Effectiveness of teaching undergraduate students how to perform temporomandibular disorder examinations

Skuteczność nauczania studentów procedury badania zaburzeń skroniowo-żuchwowych

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Summary

   Introduction. *Difficulties in examination of the masticatory muscles and temporomandibular joints by students of dental faculties were an inspiration to introduce and teach the protocol according to the standardized RDC/TMD questionnaire.*

   Aim of the study. *To assess the effectiveness of teaching students of the fifth year of dentistry how to perform theclinical examination of the masticatory system in accordance with the RDC/TMD questionnaire.*

   Material and methods. *Fifty-five students of dentistry took part in the study. The study protocol contained theoretical information on the RDC/TMD examination axis I clinical procedures presented during a lecture. During a seminar, the examination rules were demonstrated. Groups of four to six students were then presented with the practical manual procedure. These groups were examined using the RDC/TMD procedure by a teaching dentist and a student. The examination*

Streszczenie

   Wprowadzenie. *Trudności w zakresie wykonywania badania mięśni żucia i stawów skroniowo-żuchwowych przez studentów kierunku lekarsko-dentystycznego były inspiracją do przedstawienia i nauki badania wg standaryzowanego kwestionariusza BKD/ZCURNŻ.*

   Cel pracy. *Ocena skuteczności dydaktycznej w nauce badania klinicznego układu ruchowego narządu żucia, zgodnie z kwestionariuszem BKD/ZCURNŻ, wśród studentów piątego roku studiów kierunku lekarsko-dentystycznego.*

   Materiał i metody. *Pięćdziesięciu pięciu studentów kierunku lekarsko-dentystycznego wzięło udział w badaniu. Protokół badania zawierał teoretyczne informacje na temat procedur klinicznych badania według BKD/ZCURNŻ osi I, które były przedstawione podczas wykładu. Podczas seminarium grupom od czterech do sześciu studentów przedstawiono praktyczną procedurę manualną badania. Grupy te zostały zbadane wg BKD/ZCURNŻ przez doświadczonego lekarza i*

results were compared with the statistics calculated using the R program in turn by both the dentist and the student.

Results. *Forty-seven students were included in the analysis (34 female and 13 male). The examination results in qualitative variables were generally similar (from 85% to 100% repeatability), except for the identification of pain during maximum opening of the mouth and the identification of the midline shift, which had 78% and 74% concordance, respectively. The highest concordance (very good) was obtained when measuring the maximal mouth opening and interincisal distance (ICC = 0.937), while the poorest concordance was seen in the measurements of sounds produced during mandibular movements (ICC < 0.4).*

Conclusions. *The training of fifth-year dental students using the RDC/TMD axis I questionnaire with the method described above proved to be effective.*

studenta. Wyniki badań były porównywane kolejno przez lekarza i studenta, ze statystykami obliczonymi za pomocą programu R.

Wyniki. *Do analizy włączono 47 studentów, w tym 34 kobiety i 13 mężczyzn. Wyniki badania w zmiennych jakościowych były zbliżone (od 85% do 100% powtarzalności), z wyjątkiem identyfikacji bólu podczas maksymalnego otwarcia ust oraz identyfikacji przesunięcia linii pośrodkowej, które wykazywały zgodność odpowiednio 78% i 74%. Największą zgodność (bardzo dobrą) uzyskano przy pomiarach maksymalnego otwarcia ust i odległości międzysiecznej (ICC = 0,937), natomiast najsłabszą zgodność zaobserwowano w pomiarach dźwięków wytwarzanych podczas ruchów żuchwy (ICC < 0,4).*

Wnioski. *Nauka badania klinicznego układu ruchu narządu żucia, studentów V roku studiów kierunku lekarsko-dentystycznego z wykorzystaniem kwestionariusza osi I BKD/ZCURNŻ opisaną metodą, okazała się skuteczna.*

