater impact in TMD subjects before and after exams when compared to non-TMD subjects. TMD subjects, in addition to

management of anxiety will require long term comprehensive management of stress as well as TMD symptoms.

"The present study employed electromyography to assess masticatory muscle activity in students diagnosed with stress-induced temporomandibular disorder (TMD) issues. A significant benefit of using global electromyography is its non-invasive nature, as it utilizes surface electrodes placed on the skin, making it easily applicable in studies involving students. The results underscore the importance of considering alterations in the electromyographic potentials of the trapezius and masseter muscles in individuals with TMD. The study revealed that masticatory muscle electrical activity varied among students before and after exams. Specifically, the EMG activity of the trapezius muscle was higher, and the masseter muscle activity was lower at rest in these subjects (20). Furthermore, muscle activity increased before exams among the study subjects, indicating hyperfunction of the masticatory and trapezius muscles associated with stress compared to after exams".

"The mean stress values related to clinical factors were found to be highest in BDS 4th-year students. The increase in stress levels among final-year BDS students was attributed to concerns regarding patient treatment and the shortage of allocated clinical time". This finding is consistent with the studies conducted by Kumar et al. and Acharya.

While the exact cause of temporomandibular disorder (TMD) remains uncertain, psychological factors have been implicated in its predisposition, onset, and persistence. The overarching significance of such research lies in elucidating the origins of stress among dental students and understanding the correlation between stress levels and TMDs. This knowledge has the potential to provide further insights into the diagnostic and therapeutic approaches to managing TMDs.

CONCLUSION

The conclusions drawn from the findings of this study strongly suggest that stress plays a significant role in both the onset and persistence of Temporomandibular Disorders (TMDs), particularly among dental students. Certain factors prevalent among dental students appear to contribute to stressful situations, thereby increasing their susceptibility to TMDs before and after exams. The EMG recordings of the masseter and Trapezius muscles revealed significant changes before exams compared to after exams. This provided valuable insights for diagnosing this intricate array of TMDs problems.

The findings of our study confirmed differences in electrical activity between the trapezius and masticatory muscles before and after exams. Analysis of the EMG recordings revealed significant intergroup disparities in the electrical potentials of the trapezius and masseter muscles, with the trapezius muscle exhibiting higher EMG activity before exams compared to afterward. In subjects with Temporo-mandibular Disorders (TMD), the trapezius and masseter muscles displayed significantly higher activity levels before exams compared to non-TMD subjects. Additionally, the reduction in muscle activity in both muscles after exams was more pronounced in TMD subjects. Therefore, further studies with larger sample sizes are necessary to confirm the prevalence of TMDs and their association with stress.

Funding : Self- supported.
No grant obtained
Informed consent taken

Acknowledgements: I would like to thank all the authors who viewed the manuscript and agreed the submission. Special thanks to Dr Santhosh for the statistical analysis and illustrations.

REFERENCES

1. Ahuja V, Ranjan V, Passi D, Jaiswal R. Study of stress-induced temporomandibular disorders among dental students: An institutional study. National journal of maxillofacial surgery. 2018 Jul 1;9(2):147-54.
2. Acharya S. Factors affecting stress among Indian dental students. Journal of dental education. 2003 Oct;67(10):1140-8.
3. Bhat S. Etiology of temporomandibular disorders: the journey so far. Int Dent SA. 2010;12(4):88-92.
4. Szyszka-Sommerfeld L, Machoy M, Lipski M, Woźniak K. Electromyography as a Means of Assessing Masticatory Muscle Activity in Patients with Pain□Related Temporomandibular Disorders. Pain Research and Management. 2020;2020(1): 9750915.
5. Basafa M, Shahabi M. Prevalence of TMJ disorders among students and its relation to malocclusion.
6. Baskan S, Zengıngul A. Temporomandibular joint, disorders and approaches. Biotechnology & Biotechnological Equipment. 2006 Jan 1;20(2):151-5.
7. Buescher JJ. Temporomandibular joint disorders. American family physician. 2007 Nov 15;76(10):1477-82.
8. Jerjes W, Upile T, Abbas S, Kafas P, Vourvachis M, Rob J, Mc Carthy E, Angouridakis N, Hopper C. Muscle disorders and dentition-related aspects in temporomandibular disorders: controversies in the most commonly used treatment modalities. International archives of medicine. 2008 Dec;1:1-3.
9. Fantoni F, Salvetti G, Manfredini D, Bosco M. Current concepts on the functional somatic syndromes and temporomandibular disorders. Stomatologija. 2007 Jan 1;9(1):3-9.
10. Knight J. Practice Strategies: Diagnosis and Treatment of Temporomandibular Disorders in Primary Care. Hospital physician. 1999;35:55-63.
11. Milam SB. Pathophysiology and epidemiology of TMJ. Journal of Musculoskeletal and Neuronal interactions. 2003 Dec 1;3(4):382-90.
12. Miyake R, Ohkubo R, Takehara J, Morita M. Oral parafunctions and association with symptoms of temporomandibular disorders in Japanese university students. Journal of oral rehabilitation. 2004 Jun;31(6):518-23.
13. Naidu RS, Adams JS, Simeon D, Persad S. Sources of stress and psychological disturbance among dental students in the West Indies. Journal of dental education. 2002 Sep;66(9):1021-30.
14. Rodrigues D, Siriani AO, Bérzin F. Effect of conventional TENS on pain and electromyographic activity of masticatory muscles in TMD patients. Brazilian oral research. 2004;18:290-5.
15. Kumar VP, Dodamani A, Kerudi V, Shirahatti R, Telka S. Perceived sources of stress among Indian dental students. Journal of Indian Association of Public Health Dentistry. 2011 Jul 1;9(17):171-7
16. Poveda Roda R, Bagán JV, Díaz Fernández JM, Hernández Bazán S, Jiménez Soriano Y. Review of temporomandibular joint pathology: Part I: Classification, epidemiology and risk factors. Medicina Oral, Patología Oral y Cirugía Bucal (Internet). 2007 Aug;12(4):292-8.
17. Manfredini D, Guarda-Nardini L, Winocur E, Piccotti F, Ahlberg J, Lobbezoo F. Research diagnostic criteria for temporomandibular disorders: a systematic review of axis I epidemiologic findings. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 2011 Oct 1;112(4):453-62.
18. Maydana AV, Tesch RD, Denardin OV, Ursi WJ, Dworkin SF. Possible etiological factors in temporomandibular disorders of articular origin with implications for diagnosis and treatment. Dental Press Journal of Orthodontics. 2010;15:78-86.
19. Kumar S, Dagli RJ, Mathur A, Jain M, Prabu D, Kulkarni S. Perceived sources of stress amongst Indian dental students. European journal of dental education. 2009 Feb;13(1):39-45.
20. WoŸniak K, Piątkowska D, Lipski M, Mehr K. Surface electromyography in orthodontics–a literature review. Medical science monitor: international medical journal of experimental and clinical research. 2013;19:416.