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Cephalometric analysis in pediatric Dentistry: A scoping review

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Abstract
Introduction: Pediatric dentists are constantly confronted with patients who present dental malocclusions, however the necessary information to personalize treatment is not always available.
Objective: To analyze the different cephalometric analyses in pediatric dentistry such as Steiner, Ricketts, Downs, McNamara, Björk-Jarabak and Tweed.
Methodology: A search strategy was carried out in PubMed, Scopus and Google Scholar databases, using a combination of keywords including: "cephalometric Steiner", "cephalometric Ricketts", "cephalometric Downs", "cephalometric McNamara", "cephalometric Björk-Jarabak"; "cephalometric Tweed".
Results: Steiner yields measurements for the anteroposterior evaluation of the jaws, however, it is limited to the vertical evaluation. Ricketts evaluates dental relationships, skeletal, vertical dimensions and facial esthetics, however, a more complex preparation is required for its use. Downs evaluates anteroposterior relationships between the maxillae and mandible; however, it may limit the comprehensive evaluation of malocclusions. McNamara studies anteroposterior as well as vertical relationships but his study is limited to the three-dimensional. Björk-Jarabak relies on measurements in relation to the patient's facial growth pattern, but fails to take anterior angulation into account. Tweed considers facial esthetics by analyzing the relationship between the soft tissues and the position of the lips in relation to the teeth, but is limited to a two-dimensional study.
Conclusions: After analyzing the literature, it was concluded that the best analysis to use is Steiner's as his measurements are more focused on detecting craniofacial and dental defects and the results are more accurate considering soft and hard tissue.

Keywords: Cephalometry, orthopedics, malocclusion, Steiner, Ricketts, downs, Mcnamara, Björk-Jarabak, tweed

Introduction

In the field of pediatric dentistry, we are constantly immersed in studies related to dental malocclusions, which raises questions about the available cephalometric analyses and which one would be the most suitable for each patient [1]. Delving into each of these perspectives not only allows us to understand the wide range of options available, but also equips us with the ability to discern when and how to skillfully apply these tools in the practice of dentofacial orthopedics [2]. In this critical review, we will explore the advantages and disadvantages of these approaches, unraveling their goals to illustrate the path to more informed and effective orthopedics [3].

A current analysis of the literature allows us to detect that a systematic review on the different cephalometric analyses currently available is necessary in order to know them more thoroughly and to be able to have the necessary knowledge in consultation of what type of analysis is required according to the needs of each patient. The objective of this work was to investigate the current literature on the most common cephalometric analyses used in dentistry today, such as the Steiner, Ricketts, Downs, McNamara, Björk-Jarabak and Tweed analyses, studying their advantages, disadvantages and objectives.

2. Materials and Methods

An electronic search was carried out through PubMed, Google Scholar and Scopus, using the terms: cephalometric analysis; sagittal discrepancy; vertical discrepancy; cephalometric analysis; cephalometric Steiner, cephalometric Ricketts, cephalometric Downs, cephalometric McNamara, cephalometric Björk-Jarabak; cephalometric Tweed; sagittal discrepancy; vertical discrepancy, using Boolean operators "AND" and "OR". The quality of the articles was evaluated using guidelines tool. As inclusion criteria, only articles from high impact journals were collected, including systematic reviews, literature reviews or clinical studies that treated in behavior management techniques. Likewise, the search was delimited in terms of publication date, taking only recent articles, published mainly within the last 5 years. The selection of articles was made according to the relevance of the title and/or abstract to the topic to be analyzed. After the selection of relevant studies, their references were searched for possible additional relevant studies that met the inclusion criteria.

3. Results

3.1 Steiner analysis

3.1.1 Advantages: It stands out for its ability to provide accurate measurements for the anteroposterior evaluation of the jaws [4], it is also recognized for its clarity and reproducibility, which guarantees consistent results in the cephalometric evaluation of the patient [5]. It is effective for the diagnosis of class I, II and III malocclusions, both skeletal and dental, which allows an accurate classification of dentofacial discrepancies. Finally, it addresses esthetic aspects by evaluating the position of the incisors [6].

3.1.2 Disadvantages: It has a limitation in vertical assessment and may be sensitive to individual variability [7]. It does not comprehensively address muscular factors or fully consider craniofacial complexity in three dimensions [8]. Its relatively rigid approach and reliance on specific cephalometric points are aspects that may affect the flexibility of the analysis [1]. Although Steiner's analysis has limitations, its value in orthodontics is not diminished. In fact, its usefulness is maximized when combined with other clinical approaches and assessments, allowing for a comprehensive and personalized perspective for diagnosis and treatment planning [9].

3.1.3 Purpose: To evaluate the position of the jaws and mandible in relation to the skull base. To provide measurements that contribute to the diagnosis of malocclusions and orthodontic treatment planning [2].

