RICKETTS CEPHALOMETRIC METHOD IN ORTHODONTIC DIAGNOSIS

Brotskyi N. O.
National Pirogov Memorial Medical University, Vinnytsya (Pyrogov street 56, Vinnytsia, Ukraine, 21018)

Annotation. Cephalometric techniques are key tools in orthodontic diagnosis, planning and evaluation of treatment results. The Ricketts method is important because of its accuracy and reliability. Features of the approach to the analysis of craniofacial structures require detailed analysis to optimize the choice of this method depending on specific clinical situations. In this regard, there is a need for a review of new literary sources related to this topic, as it provides a systematic review of the specified technique, which will help orthodontists to improve the efficiency of diagnosis and treatment of patients. The purpose of the study is to evaluate the achievements of the Ricketts cephalometric analysis method in the conditions of modern orthodontic practice. An analysis of literary sources was carried out using the PRISMA principle in order to select scientometric sources from the Google Scholar, Scopus, Web of Science databases. Out of 77 publications found according to the criteria, 20 were selected for the review. The technique of cephalometric analysis according to Ricketts is an important tool in orthodontic diagnostics, which allows for accurate and comprehensive analysis of craniofacial structures. Thanks to its unique parameters and measurements, this technique provides an opportunity to assess the patient’s condition in detail, predict treatment results and develop effective orthodontic plans. The practical application of the Ricketts technique in clinical practice confirms its effectiveness in various orthodontic cases, including complex diagnostic situations. However, to ensure the maximum accuracy of the results, it is important to follow the technical recommendations for performing measurements and use modern equipment. Scientific research and experience in the practical application of the Ricketts method testify to its reliability and usefulness in orthodontic diagnostics. The Ricketts technique is an integral part of modern orthodontic practice, helping to improve the efficiency of diagnosis and treatment of patients with craniofacial anomalies. At the same time, a strong dependence of the method on such parameters as ethnicity, age, gender, and face type was revealed. Thus, further research is necessary for the full integration of the cephalometric analysis method into the practice of Ukrainian orthodontists.

Keywords: cephalometric analysis according to Ricketts, orthodontics, sex, age.

Introduction
Dental anomalies are a common orthodontic problem, which include bite pathologies such as crowded teeth, spaces, overbites, underbites, crossbites, openbites, presence of additional teeth, congenital absence of a tooth. The cause of these anomalies is a complex combination of etiological factors, including hereditary and environmental factors. The prevalence of malocclusion varies considerably and is estimated to range from 39 % to 93 % among children and adolescents. Class I is the most common, followed by classes II and III. Crowding of teeth is common - 84 %, as well as widening of the spaces between teeth - 60 %. Significant differences in the prevalence of different types of malocclusion among different populations also indicate the importance of genetic and environmental influences specific to each population [6].

A meta-analysis of literature sources regarding the prevalence of orthodontic pathologies in Saudi Arabia showed that abnormal distal bite was observed in 12.5 % of children, 35.49 % had excessive deep bite, and the remaining 8.03 % had reduced deep bite. The prevalence of anterior crossbite in the permanent dentition was 6.25 %, deep bite was found in 22.15 %, crowding was 36.78 %, and buccal crossbite was 16.41 %. The prevalence of scissor bite in the mixed/permanent dentition was 1.23 %, and increased spaces between the teeth was 24.99 % [2].

A survey of the Finnish population revealed that 39.5 % of those surveyed had at least one sign of malocclusion. Lateral crossbite was found in 17.9 % of the population. In men, crossbite on the left premolars, reduced bite and overbite were more often detected [17].

A study evaluating non-Hispanic whites, non-Hispanic blacks, and Mexican Americans in three age groups - 17-26, 27-36, and 37-46 - found that the prevalence of clinically significant mandibular misalignment, overjet, and deep overbite increased significantly with age, while the posterior crossbite decreased. Males had a significantly higher prevalence of clinically significant mandibular misalignment, deep bite, open bite, and reverse protrusion compared to females [4].

