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METHODS OF CEPHALOMETRIC ANALYSIS ACCORDING TO BURSTONE C. J., TWEED C. H. AND KIM Y. H.: OPPORTUNITIES, PROSPECTS AND PROBLEMS OF USE IN UKRAINE

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Annotation. Increased attention to the methods of cephalometric analysis by dentists in Ukraine requires a more detailed acquaintance with them to understand both the advantages and disadvantages of each of them. The purpose of the study is to analyze the literature on the possibilities, prospects and problems of using the methods of cephalometric analysis by Burstone, Tweed and Kim in Ukraine. The analysis of the most relevant scientometric databases for the last 10 years has shown that it is impossible to speak unequivocally about the predominance of one method over another. However, according to international researchers, for the effective implementation of a certain cephalometric method of analysis of lateral telerradiograms, it is necessary to conduct a study on the local population, taking into account such features as age, sex, facial features, which has not yet been done in Ukraine.

Keywords: Burstone, Tweed and Kim methods, telerradiography.

Introduction

One of the main problems of modern orthodontics is the treatment and prevention of dental-jaw anomalies and deformities. The prevalence of various types of pathologies of the dental and maxillofacial system is heterogeneous and varies from country to country. Thus, taking into account the pathology of occlusion, among Iranian children (sample of 28,693 children aged 3-18 years) the overall prevalence of malocclusion of the first class is 54.6 %, class II - 24.7 %, class III - 6.01 %. Moreover, among girls bite pathology of I and III class was observed more often than in boys (48.8 % and 5.5 % against 44.6 % and 4.5 %) [2].

In Nepal, a survey of 1,149 boys and 925 girls aged 12-15 years revealed the following distribution of occlusal pathologies: the prevalence of occlusion pathologies of class I was 48.5 %, class II - 32.68 %, class III - 4.32 %. When calculating according to the Index of needs of orthodontic treatment, it was found that 21.59 % had an extreme need for treatment, 24.67 % - an acute need, 24.07 % - a moderate need, 14.7 % - a mild need for treatment. 15.02 % of respondents did not need treatment [29].

A study to assess the aesthetic component of the smile (AC) of Nepalese orthodontists in a sample of 207 patients indicates that most of the subjects had a problem with the aesthetic appearance of their own teeth, namely: 4.8 % had AC 10, 7.2 % - AC 9, 16.9 % - AC 8, 8.7 % - AC 7, 12.1 % - AC 6, 16.4 % - AC 5, 15.5 % - AC 4, 6.3 % - AC 3, 8.7 % - AC 2 and 3.4 % had AC 1 [12].

One of the important elements of correction of dental and maxillofacial pathology is the use by orthodontists of the methods of cephalometric analysis of lateral telerradiograms. There is a great variety of these techniques, which are known by the names of the discoverers.

Ukrainian practical orthodontists and scientists working in this field have long been familiar with most of these

methods, and more, the first studies on the adaptation of cephalometric analysis by Steiner, Burstone and Schwarz for the Ukrainian population [6, 7, 25].

These studies have become an expected continuation of work performed in the anthropometric direction, to study the features of cephalometric, odontometric and other indicators among the population of Ukraine in different regions, different ages and sex [11, 30].

Indeed, the data of modern research confirm the relationship between the structure and type of person and ethnicity, sex, features of the structure of the dental apparatus, cephalometric indicators, etc. [5, 16, 23, 26, 28]. And accordingly the same factors must be taken into account when using the methods of cephalometric analysis.

Among the promising methods for practical use in Ukraine are such methods as Burstone, Tweed and Kim. However, the question arises - is there a necessary theoretical basis for these methods for their full implementation in the practice of orthodontists in Ukraine?

The purpose of the study is to analyze the literature on the possibilities, prospects and problems of using the methods of cephalometric analysis by Burstone, Tweed and Kim in Ukraine.

Materials and methods

The analysis of scientometric databases PubMed, Web of Science, Scopus and Google Academy for the period 2010-2020 is carried out.

Results. Discussion

The first method of cephalometric analysis was considered - by Kim. The analysis of literature sources did not reveal any mention of research on the adaptation of this method for the Ukrainian population.

As for foreign studies, V. E. Adediran and I. L. Utomi [1] processed data from 50 teleradiograms obtained from ethnic Nigerians aged 18-25 years with open bites to identify ethnic characteristics in this sample, compared to the normative indicators of the analysis by Kim. Statistical processing revealed that the Overbite Depth Indicator (ODI) in the experimental group was lower than in the control group (63.13 ± 6.71 and 66.85 ± 4.46 , respectively).