Steiner's cephalometric analysis is noted for its ability to provide an accurate assessment of the anteroposterior relationship of the maxillae and mandible, thus contributing to orthodontic diagnosis and treatment planning. However, it has some limitations, such as its limited ability to assess the vertical dimension and its susceptibility to individual variability. Despite these limitations, its comprehensive approach and direct clinical applicability make it a valuable tool. Taken together, the advantages and disadvantages highlight the importance of using Steiner analysis as part of a comprehensive evaluation, considering other clinical tools and assessments to gain a more holistic and personalized perspective of orthodontic treatment.

3.2 Ricketts analysis

3.2.1 Advantages: It addresses a wide range of aspects, including dental and skeletal relationships, vertical dimensions and facial esthetics, thus providing a detailed and comprehensive assessment [10].

A particularly advantageous aspect is its consideration of facial esthetics, as it incorporates specific measurements to assess soft tissue harmony and lip position, allowing for treatment planning focused on achieving favorable esthetic results [11].

In addition, Ricketts analysis takes into account muscle function, examining the relationship between orofacial muscles and bony structures, which helps to optimize the long-term stability of the treatment [12].

Its adaptability to different types of malocclusions, the use of specific measurements and the reproducibility in measurements are features that reinforce its clinical usefulness, providing guidance for the planning of personalized and esthetically satisfactory orthodontic treatments [13].

3.2.2 Disadvantages: Due to its detailed and complex approach it may require more time and experience to implement and fully understand, which could be challenging for some practitioners. In addition, accurate identification of anatomical points is crucial, and errors in this process may affect the accuracy of measurements [14]. Subjectivity in the interpretation of certain measurements, especially those related to facial esthetics, could limit reproducibility and lead to different interpretations among practitioners. Despite being adaptable to various malocclusions, some critics argue that its approach may not be universally applicable and may not address all anatomical variations [15]. Furthermore, by focusing predominantly on craniofacial aspects, Ricketts' analysis may lack a detailed assessment of tooth position and relationship, limiting its ability to address some specific aspects of dental malocclusions [10].

3.2.3 Purpose: Developed by Robert M. Ricketts, this analysis evaluates the relationship of facial and dental structures in terms of facial harmony [16]. It uses specific cephalometric points and angular measurements to analyze the position and proportion of facial and dental components [3].

Ricketts' cephalometric analysis is notable for its comprehensive approach that addresses skeletal, dental, and esthetic aspects in orthodontic evaluation. Its advantages include consideration of facial esthetics, assessment of muscle function, and its good adaptability to various malocclusions. However, it presents some challenges, such as its complexity and the possibility of subjectivity in certain measurements. The lack of a detailed assessment of tooth position and the need for specific radiographs are important considerations. Despite these disadvantages, the Ricketts analysis fulfills its goal of orthodontic treatment planning by providing a comprehensive assessment that considers both esthetic and functional aspects, allowing for optimized patient outcomes.

3.3 Downs Analysis

3.3.1 Advantages: Its approach focuses on specific craniofacial measurements, such as S-N-A, S-N-B, and A-B-Pog angles, thus providing a detailed assessment of the anteroposterior relationships between the maxillae and mandible [17].

This analysis also incorporates measurements that evaluate the relationship of the bony bases and skull base length (S-N), which contributes to a complete understanding of

malocclusions and facilitates orthodontic treatment planning [18]. In addition, Downs analysis is based on clearly defined anatomical references, which improves reproducibility and consistency in the interpretation of cephalometric radiographs [19].

3.3.2 Disadvantages: Although its focus on specific measurements is detailed, it may limit the comprehensive evaluation of malocclusions by focusing on the anteroposterior relationships between the maxillae and mandible. In addition, the simplification of the analysis may not address all the anatomical and functional complexities present in each clinical case [20]. Another limitation lies in its dependence on specific cephalometric points, which makes it susceptible to errors in the identification of these points, and which may affect the accuracy of the measurements. The interpretation of certain angles and measurements can also be subjective, which could lead to variations in assessment between practitioners [21]. Taken together, these disadvantages highlight the importance of considering Downs analysis as a complementary tool in conjunction with clinical evaluation and other approaches to obtain a more complete and accurate diagnosis [22].

3.3.3 Purpose: Proposed by William Downs, this analysis focuses on the evaluation of the relationship between the maxillae and the mandible, as well as the position of the teeth in relation to the skull base [23]. It is used to diagnose malocclusions and plan orthodontic treatments [24].
Its focus on specific measurements, although detailed, may limit the comprehensive evaluation of malocclusions by focusing on the anteroposterior relationships between the maxillae and mandible. In addition, the simplification of the analysis may not address all the anatomical and functional complexities present in each clinical case. Another limitation lies in its dependence on specific cephalometric points, and errors in the identification of these points may affect the accuracy of the measurements. The interpretation of certain angles and measurements can also be subjective, which could lead to variations in assessment between practitioners.