Introduction

Disorders of the temporomandibular joints and of the muscles of the masticatory organs are commonly reported by dental patients. Their etiology is multifactorial, and there are two age ranges at which temporomandibular disorders (TMDs) are the most common: around twenty and forty-five years of age.[1-3] TMDs more frequently affect women as a result of hormonal fluctuations.[4,5] In the general population of patients presenting with temporomandibular joint pain or muscle dysfunction, the frequency of TMD is between 27% and 76%.[6-9] Studies conducted in Poland indicate the frequency of TMDs at between 26.5% and 54%, depending on the research group.[8,10,11] Patients with TMDs complain of recurring headaches, pain in the area of the temporomandibular joint (TMJ), greater tension of the muscles in the head and neck, and tinnitus.[12] Some patients experience acoustic

symptoms in the TMJ during daily activities like eating and speaking, and yawning.[13,14] The symptoms in TMD affect general well-being and significantly decrease the quality of life.[15-17] A diagnosis of TMD requires a full examination, including a physical examination, and a reference questionnaire should be used on account of its many subjective symptoms. The Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) is such a questionnaire, and has been accepted by international specialists in the field. It has also been translated (with reverse-translation for verification) into a wide range of languages.[18]

In 2014, a modified version of this questionnaire entitled Diagnostic Criteria for Temporomandibular Disorders (DC/TMD) was created by *Schiffman* et al.[19] However, it has not yet been translated into Polish, so the study was based on axis I of the available RDC/TMD questionnaire.

Using a uniform questionnaire makes it possible to compare the results of studies conducted in different populations and to evaluate the worldwide frequency of TMD. The official translation of the RDC/TMD questionnaire became available in Poland in 2013 (as "Badawcze Kryteria Diagnostyczne Zaburzeń Czynnościowych Układu Ruchowego Narządu Żucia (BKD/ZCURNŻ): polska wersja dwuosiowego systemu diagnostycznego ZCURNŻ. Formularz BKD/ZCURNŻ").[20] The original RDC/TMD questionnaire was created by Samuel F Dworkin and Linda LeResche and published in 1992 in the *Journal of Craniomandibular Disorders, Facial & Oral Pain* (now the *Journal of Oral and Facial Pain and Headache*), with the acceptance and comments of fourteen other researchers.[18]

The questionnaire, which to date has been translated into 21 languages, consists of two diagnostic axes (axis I and axis II), a clinical examination questionnaire, and instructions on performing the clinical examination, including specific verbal instructions, which allow the examination to be standardized and the biases of the patient and the physician minimized. The final element of the RDC/TMD is the diagnostic algorithm for both axes.

The clinical examination questionnaire (axis I) involves finding the place where the patient localizes the pain, the trajectory and range of the mandibular opening in millimeters, the location of the pain during horizontal movement, and the occurrence of any acoustic symptoms during mandibular movements (opening and closing, forward and horizontal movements). For this axis, muscle palpation is carried out, with an assessment of the intensity of the pain arising during the examination. The patient's estimated pain intensity is recorded. It is also specified how the palpation of the muscles and joints should be performed. For this purpose, the examiner should assess the tenderness of the muscles and the joint capsule by applying pressure with the fingertips. The pressure force is specified as 2 lb. when examining the temporalis and masseter muscles and 1 lb. when examining the joints, posterior mandibular region, submandibular region, and extra-oral muscles. These precise guidelines ensure objectivity in the examination results. The diagnosis is established using specific detailed algorithms separately for the right and left sides. The RDC/TMD questionnaire enables the assessment of the TMJ and the masticatory muscles. The possible diagnoses include three groups of clinical problems: I – musculofascial disorders (IA: pain of musculofascial origin; IB: pain of musculofascial origin with limited range of opening), II – displacements of the articular disc (IIA: displacement of the articular disc with reduction; IIB: displacement of the articular disc without reduction with limited mandibular movement; IIC: displacement of the articular disc without reduction and without limited opening); III – arthralgia, inflammation, and degeneration of the temporomandibular joint (IIIA: arthralgia; IIIB: arthritis; IIIC: degeneration of the joint). The diagnosis is established separately for the right and left TMJ. The patient may receive no diagnosis or may receive several.

