ISSN Print: 2394-7489
ISSN Online: 2394-7497
IJADS 2023; 9(3): 195-199

www.oraljournal.com
Received: 25-05-2023
Accepted: 28-06-2023

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Cephalometric analysis by Ricketts, McNamara, Steiner and Jarabak

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DOI: https://doi.org/10.22271/oral.2023.v9.i3c.1809

Abstract
Introduction: Orthodontic diagnosis is fundamental to analysing the functional, economic, esthetic needs of each patient for a successful treatment.
Objective: To analyze the literature about the study of facial growth, morphological anomalies, malocclusions and the evaluation of the possible results of orthodontic treatment, through the analysis of Ricketts, McNamara, Steiner, Jarabak.
Methodology: PubMed, SCOPUS and Google Scholar databases were reviewed to find recent articles published on cephalometric with the following keywords "Cephalometric", "Orthodontics", "Ricketts", "McNamara", "Steiner", “Jarabak”.
Results: Cephalometric are distinguished by a specific use, and each analysis provides ideal advantages for study and diagnosis, Ricketts analyzes and predicts facial growth, McNamara uses his data for planning surgical and orthopaedic procedures, Steiner has dental, skeletal parameters and influence of band tissues and Jarabak is focused on dental alterations that may be produced by facial development. However, the main disadvantage of cephalometrics are studies obtained by means of radiographs that involve a percentage of radiation.
Conclusions: With cephalometries of we can predict and analyze facial growth data, obtain a surgical or orthopaedic approach, analyze anatomical structures with respect to the cranial base and the influence of the airways on the facial biotype.

Keywords: Cephalometrics, orthodontics, Ricketts, McNamara, Steiner, jarabak

1. Introduction
Orthodontic diagnosis is fundamental to analyze the functional, economic and esthetic needs of each patient for a successful treatment [1].
Lateral skull radiographs are used in orthodontics to evaluate the development, growth and morphometric relationships of the craniofacial and dental structures, the detailed analysis of lateral skull radiographs is called cephalometry [2]. These are made up of a series of anatomical points, lines and angles that provide specific data that classify, predict, and inform the patient's condition [3]. The cephalometric analysis serves as a fixed and unique parameter for the examination of an individual and in determining the diagnosis and planning of orthodontic treatment [4].
Facial type is a determining factor in selecting the most appropriate orthodontic treatment plan to follow, also known as facial pattern or facial skeletal pattern [5]. Typically, the clinician uses radiographs or photographs of the patient to obtain angular, linear or proportional measurements [6]. Based on these, they are classified as: dolichofacial (long and narrow face), brachyfacial (short and wide face) and an intermediate type called mesofacial [7].
The correct orthodontic evaluation is fundamental for the beginning of a treatment, so it is of utmost importance that the clinician knows the different types of cephalometries, with their main characteristics, advantages and disadvantages, in order to know how to select the best diagnostic method, which guarantees a successful treatment.

In this work we analyzed the literature on the study of facial growth, morphological anomalies, malocclusions and the evaluation of the possible results of orthodontic treatment, through the analysis of Ricketts, McNamara, Steiner and Jarabak.

2. Materials and Methods

Articles on the subject published through the PubMed, SCOPUS and Google Scholar databases were analyzed, with emphasis on the last 5 years. The quality of the articles was evaluated using guidelines, i.e., identification, review, choice and inclusion. The quality of the reviews was assessed using the measurement tool for evaluating systematic reviews. The search was performed using Boolean logical operators AND, OR and NOT, with the keywords: Cephalometrics, Orthodontics, Ricketts, McNamara, Steiner, Jarabak.

3. Results and Discussion

3.1 Ricketts Lateral Cephalometry

Ricketts' cephalometric analysis (VERT index) is the representation of traces of cephalometric points that provide specific measurements. With this study we can identify the facial skeletal pattern, thus classifying the facial biotype of each patient [5].

