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## Cluster analysis of aetiological parameters of bruxism

**The aim of the study** – to establish a correlation between the degree of severity and the etiological factors of bruxism.

**Materials and methods.** After a clinical dental examination of 377 people aged 25 to 44 years, 81 parameters characterizing the diagnosis of bruxism will be determined, to which the results of the dental examination were assigned (history collection, index and instrumental assessment of dental status, condition of masticatory muscles, TMJ and additional methods (occludogram, orthopantomography, TMJ computer tomography, Brooks checker, masticatory muscle electromyography), polysomnography and temperature assessment. The digital material was processed by the method of variational statistics, the calculations were carried out using the computer program "MULTIFAC" 2/2 using multivariate, correlation and regression analysis. Mathematical analysis and verification of the reliability of the results, as well as the calculation of the arithmetic mean and root mean square errors were carried out on the basis of the "Statistica" software 6.0" and "Microsoft Office Excel 2003".

**Results and their discussion.** When conducting a cluster analysis of the etiology of bruxism of 81 indicators, three groups of subjects were distinguished depending on the prevailing factor: the first group of patients with bruxism from the indicated signs showed a high correlation ( $r=0.99$ ,  $p<0.05$ ) with indicators: pathological types of bite (distal, deep, cross), the presence of supracontacts and orthodontic pathology; the second – with a high correlation ( $r=0.98$ ,  $p<0.05$ ) according to the signs: pathology of the temporomandibular joint; in the third group, the excited choleric temperament and psychoemotional state according to the criteria of lability of the autonomic nervous system in threatening situations and sleep disorders associated with general internal tension are reliably correlated with high indicators of temperament.

**Conclusions.** The correlation in the first group was ( $r=0.99$ ,  $p<0.05$ ); in the second – ( $r=0.98$ ,  $p<0.05$ ), in the third ( $r=0.97$ ,  $p<0.05$ ), which allows prescribing etiotropic treatment.

**Key words:** Bruxism, young patients, occludogram, pathological wear of teeth, bioelectrical potential of masticatory muscles, occlusion index, psychoemotional state, correlational dependencies.

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## Кластерний аналіз етіологічних параметрів бруксизму

**Мета дослідження.** встановити кореляційну залежність між ступенем вираженості та етіологічними чинниками виникнення бруксизму.

**Матеріали і методи.** Після проведеного клінічного стоматологічного обстеження 377 осіб віком від 25 до 44 років було визначено 81 параметр, що характеризує діагноз бруксизму, до якого були віднесені результати стоматологічного обстеження (збір анамнезу, індексна та інструментальна оцінка стоматологічного статусу, стан жувальних м'язів, СНЩС та додаткових методів (оклюдограма, ортопантомографія, комп'ютерна томографія СНЩС, бруксчекер, електроміографія жувальних м'язів), полісомнографія та оцінка температури. Цифровий матеріал оброблено методом варіаційної статистики, розрахунки проводили за комп'ютерною програмою.

мою «MULTIFAC» 2/2 з використанням багатофакторного, кореляційного та регресійного аналізу Математичний аналіз та перевірка достовірності результатів, а також обрахунок величин середньоарифметичних та середньоквадратичних похибок здійснювався на основі програмного забезпечення «Statistica 6.0» та «Microsoft Office Excel 2003».

**Результати та їх обговорення.** При проведенні кластерного аналізу етіології бруксизму 81 показника виділено три групи досліджених в залежності від превалюючого чинника: перша група пацієнтів із бруксизмом із зазначених ознак високою виявилася кореляція ( $r=0,99$ ,  $p<0,05$ ) із показниками: патологічні види прикусу (дистальний, глибокий, перехресний), наявність супраконтактів та ортодонтичної патології; друга – з високою кореляцією ( $r=0,98$ ,  $p<0,05$ ) за ознаками: патологія скронево-нижньощелепного суглобу; в третій групі достовірно корелюють з високими показниками за темпераментом збуджений холерик та психоемоційний стан за критеріями лабільність вегетативної нервової системи в загрозливих ситуаціях та розлади сну, пов'язані із загальним внутрішнім напруженням.