Axis II contains a personal questionnaire consisting of 31 questions to be answered by the patient. These cover information about the general health, pain, chronic pain, physical symptoms, mental and emotional state (including tendency to depression), and questions from the demographic domain. The chronic pain assessment protocol details which data should be examined to determine the degree of chronic pain or psychosomatic state. Based on this, diagnoses of chronic pain, depression, or somatization can be made.

The RDC/TMD questionnaire has been used worldwide for many years. It specifies detailed instructions for performing the test, the verbal messages to be used with the patient during

the examination, and a detailed algorithm for establishing the diagnosis, which makes the use of the questionnaire in clinical practice easy to learn and helpful in diagnosing TMD. The medical examination and the symptoms described by the patient may be highly subjective, so it is reasonable to use a uniform, validated tool to assess dysfunction. The questionnaire is available for dentists in many languages, including Polish.

The undergraduate teaching program for dental students in Poland is described in Polish statutory law (Dz. U 2017 poz. 1728:21), which outlines a framework program of practical training. In the section on practical training in prosthodontics (item 6, 1, a), it requires "examination of the patient and recognition (...) of functional disorders of the masticatory organs...", and in the section on practical learning outcomes (point 13), under the heading of "skills A", - that is activities that a student should be able to perform correctly and fully independently, under item 68 it requires having the ability to "recognize and prevent functional disorders of the masticatory organ". We have adapted our usage of the RDC/TMD to these statutory guidelines. A teaching plan involving practical training in the questionnaire was undertaken. In order to assess the difficulty of effectively using this tool (Axis I RDC/TMD), it was decided to conduct an evaluation of the course among final-year students of the dental faculty, and to determine whether this skill could be put to practice under clinical conditions.

The aim of the study was to evaluate the effectiveness of teaching final-year dental students how to perform clinical examinations with the RDC/TMD questionnaire.

Methods

All fifty-five fifth-year dental students of the Dental Institute in Kraków in the 2018–2019 academic year participated in the study. After applying the exclusion criteria, the results of forty-seven students (86%), including thirty-four women, ranging in age from 22 to 28 years, were eligible for further analysis. The average age of the participants was 24 years. Each eligible student formed a pair with one physician, resulting in thirty-four physician+female student (physician–♀) and thirteen physician+male student (physician–♂) pairs. Data on outcome measures (quantitative) and palpation examination (qualitative) were analysed separately. Data for all the students were evaluated, and the physician–♀ and physician–♂ results were compared. The results were presented in the order of examination, as found in the RDC/TMD questionnaire, first with respect to the results obtained among students overall, then by gender.

The study received approval from the Bioethics Committee of the Jagiellonian University (consent number 1072.6120.314.2018). The participants were informed of the purpose of the study and how it would be conducted, and gave their written consent for voluntary participation. The inclusion criterion was fifth-year dental students participating in the Dental Prosthodontics 2/2 course. The exclusion criterion was not consenting to participate in the study or incorrectly completed the study form.

The experiment was guided by the "tell=show-do" approach, and the study was divided into three stages:

Stage 1: Tell

A lecture, which discussed the epidemiology, causes, and characteristics of TMD was delivered to all the students. The students were familiarized with the Polish version of the RDC/TMD questionnaire. They received the full text of the forms along with the description of the prompts to be used by the examiner. The clinical procedures for the diagnostic examination of patients according to axis I of the RDC/TMD

questionnaire were also presented.

Stage 2: Tell-Show

A seminar was conducted separately for each of four student groups and led by the same person for every group, a specialist in dental prosthodontics, experienced in using the RDC/TMD questionnaire (JEL). During the seminar, clinical examination procedures were discussed, along with details of the clinical examination and verbal prompts for the patient.