The literature describes factors to be considered within this cephalometric study, each dentist selects the factors to be analyzed, according to the information and approach he/she wishes to obtain [5].

Ricketts's analysis provides references of the direction of chin growth, predict or classify a skeletal open bite, deep vertical overbite, skeletal class II and III classification, jaw shape among many more data [8]. Nowadays having a cephalometric study of which we can have so much specification helps research to classify patients and obtain scientific advances. With the help of the classification given by Ricketts, it has been proven that the posterior tongue pressure influences the facial type, nasal septum deviation is related to class III malocclusion and hypertrophy of inferior turbinates and tonsils is common in patients with a more elongated face (dolichofacial) [7-9].

With Ricketts cephalometry it has been possible to demonstrate the correlation of anatomical and/or dental structures with the facial biotype, in dolichofacial patients it is common to find the greater palatal foramen more distant from the palatal crest with respect to the distance found in other facial biotypes (Lacera) [10]. Likewise, facial patterns are a significant sign for the maturation stage of the midpalatal suture [11].

Ectopic eruption of the bilateral lower permanent first molar plays a crucial role in palatal plane values and a more posterior position of the upper incisor altering the facial biotype [12].

Ricketts shows that facial parameters (facial axis, lower facial height and mandibular plane angle) proved to be strong predictors of third molar agenesis risk, with the prevalence of agenesis being significantly lower in dolichofacial individuals [13].

The vertical dimension of the maxillary alveolar ridge in edentulous patients appears to be closely related to lower jaw morphology [14].

We can conclude that Ricketts cephalometry is of great importance in orthodontics, providing information that helps us to predict facial growth data that influence the occlusion of each patient. Currently, this analysis allows us to correlate the maturation of bone and/or dental structures with facial parameters. With this it is possible to reach an accurate diagnosis and a correct methodological treatment plan according to the patient's needs, which is not limited to dental structures.

3.2 McNamara Cephalometry

McNamara cephalometry is a method widely used in orthodontics [15], it evaluates skeletal discrepancy lines and helps in the diagnosis and planning of orthopaedic or surgical cases, which gives it an advantage over other analyses [5]. The study depends on lines and not angles which facilitates the orthopaedic study, it analyzes the sagittal and vertical intermaxillary relationship. The approach makes the actual analysis most suitable for diagnosis, treatment planning and treatment evaluation, not only for conventional orthodontic patients but also for patients with skeletal discrepancies who are candidates for dentofacial orthopaedics and orthognathic surgery [16].

The variables analyzed by McNamara range from cephalometric points in the jaws to the skull base, locating dental and skeletal discrepancies in each patient.

McNamara proposed an airway analysis to evaluate the widths of the upper and lower pharyngeal airways [17], facilitating the study of these in a superficial manner [18], a tendency to smaller airway dimensions has been observed in younger patients with female gender of skeletal class II [19].

The McNamara measurement is obtained by analyzing the position and morphology of the structures of the facial skeleton looking for a relationship between the upper and lower jaw with respect to the base of the skull, evaluating the intermaxillary relationship with the vertical dimension, its main purpose is to obtain differences between the skeletal and dento-alveolar components using the triangle called with the same name [5, 18]. The identification of protruded maxilla is evident through this analysis [20].

As there is diversity in craniofacial structures among children of different populations, different ethnic origins and different age groups, studies are performed with McNamara's cephalometric values [21], where it has been determined that white-Brazilians, Japanese and Japanese-Brazilians have different cephalometric characteristics. Japanese males have a significantly sharper nasolabial angle than white-Brazilian subjects [5]. The authors consider the McNamara technique to be of greater and more immediate clinical value compared to other cephalometrics [22].

The McNamara analysis provides a comparison between the intermaxillary relationship and the vertical dimension, providing data in the sagittal and vertical plane which leads to different applications in dentistry. The use of this cephalometric has a simpler system of lines, unlike others, giving a more medical, orthopaedic and surgical approach.