**Висновки.** Кореляції в першій групі становила ( $r=0,99$ ,  $p<0,05$ ); в другій – ( $r=0,98$ ,  $p<0,05$ ), в третій ( $r=0,97$ ,  $p<0,05$ ), що дозволяє призначати етіотропне лікування.

**Ключові слова:** Бруксизм, особи молодого віку, оклюдограма, патологічна стертість зубів, біоелектропотенціал жувальних м'язів, оклюзійний індекс, психоемоційний стан, кореляційні залежності.

**Introduction.** Bruxism is a complex polyetiological dental pathology, the main symptom of teeth grinding when the jaws are compressed due to involuntary contraction of the chewing muscles. The prevalence of bruxism is from 5 to 90% in the adult population and from 10 to 50% in children; prevalence decreases in people over 60 years old [1, 2]. Significant discrepancies are explained by imperfect diagnosis, since the verification of the diagnosis until now is based on the subjective data of questionnaires of states during sleep, as the first symptoms of the disease [3].

It has been proven that the leading factor in the occurrence of bruxism is psycho-emotional instability, frequent stressful situations. The occurrence of this pathology is influenced by genetics, alcohol abuse, smoking, use of narcotic substances, as well as specific groups of medicines [4].

Dental diagnosis of bruxism is based on several methods (presence of abrasion, bruxchecker, occludogram, evaluation of the condition and functioning of the masticatory muscles), however, there is no clear algorithm for examining this contingent of patients, which leads to ineffective treatment and progression of the pathology [5].

**The purpose of the study** – establish a correlation between the degree of severity and the etiological factors of bruxism.

**Materials and methods.** After a clinical dental examination of 377 people aged 25 to 44 years, 81 parameters characterizing the diagnosis of bruxism will be determined, to which the results of the dental examination were assigned (history collection, index and instrumental assessment of dental status, condition of masticatory muscles, TMJ and additional methods (occludogram, orthopantomography, TMJ computer tomography, Brooks checker, masticatory muscle electromyography), polysomnography and temperature assessment [6, 7].

Three clinical groups with a predominance of the etiological factor were identified; the first consisted of 30 patients aged 25 to 44 years, in whom bite pathology and premature contacts prevailed, of which 15 men (50%) and 15 women (50%). The second group included 25 patients, aged 25–44 years, with the prevalence of pathological changes in the temporomandibular joints caused by injuries, inflammatory processes in the joints, parafunctions of the masticatory muscles (12 men – 48% and 13 women – 52%). The third group included 30 patients aged 25 to 44, with clearly expressed psychoemotional lability.

The digital material was processed using variational statistics. The differences between the compared values were

considered probable at the level of statistical significance  $p<0.05$ . Mathematical statistical processing was carried out using Microsoft Excel 2003. Student's t-test and correlation test ( $r$ ) in G's modification were calculated when processing research data. F. Lakina (1980) and confidence limits of the average value [8, 9, 10]. Non-parametric criteria were used to analyze variational series, which were different in form from the normal distribution:  $\chi^2$  and Fisher's method. Statistical calculations were carried out using a special computer program "MULTIFAC" 2/2 using multivariate, correlation and regression analysis. Mathematical analysis and verification of the reliability of the results, as well as the calculation of the arithmetic mean and root mean square errors were carried out based on the "Statistica" software 6.0" and "Microsoft Office Excel 2003" [11, 12].

We performed statistical analysis of the obtained data using the recommendations of O. P. Mintsera, Yu. IN. Voronenko [13] and standard statistical programs "Statistica 6.0" and "SPSS 14" (Stat Soft Inc.). Data entry and documentation of experimental research were carried out using computer registration methods by filling in the appropriate graphological cells for further statistical processing.

**Research results and their discussion.** Correlation analysis of signs according to separated groups was carried out. Within the first group of patients, which includes the results of occluderograms, the severity of bruxism, the prevalence of bite types. Figure 1 presents the results of the correlations of the studied features with the severity of bruxism in more detail. Bruxism of 2.4 teeth correlates with the largest number of signs (Fig. 1).