A similar study was conducted for Latin Americans. In the statistical analysis of the obtained data, the researchers found that significant differences in ODI are present in all groups ($p < 0.001$) except for groups with open occlusion of class I and II (65.87 ± 4.26 and 67.19 ± 3.58 , respectively). Significant differences were also found for anterior-posterior dysplasia (APDI) in all groups ($p < 0.001$) except for the balanced group and the class I open occlusion group (83.18 ± 1.71 and 81.78 ± 2.69 , respectively). Thus, the effectiveness of ODI and APDI for Latin Americans has been proven [4].

ODI and APDI were used to detect cephalometric differences between Japanese and Europeans (113 individuals and 106 individuals, respectively). The average age of the Japanese group was 14.1 ± 5.0 years, the European group 13.5 ± 7.3 years. Data analysis did not reveal statistically significant differences in ODI for Japanese and Europeans. At the same time, the values of APDI in the group of Japanese with class II occlusion were lower than in the corresponding group of Europeans [8].

The dynamics of the experiment of Korean scientists with 51 children aged 14 years, revealed statistically significant data on annual and overall age changes in odontometric indicators, including ODI, which was characterized by a statistically significant annual increase [13].

Brittany Koncz (2012) investigated the factors influencing the conduct of MEAW therapy. A total of 28 teleradiograms were evaluated in patients with anterior open occlusion at the beginning and end of therapy. The largest changes were found in the soft tissues of the face, namely - an increase in the lip U ($p < 0.04$) [17].

A comparative analysis of ODI and APDI for the white population of the United States and African Americans (160 patients aged 7 to 14 years; 97 boys and 63 girls). It was found that African Americans have significantly lower ODI and APDI (70.9° and 78.1° , respectively) ($p < 0.0001$) compared to the white population. In addition, no sex differences were found in the study groups [22].

Cephalometric analysis by Burstone is more widely known among domestic researchers and is represented by some works. In particular, M. O. Dmitriev and co-authors (2018) compared cephalometric parameters between Ukrainian boys and girls. Boys had higher anterior upper facial height, posterior upper facial height, and anterior lower facial height compared to girls [6].

I. V. Gunas and others (2018) as a result of work with teleradiograms of 38 boys and 55 girls built a regression

model of teleradiography, which can be used in cephalometric analysis by Burstone for this age group in people with normal occlusion and a harmonious face [10].

Features of cephalometric indicators for Burstone analysis have been established for residents of northern India. Northerners have more convex faces, protruding lips, and nasolabial folds than the norm in Burstone.

The third method of cephalometric analysis, considered in this review - by Tweed. It is worth noting that most work on the adaptation and study of this type of analysis is found among scientists from Bangladesh.

M. K. Alam and co-authors (2013) conducted a study on a sample of 100 people aged 18-24 years, 50 men and women. The results were compared with Tweed regulations [3]. Compared to the normative data, women from Bangladesh have significantly lower FMA, FMIA and much higher IMPA values. Similar data were found by another group of scientists from Bangladesh in a sample of 112 people (56 men and women with an average age of 19 years) [14].

L. Kumari and A. Das (2017) conducted a teleradiographic study of 50 individuals with normal occlusion and an acceptable facial profile, followed by cephalometric analysis by Tweed [18]. In contrast to previous work, the authors found a greater slope of the lower incisors compared to the normative indicators for Tweed. In addition, manifestations of sexual dimorphism were found in the studied population - mandibular angle was higher in women ($t_{48} = 2.97$; $p < 0.01$), and the value of the angle of the mandibular incisor was higher in men.

It has been established that Iranians have significant differences in cephalometric parameters according to Tweed-analysis compared to normative indicators. Thus, the analysis of the E-Line revealed that both the upper ($p < 0.001$) and lower lip ($p < 0.01$) in Iranians are behind the E-line. It was also found that the Z-angle and H-angle have significantly lower values in the Iranian sample ($p < 0.001$ in both cases) [9].

Cephalometric study of black residents of Piracicaba (Brazil) found that this category of people has statistically significant differences in the following indicators of cephalometric analysis Tweed: these people have a more convex facial profile and a greater inclination of the lower incisors. Manifestations of sexual dimorphism have not been detected by scientists [19].