Stage 3: Show-Do

During classes, students in groups of 4-6 were shown a practical examination procedure. The students practised in pairs, with each student being examined by the instructor of the group and by one fellow student. In consequence, all the students were examined using the axis I RDC/TMD twice: by an experienced clinician and by a student. Each student performed one clinical examination of TMD according to the axis I questionnaire procedure.

Prior to the palpation test, students verified 2 lb. and 1 lb. finger forces with a kitchen weighing scale. In the original protocol, the device used for estimating the palpation pressure was different, but in this case a kitchen weighing scale proved easier to use during classes with students. The weighing scale was calibrated and placed horizontally on the working surface. Each student pressed his or her finger on the weighing scale, and a colleague read the result until the required finger force could be obtained multiple times.

The results of the study were statistically analysed to assess reproducibility for each physician–student pair. The results were compared in terms of the gender of the students and physicians.

An analysis of the qualitative and quantitative variables was carried out. The quantitative variables were examined using the intraclass correlation coefficient (ICC), which was interpreted according to the following rule: ICC below 0.4: poor concordance; ICC

0.4–0.6: medium concordance; ICC 0.6–0.75: high concordance; ICC 0.75–1: very high concordance.[21] This analysis was performed in R version 3.6.1.[22]

Results

The results of the qualitative variable analysis were presented in terms of the RDC/TMD questionnaire. The parameters with the highest concordance scores are described first, followed by the data with the lowest repeatability scores. The remaining concordance results are presented in Table 1.

The quantitative variables are presented in the order in which they appear in the RDC/TMD: the results with the highest ICC value are presented first, proceeding to the lowest values. Table 2 presents the data whose concordance scores fell between the highest and lowest values of the ICC coefficient. The differences in the measurements made by the students in relation to the reference results obtained by the physicians are also presented.

All the students in total

In our study of the TMJ assessment, the highest concordance of results was found in the measurements of the opening movement, where 40 out of 47 pairs of values were compatible– a correlation level of 87%. The data indicate that concordance of measurements of the abduction motion among physician–♀ pairs occurred in 30 out of 34 possible pairs, which is 88%; while among physician–♂ pairs, this value was 83% (ten out of twelve pairs were compatible). There was a 5% concordance for the assessment of pain at maximum active opening (among physician–♀ pairs the repeatability of the physician score was 82%, while in physician–♂ pairs this was 92%). The assessment of lateral mandibular movements – left lateral displacement and the presence of pain during this movement, as well as the assessment of anterior movement, the presence

T a b l e 1. Concordance of physician–student pairs in TMJ assessment

Variable	Concordance in %		
	Men and women [number of pairs, result in %]	Women [number of pairs, result in %]	Men [number of pairs, result in %]
Horizontal mandibular movements: right	43/47, 91%	32/34, 94%	11/13, 85%
Sounds in left TMJ during opening	44/47, 93%	31/34, 91%	13/13, 100%
Sounds in left TMJ during closing	43/47, 91%	30/34, 88%	13/13, 100%
Sounds in right TMJ during closing	43/46, 93%	33/34, 97%	11/13, 85%
Assessment of click elimination	40/46, 87%	29/33, 88%	11/13, 85%
Assessment of sounds in ight TMJ during horizontal movements: right	44/47, 94%	32/34, 94%	12/13, 92%
Clicking in TMJ on protrusion	44/47, 94%	32/34, 94%	12/13, 92%

of clicking during mandibular retraction at the right joint, and the presence of joint sound during left lateral movement – was 96% in both physician–♂ and physician–♀ pairs.

One of the least compatible results among physician–♀ pairs was for the assessment of the presence of pain with vertical opening movement during maximal passive opening, with 76% agreement; and for the assessment of midline shift, with 79% agreement. In the same measurements among physician–♂ pairs, there was 85% and 62% agreement, respectively. Problems with horizontal interincisal distance were noted in physician–♂ pairs, a reproducible result in 62%, whereas among physician–♀ pairs, concordance was 85%. Other results are presented in Table 1.