All studied types of bite correlate with 20–21 indicators out of 81, the least correlated relationships are revealed by the results of the occluderogram – 70–80%, the others correlate with a significant number of signs from 15 to 20. The number of correlations in the second group of patients, which includes the results of palpation of the masticatory muscles and TMJ, is as follows (Fig. 2).

Figure 3 shows the correlation relationships separately. The maximum number of correlations is demonstrated by the indicator of 3.3 cR (10 signs). Others are interdependent with 2–3 signs.

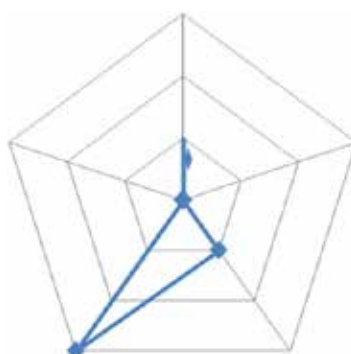
According to Figure 4, the number of correlations with indicators of the results of the occlusion index is as follows: with the largest number of signs, signs with 3 points on the strength scale were correlated. These are problems with chewing, discomfort when closing the jaws, pain in the teeth (15–20 signs). Indicators evaluated by power of

bruxism 1,5

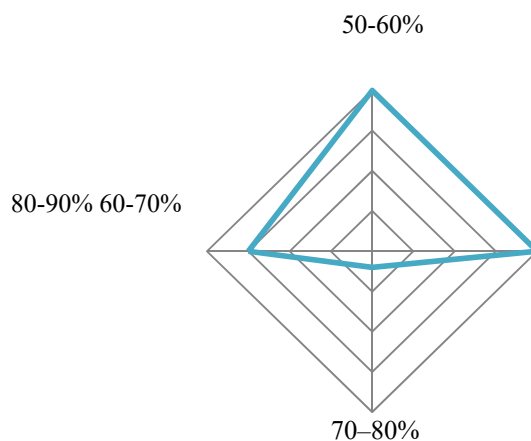
bruxism 3,3

bruxism 3,4

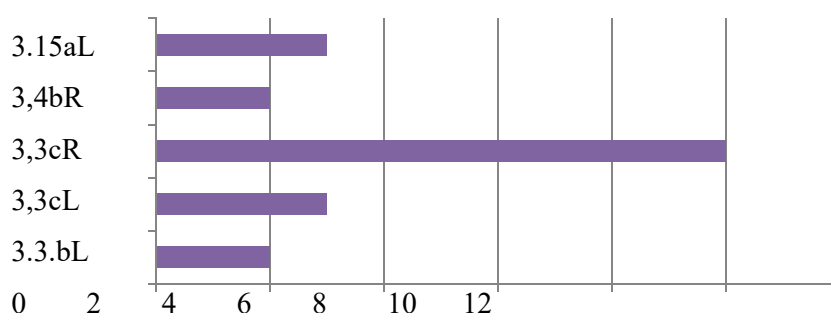
bruxism 2,4 bruxism 3,1



**Fig. 1. Number of correlations between severity of bruxism and other investigated signs**



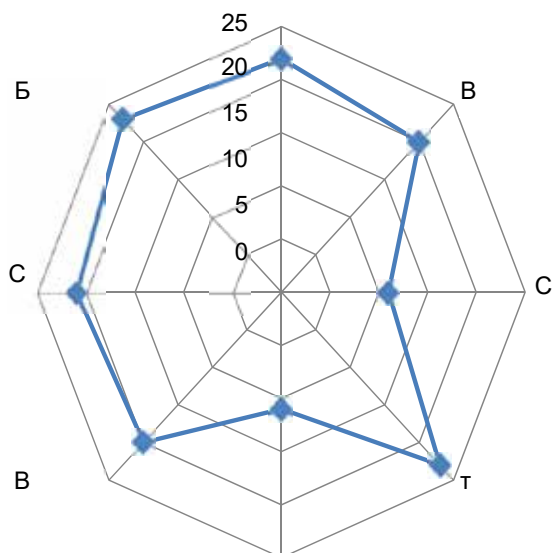
**Fig. 2. The number of correlations between the results of the occlusion index and other features, including among themselves**



**Fig. 3. Number of correlations between masticatory muscle palpation indicators and other signs, including among themselves**

2 points show the relationship of 5–15 features. Fewer than 5 signs with which these indicators were correlated are TMJ pain, headache, except for pain with a strength of 2 points and muscle spasms on a strength scale of 1 point. Correlated features in the third group of patients, including temperament and psychoemotional state, were also analyzed.