In the above works, the researchers described the results of the analysis of indicators taking into account the age groups of people, their ethnic and regional affiliation, sex, however, did not take into account the distribution according to the type of face. Although, as the results of both domestic and foreign authors [9, 20, 25, 27] show, the latter is closely interrelated with the dental-maxillary system.

A. V. Marchenko and others (2020) analyzed and developed 18 reliable regression models of sizes required to build the correct shape of dental arches for adolescents, males with a wide face type, depending on cephalometric

and dental-maxillary parameters [20].

Data processing of 483 telerradiograms performed on Mexicans aged 8-58 years revealed an association between short facial type in men and mandibular hypodivergence and short facial type in women and mandibular hyperdivergence [21].

O. S. Prokopenko and co-authors (2020) investigated the dependences of profiles and face types and cephalometric parameters by the method of Schwarz, Bjork and Ricketts [25]. The largest number of differences in the indicators was found between the indicators according to the methods of Schwarz and Bjork. The least number of differences in the Ricketts method. In both cases, these trends were the same for both boys and girls.

S. Sadry and U. Ok (2019) did not find statistically significant data on the relationships between odontometric parameters studied, namely the position of the third molar, and facial type ($p=0.386$) [27].

A group of authors identified the manifestations of sexual dimorphism in assessing the impact of the type of bite on the thickness of the soft tissues of the face. Men with malocclusion have a greater thickness of the soft tissues of the face [24].

Thus, the review of the literature revealed that all three selected methods of cephalometric analysis are relevant and widespread in different parts of the world, where

scientists adapt these indicators according to ethnicity, age and sex. As for Ukraine, only Kim's method of analysis has so far been left out of the process of adaptation for the Ukrainian population, in contrast to the Burstone and Tweed methods. In addition, it was found that both in Ukraine and abroad, scientists have not yet taken into account such an indicator as the peculiarity of the structure of the human face when working with cephalometric analysis, although the work described in this review convincingly proves - facial type significantly affects performance of tooth-jaw system.

Conclusions and prospects for further development

1. The analysis of scientometric databases PubMed, Web of Science, Scopus and Google Academy for the period 2010-2020 showed that the only way to effectively implement a method of cephalometric analysis for a certain population is to conduct a preliminary study based on ethnicity, regional affiliation, sex, age and facial features. Studies conducted by Ukrainian scientists cover these criteria only in part, which prevents the full use of these methods of cephalometric analysis.

Thus, in Ukraine there is a need to conduct research to determine the characteristics of cephalometric indicators by the methods of Burstone, Tweed and Kim, taking into account the above data.