Quantitative variables were assessed using the ICC intraclass correlation coefficient.

The parameters were measured in millimeters. The following quantitative variables were included for evaluation: pain-free opening,

maximum active opening, maximum passive opening, vertical interincisal distance, horizontal interincisal distance, midline position, and horizontal mandibular movements on the right and left and protrusion.

The concordance of the pain-free opening movement measurement was 0.919, which is very high. The ICC allows us to note that physician–♂ (ICC = 0.942) was more concordant than physician–♀ (ICC = 0.906), but both genders showed a high degree of concordance with physicians, at ICC = 0.919.

During the clinical examination, the highest concordance (ICC = 0.937) was found for both the maximum active opening and the vertical interincisal distance. For physician–♀, these were 0.91 and 0.939 respectively, while for physician–♂, they were 0.978 and 0.936, respectively.

The lowest concordance scores were for the left lateral movement (ICC 0.646) for both sexes and the right lateral movement (ICC

0.688), for both physician–♀ and physician–♂.

While analysing the results, we assessed the discrepancy between the measurements taken by the students and the physicians. The mandibular opening range test (without pain), as measured by the students, differed by an average of 2.26 mm from those measured by the physicians, and ranged from 9 mm in the physician–♀ group to 6 mm in the physician–♂ group.

The assessment of maximum active opening also showed a significant discrepancy. The mean measurement difference between students and physicians was 1.65 mm, while the maximum recorded measurement difference was 9 mm among physician–♀ pairs and 4 mm in physician–♂ pairs.

The smallest mean discrepancy was observed for the measurement of horizontal interincisal distance, averaging 0.21 mm in both sexes with a maximum difference of 1 mm among physician–♀ and physician–♂ pairs. The other values of the ICC, the study variables, and the maximum discrepancy in the results in mm are shown in Table 2.

Analysis of qualitative variables and evaluation of the measure of concordance.

As for palpation, the greatest compatibility (100%) in both physician–♀ and physician–♂ pairs involved the examination of the mastoid process, frontal, vertex, and posterior part of the temporalis muscle (back of the temple), the submandibular region (stylohyoid muscle/posterior belly), and digastric muscle.

During palpation, 100% repeatability of the results was noted among physician–♂ pairs in assessing pain in the joint-lateral region. Among physician–♀ pairs, compliance when assessing pain within the joint-lateral region was 97%. When assessing pain within the joint (posterior attachment, examination in ear), concordance among physician–♀ pairs was 100%, while among physician–♂ pairs it was 92%.

Concordance in both sexes combined was 93% for the examination of the middle part of the temporalis muscle; when analysed by sex, the unity of results was 94% in ♀ and 92% in ♂. On the other hand, the evaluation of the anterior part of the temporalis muscle was 89% compatible with the physicians (♀ 91%, ♂ 85%). Other components of the palpation examination are shown in Table 3.

The greatest differences were noted when assessing the masseter muscle on the medial

T a b l e 2. ICC and the discrepancy between student and physician measurements

Variable	Concordance in %					
	Men and women		Women		Men	
	IICC	Max discrepancy in mm	IICC	Max discrepancy in mm	IICC	Max discrepancy in mm
Maximum passive opening	0.925	14	0.890	14	0.981	3
Horizontal interincisal distance	0.94	1	0.946	1	0.939	1
Midline	0.888	3	0.884	2	0.870	3
Protrusion	0.794	6	0.828	4	0.755	6

T a b l e 3. Concordance of physician–student pair scores for palpation

Area	Concordance in %		
	Men and women	Women	Men
M. masseter, superior part	87%	88%	85%
M. masseter, medial part	74%	71%	85%
M. masseter, inferior part	89%	88%	92%
Posterior mandibular area	87%	85%	92%
Posterior TMJ area	98%	100%	92%

part (cheek, side of the face). For palpation of this area, the level of concordance among physician–♀ and physician–♂ pairs was 74%. This means that the result was the same during the examination in 35 pairs. Among 34 physician–♀ pairs, concordance in this parameter occurred in 24 individuals, or 71%. On the other hand, among 13 physician–♂ pairs, 11 had the same test result, which gives a concordance of 85%.