According to the figure, it is visualized that there is a significant number of investigated parameters, which has a correlation dependence on the temperament and psycho-emotional state of the patients. The largest number of correlated signs is 23, for example, for patients with temperament D, and 22 signs for temperaments A and B, 21 signs for – anxiety C, 20 – for temperament B



**Fig. 4. The number of correlations between temperament, anxiety and other characteristics of the third group of patients with bruxism**

and anxiety B, and the smallest number of investigated indicators correlates with anxiety A. Temperament C and anxiety A are intercorrelated only with each other, anxiety C is correlated only with temperament A, while the latter also shows a reliable correlation with temperament D and anxiety B. The most cases of correlation are observed in 4: for temperament D and anxiety B. Obviously, these are the most unstable conditions of patients. All correlation indicators are high and reliable,  $r=0.99-1.0$ ;  $p<0.05$ .

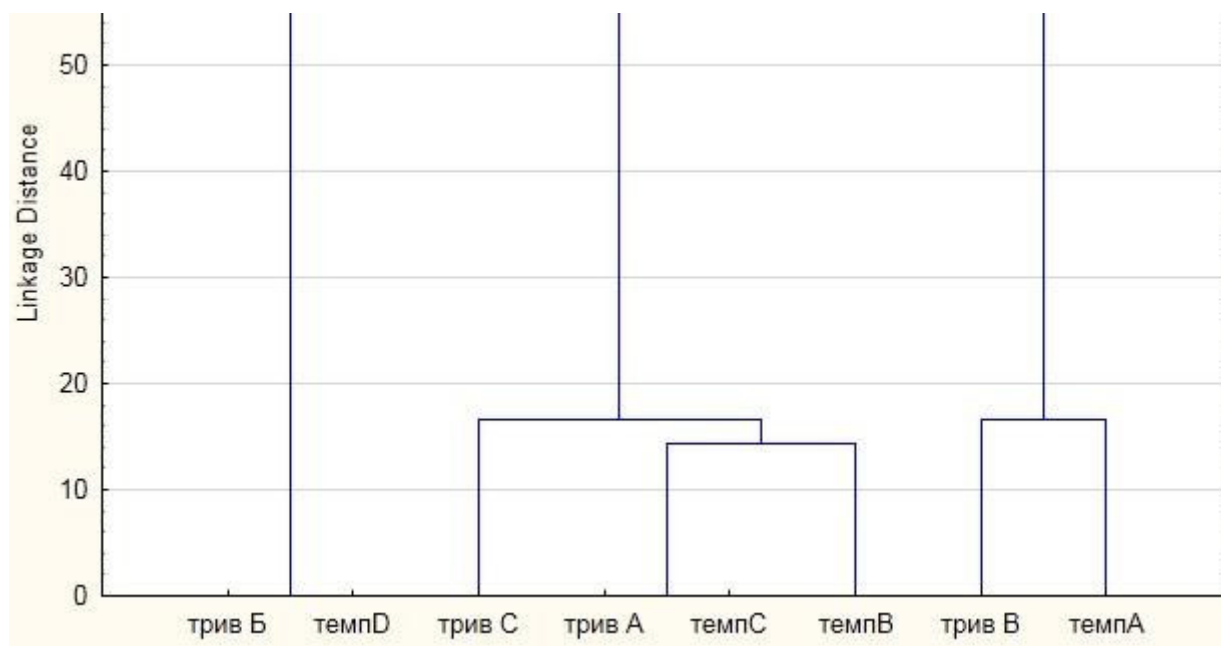
Figure 5 shows the similarity of determined states and temperaments among themselves in group 3 of patients. The study was conducted using cluster analysis. Three groups are distinguished. The first consists of type B

anxiety and D temperament; second anxiety C and A, and temperaments C and B; the third – A's temperament and B's anxiety. Within each group, anxiety and temperament are somewhat related.