Examination of a sample of 473 individuals revealed that 16.7 % of them had at least 1 dental and jaw development anomaly. Hypodontia was found in 7.2 %, microdontia in 2.5 %. Hypodontia and microdontia are more common in women than in men, while hyperdontia and macrodontia are more common in men [12].

Considering the prevalence of orthodontic anomalies, doctors were interested in finding methods for planning and predicting treatment measures. Cephalometric analysis became one of such methods that became widely used among orthodontists. The era of cephalometry began in 1931 with the creation of a cephalostat. However, the real breakthrough occurred closer to the 1960s, when cephalometric radiography was proposed [30].
Ricketts proposed in 1957 his own method of cephalometric analysis, which consisted in using a line from point A to Pog, as the so-called “compensation line” and connected the incisal edge of the lower incisor to this line. By aligning the incisal edge with this line, he automatically introduced a certain compensation of the teeth [23]. This method provides identification of the structures of the facial skeleton, thus classifying the biotype of each patient's face. Ricketts cephalometry is of great importance in orthodontics, providing information that helps to predict facial growth data that affect the occlusion of each patient - to correlate the maturation of bony and/or dental structures with facial parameters [24].

Currently, there are ongoing discussions about whether 3D cephalometric technologies can replace classical 2D methods. A. Heil et al. [14] established a high level of agreement between the two methods, the range was from -0.66 to 0.61 mm (0.06±0.44) for distances and from -1.33 to 1.14° (0.06±0.71) for angles. With the exception of the incisal angle (p=0.17), all measurements were statistically equivalent (p<0.05).

Also, scientific and technical progress has made it possible to create automatic programs that can independently measure cephalometric angular and linear indicators, the accuracy of which is in no way inferior to manual measurement [22].

Analysis of 968 publications regarding the determination of the importance of the role of cephalometry in planning orthodontic treatment did not reveal convincing evidence for or against the use of this method in the field of orthodontics. The author of the study notes that for the final solution of this issue, more studies with significant samples of subjects are needed [11]. In addition, the question of how ethnicity, age, and sex affect changes in cephalometric indicators remains open.

The purpose of the study is to evaluate the achievements of the Ricketts cephalometric analysis method in the conditions of modern orthodontic practice.

Materials and methods

The analysis of scientific sources for the last 10 years was carried out using the scientometric databases of Google Scholar, Scopus, Web of Science. The search was carried out using keywords both individually and in combinations: "odontological pathology", "cephalometric analysis", "orthodontics", "sex", "age". The review included articles that met such criteria as: the presence of a review process in the journal (criterion 1), a representative sample of the study (criterion 2), statistical processing of the results (criterion 3). Of the 77 publications found, 20 were included in the review.

PRISMA was used for organization and the PRISMA flow diagram for visualization of the process of selecting publications for review of literary sources in accordance with international standards for writing review articles [13].

Results. Discussion

A. V. Chernysh constructed regression models of teleroentgenographic indicators according to the Ricketts method in Ukrainians with a harmonious face type. In the construction of the models, such indicators as the distances Go-CF, Xi-Pm, 6l-6i, Overjet, Overbite, 6u-PTV, 1l-APog, 1u-APog and Xi-OcP, as well as the angle Max1-APog [8] were used.

Compared with normative indicators, representatives of the Ukrainian population showed higher values of Mand1-APog angle, smaller values of the angle Max1-APog, ANS-Xi-PM, larger values of the distance Xi-OcP, larger values of the angles NBa-PIg and POr-NBa, smaller values of the angle NPog -POr, POr-SpP, POr-NBa and NPog-POr, larger values of P-PTV distance and smaller values of NCC distance, POr-CFXi angle, higher values of MeGo-NPogangle [10].

Analysis of Ricketts cephalometric indicators in 126 Malays aged 19 to 40 years revealed that representatives of this nationality compared to Caucasians have a more prominent upper and lower lips to the E line [19].