References

- [1] Adediran, V. E., & Utomi, I. L. (2013). Overbite Depth Indicator (ODI) Values in a Nigerian Population of Adults with Anterior Open Bite. *West African Journal of Orthodontics*, 2(2), 24-29.
- [2] Akbari, M., Lankarani, K. B., Honarvar, B., Tabrizi, R., Mirhadi, H., & Moosazadeh, M. (2016). Prevalence of malocclusion among Iranian children: A systematic review and meta-analysis. *Dental research journal*, 13(5), 387-395. PMID: 27857763
- [3] Alam, M. K., Basri, R., Purnal, K., Sikder, M. A., Saifuddin, M., & Iida, J. (2013). Craniofacial morphology of Bangladeshi adult using Tweed's and Wit's analysis. *International Medical Journal*, 20(2), 197-200.
- [4] Caballero-Purizaga, P. J., Arriola-Guillen, L. E., & Watanabe-Kanno, G. A. (2019). Efficiency of ODI and APDI of Kim's cephalometric analysis in a Latin American population with skeletal open bite. *Dental press journal of orthodontics*, 24, 46-54. <https://doi.org/10.1590/2177-6709.24.3.046-054.oar>
- [5] Darkwah, W. K., Kadri, A., Adormaa, B. B., & Aidoo, G. (2018). Cephalometric study of the relationship between facial morphology and ethnicity. *Translational Research in Anatomy*, 12, 20-24. <https://doi.org/10.1016/j.tria.2018.07.001>
- [6] Dmitriev, M. O., Chernysh, A. V., & Chugu, T. V. (2018). Cephalometric studies of Ukrainian boys and girls with physiological bite by the method of Charles J. Burstone. *Biomedical and biosocial anthropology*, (30), 62-67. <https://doi.org/10.31393/bba30-2018-09>
- [7] Dmitriev, M., Gunas, V., Polishchuk, S., Olkhova, I., & Kumar, A. (2020). Modeling of Central Incisors Position Indicators in boys and girls according to CC. Steiner method for Forensic Dental Identification. *The Official Publication of Indian Academy of Forensic Medicine*, 42(3), 155-160. <https://doi.org/10.5958/0974-0848.2020.00043.3>
- [8] Freudenthaler, J., Celar, A., Kubota, M., Akimoto, S., Sato, S., & Schneider, B. (2012). Comparison of Japanese and European overbite depth indicator and antero-posterior dysplasia indicator values. *The European Journal of Orthodontics*, 34(1), 114-118. <https://doi.org/10.1093/ejo/cjq177>
- [9] Ghorbany Javadpour, F., & Khanemasjedi, M. (2014). Soft tissue facial profile and anteroposterior lip positioning in Iranians. *Journal of Dental School, Shahid Beheshti University of Medical Sciences*, 32(2), 90-95. <https://doi.org/10.22037/jds.v32i2.24802>
- [10] Gunas, I. V., Chernysh, A. V., Cherkasov, V. G., & Cherkasova, O. V. (2018). Modeling by using regression analysis of teleröntgenographic individual indicators used in the method of Charles J. Burstone. *Biomedical and Biosocial Anthropology*, (31), 59-65. <https://doi.org/10.31393/bba31-2018-08>
- [11] Gunas, V. I., Kotsyura, O. O., Babysh, L. V., Shevchuk, Y. G., & Cherkasova, O. V. (2020). Features correlations of the sizes of molars with cephalometric indicators of men of the western region of Ukraine. *Reports of Morphology*, 26(2), 51-61. [https://doi.org/10.31393/morphology-journal-2020-26\(2\)-08](https://doi.org/10.31393/morphology-journal-2020-26(2)-08)
- [12] Gyawali, R., Pokharel, P. R., Giri, J., Shrestha, G. K., & Bhattarai, B. (2016). Index of orthodontic treatment need of patients undergoing orthodontic treatment at BPKIHS, Dharan. *Orthodontic Journal of Nepal*, 6(1), 23-26. <https://doi.org/10.3126/ojn.v6i1.16175>
- [13] Han, S. H., & Park, Y. S. (2019). Growth patterns and overbite depth indicators of long and short faces in Korean adolescents: Revisited through mixed-effects analysis. *Orthodontics & craniofacial research*, 22(1), 38-45. <https://doi.org/10.1111/ocr.12255>
- [14] Hasana, M. N., Rafiqueb, T., Sultana, N., Fareend, N., & Mishud, S. M. (2014). Craniofacial morphometric evaluation of Bangladeshi adults by lateral cephalometry with Tweed-Merrifield analysis. *Update Dental College Journal*, 4(1), 27-30. <https://doi.org/10.3329/updcj.v4i1.21163>
- [15] Jain, P., & Kalra, J. P. S. (2011). Soft tissue cephalometric