Discussion

Students showed great interest in the RDC/TMD questionnaire, in learning new skills, and in being able to actively participate in the project. They attended the classes with commitment and curiosity, asking many questions. They practised measuring their finger pressure during palpation with a weighing scale, which was a new way for them to evaluate their diagnostic skills. In addition, students had the opportunity to clearly compare the structures being examined, as each examiner was observed by an experienced clinician, and there was the opportunity at all times to ask questions, if there were any concerns. Another added value was that the students themselves were examined by a physician and then by a student, which provided an opportunity to correct or direct the student colleague as feedback.

To date, there have been no published studies describing the effectiveness of student learning the use of the RDC/TMD questionnaire as a research tool. *Wahlund* et al.[24] conducted a study in which they evaluated the usefulness and reliability of a method for assessing and diagnosing TMD. The participants were two dentists who studied 50 Swedes (31 girls) between the ages of twelve and eighteen years. The mean age was fifteen years. The adolescents were tested with the RDC/TMD questionnaire to assess the reliability and reproducibility of the study. One week after the first examination, the participants were re-examined by one clinician, following several hours of training by a second clinician. Examination of the vertical range of jaw movement showed a high concordance among diagnoses, as measured by the Kappa coefficient (the closer this coefficient is to 1, the more concordant the assessments of the two judges or of the one judge per interval). For the "opening without pain" measure, the Kappa coefficient was 0.94 and 0.90 for each operator. The maximum active opening Kappa was 0.98, and the maximum passive opening Kappa values were 0.98 and 0.96. There was less convergence of results when measuring horizontal mandibular movements, including lateral movement, which corresponded to Kappa coefficients of 0.67 and 0.74. A statistically significant Spearman correlation of 0.69 was

related to the recognition of sounds in TMJ. In conclusion, the authors noted the repeatability in classifying patients into subdiagnoses using the RDC/TMD. The present study of the measurement of "opening without pain", as well as the assessment of maximum passive opening and maximum active opening, had lower result repeatability for students than for physicians. On the other hand, horizontal movements of the mandible, including the assessment of lateral movement, was not problematic for students, and had higher repeatability than in the study of *Wahlund* et al.[23] The assessment of the recognition of sounds in the TMJ in the Swedish study and in our students showed a similar consistency of results.

John et al. assessed the reliability of clinical diagnoses of TMD using the methods and instructions described in the RDC/TMD questionnaire.[24] Thirty investigators from ten international centers participated in the study and examined 230 subjects. The authors noted that the RDC/TMD questionnaire was a sufficient tool for providing the most common diagnoses. The work of international researchers and the results of our research here show a high degree of agreement.

It is worth noting that obtaining 100% agreement in the examination of the mastoid process and the frontal and vertex points should not pose any problems, because in most patients these areas are not painful when palpated. These areas are examined in order to eliminate sensitization and psychological problems.

The difference of 9 mm in both the pain-free opening and the maximum active opening is a large discrepancy, suggesting the need to look at the instrument used to perform the measurement – a flexible ruler. It is possible that there was a reading error. In addition, it is important to note the discrepancies that occurred in the number of pairs analysed by gender. The reason for the difference in results was the discrepancy in gender distribution, as 34

pairs were physician–♀ and only 13 pairs were physician–♂. Differences in results, for example when evaluating the horizontal movement of the mandible to the right among the 34 physician–♀ pairs, were identified unanimously by 32 pairs, resulting in a concordance of 94%, whereas eleven of thirteen physician–♂ pairs identified this parameter unanimously (in both cases, two pairs were not concordant), and the percentage concordance was 9% lower at 85%.