Indian researchers found that patients from a clinic in Hyderabad had mean ANB angle, S-line to upper lip, S-line to lower lip and E-line to upper lip were 1.167±0.028 mm, 1.067±1.006 mm, 1.917±1.369 mm and 3.2±1.96 mm, respectively, in patients with class I dental and skeletal occlusion. And the anterior-posterior position of the lower and upper lips relative to the E-line was 2.80+2.83 mm and 3.2+1.96 mm, respectively [26].

Examination of representatives of Nepali ethnicity showed that women had higher mean values of facial axis, mandibular plane angle, mandibular arch and convexity at point A compared to men; at the same time, men had higher values of the height of the lower part of the face, the distance from the lower incisor to the A Pog line, the angle between the lower incisor and the A Pog line, the distance from the upper molar to the PTV, and the distance from the lower lip to the E plane [28].

Manifestations of sexual dimorphism in the analysis of cephalometric parameters according to Ricketts were also found in the Saudi sample. The value of U6 to Ptv was significantly greater (p<0.001) in Saudi men than in women. Meanwhile, the values of L1 to A-Pog and lower lip to plane E were significantly greater (p<0.05) in Saudi men than in women [29].

The 12 factors of the Ricketts analysis were used to evaluate the effectiveness of the treatment of mandibular insufficiency with a mandibular advancement device. Significant changes were revealed in the retrusion and palatal inclination of the upper incisors (p=0.000), protrusion and buccal inclination of the lower incisors (p=0.000), an increase in the incisor angle (p=0.002), an improvement in the ratio of molars (p=0.003), a decrease in the angle of the mandibular plane (p=0.024) and lower lip protrusions (p=0.000), which confirmed the effectiveness of the selected treatment method [7].
The effect of removal of 4 premolars on changes in Ricketts cephalometric parameters was investigated in the Malay population. Data from the statistical analysis showed that all linear and angular measurements of changes in hard and soft tissues showed significant differences. Only the value of the angle L1 to A-pogonion (A-pog) \( p=0.05 \) did not undergo significant changes [15].

At the same time, a group of scientists led by Alroudhan I. E. analyzed 160 cephalograms of patients at the Al-Jouf University Clinic (Saudi Arabia) and did not reveal any significant differences between the indicators obtained from the local population and the normative indicators. At the same time, the presence of signs of sexual dimorphism in the studied parameters was established [3]. A similar result was obtained in a study of the Korean population of 31 individuals who were examined between the ages of 9 and 19. It was found that at such an early age, the norms laid down in the Ricketts analysis can be used for the Korean population. Other obtained data show that it is important to take into account the age and gender of the subjects [5].

Similar trends are noted in studies of other methods of cephalometric analysis. A study of 35 men and 35 women aged 18 to 28 years from South India with an acceptable profile and occlusion using Steiner analysis found that the locals had a more skeletally protruding maxilla, maxillary and mandibular teeth, which lean forward, as well as horizontal growth of the jaw compared to the norms for Caucasians. Men had more protruding skeletal and dental indicators compared to women [9].

M. M. Imani with co-authors [16] found significant differences between the Kurdish population and Caucasian norms \( p<0.05 \) in the values of: angles SNA, SNB, ANB, SND, incisal angle, GoGn-SN, L1-NB (both angular and linear measurements), SL and SE. Among Kurdish men and women, significant \( p<0.05 \) differences were observed in the values of SND, Occl-SN, GoGn-SN, U1-NA, U1-NA distance, SL and SE.

Also, significant differences with normative indicators were found when processing data received from residents of the United Arab Emirates. In the Emirati sample, a retracted lower jaw was observed (larger values of SNA and ANB and smaller values of the SNB angle, \( p<0.001 \)) than in Caucasians. A more inclined position of the upper and lower incisors according to the U1/NA and L1/NA angles, as well as a higher average MP/SN indicator \( p<0.001 \) [25] was revealed.