- norms for a North Indian population group using Legan and Burstone analysis. *International journal of oral and maxillofacial surgery*, 40(3), 255-259. <https://doi.org/10.1016/j.ijom.2010.09.011>
- [16] Jamayet, N., Viwattanatipa, N., Amornvit, P., & Alam, M. K. (2014). Comparison of Crown Width/Length Ratio of Six Maxillary Anterior Teeth between Different Facial Groups in Bangladeshi. *International Medical Journal*, 21(1), 49-54.
- [17] Koncz, B. (2012). Soft tissue, dental and skeletal factors associated with MEAW therapy and their effect on soft tissue profile and anterior tooth display. *Orthodontic Research Projects*, 1-18.
- [18] Kumari, L., & Das, A. (2017). Determination of Tweed's cephalometric norms in Bengali population. *European journal of dentistry*, 11(03), 305-310. https://doi.org/10.4103/ejd.ejd_274_16
- [19] Kuramae, M., de Araujo Magnani, M. B. B., Nouer, D. F., Ambrosano, G. M. B., & Inoue, R. C. (2016). Analysis of Tweed's Facial Triangle in Black Brazilian youngsters with normal occlusion. *Brazilian Journal of Oral Sciences*, 8(3), 401-403.
- [20] Marchenko, A. V., Shinkaruk-Dykovytska, M. M., Pozur, T. P., Gunas, V. I., & Orlovskiy, V. O. (2020). Models of individual linear dimensions necessary for the construction of the correct form of dental arches in young men with a wide face, depending on the features of odontometric and cephalometric indicators. *Wiadomosci lekarskie* (Warsaw, Poland: 1960), 73(6), 1103-1107. PMID: 32723934
- [21] Meza, R. S., & Aguilar, G. (2019). Cephalometric differences between facial height and divergence in orthodontic patients in a Mexican sample. *Revista Mexicana de Ortodoncia*, 7(2), 66-72.
- [22] Obamiyi, S., Wang, Z., Sommers, E., Rossouw, P. E., & Michelogiannakis, D. (2019). Overbite depth indicator and anteroposterior dysplasia indicator cephalometric norms for African Americans. *The Angle Orthodontist*, 89(6), 897-902. <https://doi.org/10.2319/021619-116.1>
- [23] Ouedraogo, Y., Benyahia, H., Diouf, J. S., Camara, T., Bationo, R., & Ngom, P. I. (2019). Cephalometric norms of a Burkina Faso population. *International orthodontics*, 17(1), 136-142. <https://doi.org/10.1016/j.ortho.2019.01.002>
- [24] Perovi?, T., & Blazej, Z. (2018). Male and female characteristics of facial soft tissue thickness in different orthodontic malocclusions evaluated by cephalometric radiography. *Medical science monitor: international medical journal of experimental and clinical research*, 24, 3415-3424. <https://doi.org/10.12659/MSM.907485>
- [25] Prokopenko, O. S., Beliaiev, E. V., Dmitriev, M. O., Cherkasova, O. V., & Skoruk, R. V. (2020). Features of cephalometric parameters, which usually do not change during surgery and orthodontic interventions, in Ukrainian young men and women with orthognathic occlusion and different types and profiles of the face according to Schwarz AM. *Reports of Morphology*, 26(3), 37-45. [https://doi.org/10.31393/morphology-journal-2020-26\(3\)-05](https://doi.org/10.31393/morphology-journal-2020-26(3)-05)
- [26] Roy, A. S., Tandon, P., Chandna, A. K., Sharma, V. P., Nagar, A., & Singh, G. P. (2012). Jaw morphology and vertical facial types: a cephalometric appraisal. *Journal of Orofacial Research*, 131-138.
- [27] Sadry, S., & Ok, U. (2019). An evaluation of the relation between the maxillary third molars and facial proportions using cephalometric image. *Journal of Oral and Maxillofacial Radiology*, 7(3), 49-54. https://doi.org/10.4103/jomr.jomr_24_19
- [28] Shahba'a, A., Nissan, L. M., Ahmed, H. M., & Nahidh, M. (2018). Sagittal lips' positions in different facial types. *Journal of Research in Medical and Dental Science*, 6(1), 16-21. <https://doi.org/10.24896/jrmds.2018614>
- [29] Singh, V. P., & Sharma, A. (2014). Epidemiology of Malocclusion and Assessment of Orthodontic Treatment Need for Nepalese Children. *International scholarly research notices*, 2014, 768357. <https://doi.org/10.1155/2014/768357>
- [30] Sobon, J. S., Cherkasova, O. V., Gunas, V. I., Babych, L. V., & Kotsyura, O. O. (2020). Correlations of linear sizes of molars with cephalometric indicators of practically healthy men of the southern region of Ukraine. *Biomedical and Biosocial Anthropology*, (38), 36-46. <https://doi.org/10.31393/bba38-2020-06>

МЕТОДИ ЦЕФАЛОМЕТРИЧНОГО АНАЛІЗУ ЗА BURSTONE С. J., TWEED С. H. ТА КІМ Y. H.: МОЖЛИВОСТІ, ПЕРСПЕКТИВИ ТА ПРОБЛЕМИ ВИКОРИСТАННЯ В УКРАЇНІ

Нестеренко Є. А.

Анотація. Підвищена увага до методик цефалометричного аналізу з боку стоматологів в Україні вимагає більш детального ознайомлення з ними для розуміння як переваг, так і недоліків кожної з них. Мета дослідження - провести аналіз літературних джерел щодо можливостей, перспектив та проблем використання методів цефалометричного аналізу за Burstone, Tweed та Kim в Україні. Проведений аналіз найбільш актуальних наукометричних баз даних за період останніх 10 років показав, що неможливо однозначно говорити про переважання одного методу над іншим. Проте, з огляду на дані міжнародних дослідників, для ефективного впровадження певного цефалометричного методу аналізу бокових телерентгенограм, попередньо необхідно проведення дослідження на місцевій популяції осіб, з урахуванням таких їх особливостей як вік, стать, особливості будови обличчя, що досі не виконано в Україні.

Ключові слова: методи Burstone, Tweed та Kim, телерентгенографія.