It is also worth emphasizing that the RDC/TMD questionnaire diagnoses the most common problems, but does not cover all possible diagnoses, such as hypermobility clicking and neoplastic diseases. Becoming proficient with this valuable diagnostic tool is beneficial for dentists, especially young dentists, and will help them diagnose patients with the most common functional problems. Knowing which conditions are not diagnosed by means of this tool should guide young dentists in clinical cases that need referral for further consultation and detailed examination.

Our results show a high level of agreement between the students' data and the physicians' data. The project enriched students' knowledge and allowed the teaching quality to be evaluated. It also increased students' skills, which they will be able to use in their professional work. The majority of the students had no symptoms of TMJ, and this study gave them the opportunity to learn in a practical manner how this specialist examination proceeds, how to perform the maneuvers required, and how to conduct a verbal assessment of the examination. Further education regarding patients with previously diagnosed dysfunctions is also advisable. It would be worth considering a comparative study of a larger group of patients with TMD. This would allow students to gain more exposure to patients with clinical symptoms of functional dysfunction. The examination includes procedures known to students, but the precise procedure used in the questionnaire allows the

test results to be compared and used by other dentists. Because of the standardized procedure, diagnosis is possible among people with little experience in TMD treatment. Moreover, it enables the patient's therapeutic efficacy to be monitored; it is easy to implement, and can be repeated many times.

Conclusion

Teaching fifth-year dental students a clinical examination using the axis I RDC/TMD questionnaire, following the method described here, proved to be effective. It is worth considering the use of the questionnaire as a compulsory element of undergraduate education, as it is a reproducible research–diagnostic instrument that allows the results of patients' subjective feelings to be made objective. When a modified DC/TMD questionnaire becomes available in Polish, teaching its use should be considered.

References

1. *Grosfeld O, Jackowska M, Czarnecka B:* Results of epidemiological examinations of the temporomandibular joint in adolescents and young adults. J Oral Rehabil 1985; 12(2): 95-105.

2. *Manfredini D, Piccotti F, Ferronato G, Guarda-Nardini L:* Age peaks of different RDC/TMD diagnoses in a patient population. J Dentistry 2010; 38(5): 392-399.

3. *Guarda-Nardini L, Piccotti F, Mogno G, Favero L, Manfredini D:* Age-related differences in temporomandibular disorder diagnoses. CRANIO® 2012; 30(2): 103-109.

4. *Bi RY, Ding Y, Gan YH:* A new hypothesis of sex-differences in temporomandibular disorders: Estrogen enhances hyperalgesia of inflamed TMJ through modulating voltage-gated sodium channel 1.7 in trigeminal ganglion? Medical Hypotheses 2015; 84(2): 100-103. doi:10.1016/j.mehy.2014.12.010

5. *Polur I, Kamiya Y, Xu M,* et al.: Oestrogen receptor beta mediates decreased occlusal loading induced inhibition of chondrocyte maturation in female mice. Arch Oral Biol 2015; 60(6): 818-824. doi: 10.1016/j.archoralbio.2015.02.007

6. *Chang TH, Yuh DY, Wu YT,* et al.: The association between temporomandibular disorders and joint hypermobility syndrome: a nationwide population-based study. Clin Oral Investig 2015; 19(8): 2123-2132.

7. *de Melo Júnior PC, Aroucha JMCNL, Arnaud M,* et al.: Prevalence of TMD and level of chronic pain in a group of Brazilian adolescents. PloS one 2019; 14(2): e0205874.

8. *Wieckiewicz M, Grychowska N, Wojciechowski K,* et al.: Prevalence and correlation between TMD based on RDC/TMD diagnoses, oral parafunctions and psychoemotional stress in Polish university students. Biomed Res Int 2014; 2014.

9. *Al-Khotani A, Naimi-Akbar A, Albadawi E, Ernberg M, Hedenberg-Magnusson B, Christidis N:* Prevalence of diagnosed temporomandibular disorders among Saudi Arabian children and adolescents. J Headache Pain 2016; 17(1): 41.