So, for statistical research, 81 indicators were taken from 377 surveyed residents of the city of Ternopil and Ternopil region, of whom 144 were men, and 233 were women, confirming the diagnosis of bruxism. The maximum number of interdependent signs of correlation analysis is 23, and the minimum is 0. All indicators are correlated with the reliability of  $p\leq 0.05$ , and  $r=0.97-1.0$ . Several signs are not correlated: the intensity of caries, the presence of pain in the CNS 1 point, the intensity of tooth bruxism 3.3 and 3.4. 2 pairs of interdependent correlations are correlated with one sign: the first is good and unsatisfactory hygiene conditions, and the second is the severity of bruxism: teeth 1.5 and 3.1. The prevalence of caries and the occlusion index of 79–80% correlate with the two signs. Three signs correlate simultaneously: PMA index, bruxism 2.4, muscle spasms 3.3cl, 3.15 al. All other signs correlate in the amount from 7 to 23. The intensity of correlation in all cases is sufficiently high and reliable.

Bruxism, as the main disease, is reliably correlated with 18 signs out of 81 with  $r=0.97$ ,  $p<0.05$ , namely: negative Schiller-Pysarev test, types of bite distal, deep, cross, occluderogram result 60–70%, in addition, discomfort during maximum closing of the teeth with a force of 2 points, sensitivity of the teeth as a general indicator, as well as with force 1 and 3 points, toothache general indicator and with a strength of 1 point, noises when moving the jaws with a strength of 1 point, as well as headache a general indicator, the presence of problems with posture with a 1 point, temperaments of D and B types, manifestations of anxiety of type B and B types.

When conducting a cluster analysis, groups of subjects were identified, and the correlations depended on the groups of indicators to achieve a higher degree of reliability. They



**Fig. 5. Similarity of signs of 3 groups of patients**

were grouped into three groups. In group 1 of patients with bruxism, the signs mentioned above showed a high correlation ( $r=0.99$ ,  $p<0.05$ ) with the following indicators: negative Schiller test, orthognathic, distal, mesial bite types, occlusion results (OCG) – 50–60% occlusion.

In group 2 – ( $r=0.98$ ,  $p<0.05$ ) a high correlation is observed with the following symptoms: discomfort during maximum closing of the teeth with a strength of 2 points, determination of the occlusion index (OI) – sensitivity of the teeth overall score, tooth sensitivity 1 point, tooth sensitivity 3 points, toothache overall score, toothache 1 point, noises when moving the jaws with a strength of 1 point, headache overall indicator, the presence of posture problems with 1 point.

Group 3 are patients in whom temperament and psychoemotional state indicators are reliably correlated. In the 3rd group – ( $r=0.97$ ,  $p<0.05$ ), a high correlation dependence is observed with signs: temperament – B and D types, psychoemotional state – anxiety B and B types.

All patients have a verified diagnosis of bruxism, reliably correlated with 5 symptoms for the first group of patients, 9 for the second group, and 4 for the third group.

**Conclusions.** When conducting a cluster analysis of the etiology of bruxism of 81 indicators, three groups of

subjects were distinguished depending on the prevailing factor: the first group of patients with bruxism from the specified signs showed a high correlation ( $r=0.99$ ,  $p<0.05$ ) with indicators: pathological types of bite (distal, deep, cross), presence of supracontacts and orthodontic pathology; the second – with a high correlation ( $r=0.98$ ,  $p<0.05$ ) according to the following characteristics: pathology of the temporomandibular joint, which is confirmed by the following criteria: discomfort during maximum teeth closing, tooth sensitivity, toothache, noises during jaw movement, headache, presence of posture problems; in the third group are reliably correlated with high indicators ( $r=0.97$ ,  $p<0.05$ ) by temperament, excited choleric, and psychoemotional state by criteria, lability of the autonomic nervous system in threatening situations and sleep disorders associated with general internal tension.

**Prospects for future research.** Establishing correlations between indicators of dental status in children with different degrees of caries activity who constantly live in conditions of biogeochemical deficiency of fluorine and iodine will allow to single out the most significant and develop schemes of preventive measures to improve dental health.

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