3.3 Steiner Cephalometry

Steiner measurement includes dental, skeletal and soft tissue parameters. This facilitates the study of the function, conformation and aesthetics of each patient, seeking treatment with the aim of facial harmony [23].

Steiner analysis from images obtained from cone beam computed tomography is one of the essential tools today for diagnosis in the area of orthodontics, within this aspect, its high value for the study of points, angles and cephalometric planes allows the prediction of the possible treatment plan for each patient according to the characteristics [23]. The analysis is performed in second dimension and shows no significant differences in the application of a third dimension [24].

The analysis helps us to identify the relationship between sagittal skeletal nasal profile morphology and malocclusions where skeletal class 3 individuals have longer nasal linear parameters than skeletal class 1 and skeletal class 2 individuals [24].

However, there is a correlation in the traditional Steiner skeletal and dental measurements with similar measurements in ocular distance and natural head position, this represents a disadvantage for Steiner as the clinician can obtain measurements without the need for Radiation [25]. On the other hand, Harvold's analysis is significantly more effective in locating the sagittal maxillary and mandibular position than Steiner's analysis [26]. Despite its disadvantages, there are different applications that Steiner cephalometry has had, where the knowledge gained about the pubertal growth period is longer in Class III patients than in Class III patients [27], the simultaneous validity and reliability of cephalometric analysis using smartphone applications and computer software [28], and the skeletal pattern in class III males, dental development is faster than in class I and II skeletal pattern [29], where we found differences between males and females especially with lower facial height and lip thickness [30].

Through these studies we can complement a diagnosis that goes beyond the dental or bone study of each patient, highlighting that Steiner seeks to analyze dental, skeletal and soft tissue parameters when analyzing the facial structure.

3.4 Jarabak Cephalometry

This analysis determines the facial biotype (mesofacial, brachial facial or dolichofacial) by the Björk-Jarabak polygon, which has the purpose of analyzing the affectation of the dentition by facial growth before and after treatment [31].

It has been used to compare facial variations in shape and size as a function of age, sex and race where it mainly considers vertical intermaxillary relationships and uses the cranial base as a reference [32]. The analysis uses the linear and angular values standardized by Björk Jarabak [33], using points on anatomical structures and articular surfaces [34]. With it, we can identify how different skeletal patterns show their characteristics in the smile and which length of the upper lip is not responsible for the increased incisal display during smiling. Increased incisal display during smiling is more closely associated with upper lip elevation than with vertical skeletal and dental factors [35].

Class II malocclusions have been shown to interfere in upper airway measurements with decreased and increased values in Class I patients [36-37], decreased respiratory patency decreases the growth process [38], and during the physiological growth process Class II malocclusion has specific cephalometric characteristics: lower central incisors have accentuated retroclination, the interincisal angle is very obtuse, the gonial angle shows lower values than normal towards the end of the growth period [39-40].

Jarabak analyzes the changes or alterations that occur in the dentition due to facial development, facilitating the study of the different characteristics, and skeletal patterns, and even implements the measurement of the airways that complement the orthodontic diagnosis.

4. Conclusions

A cephalometric analysis is an element for the diagnosis and study of each patient, which thanks to its different approaches and variables reveals information that goes beyond a dental analysis. With cephalometrics we can predict and analyze facial growth data, obtain a surgical or orthopaedic approach, analyze anatomical structures with respect to the cranial base and the influence of the airways on the facial biotype, however, the use of these involves minimal radiation exposure to the patient.

5. Conflict of Interest

Not available

6. Financial Support

Not available

7. References

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How to Cite This Article
Ontiveros PO, Najera RIS, Garza HV, Alanis HFM, Lozano AS, Ancona MSB, *et al*. Cephalometric analysis by Ricketts, McNamara, Steiner and Jarabak. International Journal of Applied Dental Sciences. 2023;9(3):195-199.