10. *Loster JE, Osiewicz MA, Groch M, Ryniewicz W, Wieczorek A:* The Prevalence of TMD in Polish Young Adults. J Prosthodont. 2017; 26(4): 284-288. doi:10.1111/jopr.12414

11. *Wieckiewicz M, Grychowska N, Nahajowski M,* et al.: Prevalence and Overlaps of Headaches and Pain-Related Temporomandibular Disorders Among the Polish Urban Population. J Oral Facial Pain Headache 2020; 34(1).

12. *Gonçalves DAG, Bigal ME, Jales LCF, Camparis CM:* Speciali JG. Headache and Symptoms of Temporomandibular Disorder: An Epidemiological Study. Headache: J Head Face Pain 2010; 50(2): 231-241. doi:10.1111/j.1526-4610.2009.01511.x

13. *Sato S, Goto S, Nasu F, Motegi K:* Natural

course of disc displacement with reduction of the temporomandibular joint: Changes in clinical signs and symptoms. J Oral Maxillofac Surg 2003; 61(1): 32-34. doi: 10.1053/joms.2003.50005

14. *Dias IM, Cordeiro PC deF, Devito KL, Tavares MLF, Leite ICG, Tesch R deS:* Evaluation of temporomandibular joint disc displacement as a risk factor for osteoarthrosis. International J Oral Maxillofac Surg 2016; 45(3): 313-317. doi:10.1016/j.ijom.2015.09.016

15. *Bonjardim LR, Gavião MBD, Pereira LJ, Castelo PM:* Anxiety and depression in adolescents and their relationship with signs and symptoms of temporomandibular disorders. Inter J Prosthodont 2005; 18(4).

16. *Nazeri M, Ghahrechahi HR, Pourzare A,* et al.: Role of anxiety and depression in association with migraine and myofascial pain temporomandibular disorder. Indian J Dent Res 2018; 29(5): 583-587. doi:10.4103/0970-9290.244932

17. *Minghelli B, Morgado M, Caro T:* Association of temporomandibular disorder symptoms with anxiety and depression in Portuguese college students. J Oral Science 2014; 56(2): 127-133. doi:10.2334/josnusd.56.127

18. *Dworkin SF, LeResche L:* Research diagnostic criteria for temporomandibular disorders: review, criteria, examinations and specifications, critique. J Craniomandib Disord 1992; 6(4): 301-355.

19. *Schiffman E, Ohrbach R, Truelove E,* et al.: Diagnostic criteria for temporomandibular disorders (DC/TMD) for clinical and research applications: recommendations of the International RDC/TMD Consortium Network and Orofacial Pain Special Interest Group. J Oral Facial Pain Headache 2014; 28(1): 6.

20. *Osiewicz M, Lobbezoo F, Loster B, Wilkosz M, Naeije M, Ohrbach R:* Research Diagnostic Criteria for Temporomandibular Disorders (RDC/TMD) – The Polish version of a dual-axis system for the diagnosis of TMD. RDC/TMD Form. J Stomatol (Czasopismo Stomatologiczne). 2013; 66(5): 576-649. doi: 10.5604/00114553.1065048

21. *Cicchetti DV:* Guidelines, criteria, and rules of thumb for evaluating normed and standardized assessment instruments in psychology. Psychological Assessment 1994; 6(4): 284-290. doi: 10.1037/1040-3590.6.4.284

22. *Team RC:* R: A language and environment for statistical computing. Published online 2013.

23. *Wahlund K, List T, Dworkin SF:* Temporomandibular disorders in children and adolescents: reliability of a questionnaire, clinical examination, and diagnosis. J Oral Facial Pain Headache 1998; 12(1).

24. *John MT, Dworkin SF, Mancl LA:* Reliability of clinical temporomandibular disorder diagnoses. Pain 2005; 118(1-2): 61-69.