Standardized lateral cephalometric radiographs of 100 Bangladeshi adults, including 50 men and 50 women, were analyzed. The age of the research subjects was 18-24 years. Bangladeshi females were found to have significantly lower values of FMA, FMIA and significantly higher values of IMPA compared to males. The average values of cephalometric norms according to the Tweed method differed significantly from Caucasian norms [1]. The same data were confirmed for Bangladeshis in the study by Rizvi H. and Hossain M. [27].

Norms for the Indian Bengali population have been established according to the Tweed method. The study showed that compared to Caucasians, Bengalis have more inclined lower front teeth. Manifestations of sexual dimorphism were also revealed: the average value of the Frankfurt-mandibular angle for women was significantly higher than for men, and the average value of the angulation angle of the front teeth of the jaw for men was significantly higher than for women [18]. Peculiarities of cephalometric indicators for residents of the state of Assam, which is also located in India, were also revealed [20, 21].

**Conclusions and prospects for further development**

1. The Ricketts cephalometric technique is an important tool in the arsenal of orthodontic diagnostics, which provides accurate and reliable measurement of craniofacial structures. A review of the technique shows that it is based on a careful analysis of anatomical features and relationships between various components of the facial skeleton, which allows obtaining detailed data for planning orthodontic treatment.

Further research is needed to enhance the effectiveness and accuracy of the Ricketts methodology in various clinical scenarios. Exploring the possibility of integrating both methodologies for individuals of Ukrainian nationality, specific sex, age, and creating a combined approach, may provide a more accurate and detailed diagnosis and orthodontic treatment planning for the Ukrainian population.
References


ЦЕФАЛОМЕТРИЧНА МЕТОДИКА RICKETTS В ОРТОДОНТИЧНІЙ ДІАГНОСТИЦІ
Броцький Н. О.

Анотація. Цефалометричні методики є ключовими інструментами в ортодонтичній діагностиці, плануванні та оцінці результатів лікування. Метод Ricketts займає важливе місце завдяки своїй точності та надійності. Особливості підходу до аналізу краніофаціальних структур потребують детального аналізу для оптимізації вибору цього методу в залежності від конкретних клінічних ситуацій. У зв'язку з цим існує потреба в огляді нових літературних джерел щодо даної тематики, оскільки це надає систематизований огляд зазначеної методики, що допоможе ортодонтам підвищити ефективність діагностики та лікування пацієнтів.

Мета дослідження - оцінити досягнення методу цефалометричного аналізу за Ricketts в умовах сучасної ортодонтичної практики. Проведено аналіз літературних джерел, використовуючи принцип PRISMA, з метою відбору наукометричних джерел з баз Google Scholar, Scopus, Web of Science. З 77 знайдених публікацій відповідно до критеріїв обрано 20 для проведення огляду. Методика цефалометричного аналізу за Ricketts є важливим інструментом в ортодонтичній діагностиці, що дозволяє здійснювати точний і всебічний аналіз краніофаціальних структур. Завдяки своїм унікальним параметрам і вимірам, ця методика надає можливість детально оцінити стан пацієнта, прогнозувати результати лікування та розробляти ефективні ортодонтичні плани. Практичне застосування методики Ricketts у клінічній практиці підтверджує її ефективність у різних ортодонтичних випадках, включаючи складні діагностичні ситуації. Проте, для забезпечення максимальної точності результатів, важливо дотримуватися технічних рекомендацій щодо виконання вимірів і використовувати сучасне обладнання. Наукові дослідження та досвід практичного застосування методики Ricketts свідчать про її надійність та корисність в ортодонтичній діагностиці. Методика Ricketts є необхідною частиною сучасної ортодонтичної практики, сприяючи підвищенню ефективності діагностики та лікування пацієнтів з краніофаціальними аномаліями. Водночас виявлена сильна залежність методу від таких параметрів як етнічна принадлежність, стать, вік обличчя. Таким чином подальші дослідження необхідні для повноцінної інтеграції методу цефалометричного аналізу в практику українських ортодонтів.

Ключові слова: цефалометричний аналіз за Ricketts, ортодонтія, стать, вік.