3.4 McNamara Analysis

3.4.1 Advantages: The McNamara analysis provides a comprehensive view of malocclusion. It excels in providing a comprehensive and detailed evaluation of malocclusions in orthodontics, addressing both anteroposterior and vertical maxillary-jaw relationships [25]. Its multifaceted approach considers facial and dental factors, including the position of incisors and molars, as well as morphologic and functional measurements, such as the Goniac Angle. In this way, patients are classified into three cephalometric patterns, which facilitates understanding and communication of the malocclusion present. McNamara also evaluates the facial soft tissues, thus contributing to more esthetic treatment planning [26]. In addition, it establishes specific treatment goals and uses standardized measurements, improving consistency and reproducibility in the interpretation of cephalometric radiographs.
Its applicability in growing patients allows its use in early diagnosis and preventive interventions [27].

3.4.2 Disadvantages: Due to the complexity in performing the analysis it may require a specific level of skill and experience, which could limit its applicability to professionals with specialized training [28].
The need to perform lateral skull radiographs raises concerns regarding additional radiation exposure, especially in young patients. Although the analysis focuses on three-dimensional measurements, its frontal assessment is limited, which could affect the complete understanding of malocclusion [29]. Subjective interpretation of the results and variability in the identification of anatomical points could affect the consistency between practitioners in the interpretation of the results [30].

3.4.3 Purpose: Developed by John A. McNamara, this analysis evaluates maxillary and mandibular relationships, as well as the position of teeth in relation to facial structures [31]. It provides measures for the diagnosis of skeletal and dental problems [32].
McNamara analysis is a comprehensive tool in orthodontics with several advantages, including its detailed focus on anteroposterior and vertical relationships, consideration of facial and dental factors, and classification into cephalometric patterns. It facilitates targeted treatment planning by establishing standardized parameters for consistent interpretation. However, it has disadvantages, such as interpretative complexity, limitation in three-dimensional evaluation, dependence on precise anatomical points and subjectivity in esthetic measurements. The lack of detailed assessment of muscle function and possible limitations in its universal adaptability should also be considered. Despite these limitations, this analysis remains a valuable tool that, when used prudently and supplemented with additional clinical assessments, contributes significantly to planning and diagnosis.

3.5 Björk-Jarabak analysis

3.5.1 Advantages: It stands out in orthodontic evaluation because of its individualized and dynamic approach to morphometric analysis. By focusing on the unique anatomical characteristics of each patient, this analysis allows for a more personalized assessment of malocclusion [33]. Its consideration of facial growth over time provides a dynamic perspective, especially by relying on measurements in relation to the patient's facial growth pattern. The stability in the measurements, by relating them to craniofacial basal structures, contributes to more reliable measurements [34]. In addition, Björk-Jarabak's analysis addresses the three-dimensional dimension, improving the understanding of the position and relationship of craniofacial structures. With its specific focus on posterior facial growth, the analysis provides detailed information on the position of the mandible in relation to the skull base [24].

3.5.2 Disadvantages: The complexity in performing the analysis may require a specific level of skill and experience, which could limit its applicability to practitioners with specialized training. The need for lateral skull radiographs raises concerns regarding additional radiation exposure, especially in young patients [35]. Although the analysis focuses on three-dimensional measurements, its frontal assessment is limited, which could affect the complete understanding of malocclusion.
Subjective interpretation of the results and variability in the identification of anatomical points could affect the consistency among practitioners in interpreting the results [36]. In addition, the primary focus on the posterior mandible could limit the information provided on other areas of orthodontic interest, such as facial esthetics and anterior tooth position [37].

3.5.3 Purpose: To evaluate the relationship of facial and skeletal growth over time [38]. It uses specific cephalometric lines and points to analyze facial development in relation to the overall growth of the individual [39].

Björk-Jarabak analysis is a valuable tool in orthodontics, especially for its individualized and dynamic approach to morphometric assessment of craniofacial growth. Its advantages include personalized consideration of anatomical features, stable measurements in relation to craniofacial basal structures, and the ability to assess changes in growth pattern over time. However, disadvantages, such as complexity in performance, the need for specific radiographs, limitations in frontal assessment and subjective interpretation of results, highlight the importance of using this tool carefully and complementing it with other diagnostic techniques. Although the analysis focuses on posterior facial growth, its application requires a holistic approach by considering additional aspects of malocclusion and dentofacial anatomy.

3.6 Tweed analysis

3.6.1 Advantages: It is notable for its detailed focus on dento-skeletal relationships, providing valuable information for evaluation and treatment planning. Its emphasis on accurate and reproducible measurements, using clearly defined cephalometric points, contributes to a reliable assessment of dental and skeletal characteristics [40]. In addition to guiding orthodontic treatment planning by setting specific goals for the ideal position of teeth and bony bases, Tweed also considers facial aesthetics by analyzing the relationship between soft tissues and the position of the lips in relation to the teeth. Its ability to identify potential orthodontic problems early and its applicability to different types of malocclusions make it a versatile tool [41].

3.6.2 Disadvantages: Its predominantly two-dimensional approach may limit the three-dimensional evaluation of facial and dental structures, providing a simplified representation [42]. Facial soft tissue assessment, although considered, may not be as comprehensive compared to specific approaches in this regard. Accurate interpretation of the analysis requires experience in identifying cephalometric points, and errors in this process could affect the accuracy of the measurements [43]. Furthermore, by focusing on dento-skeletal relationships and esthetics, Tweed does not comprehensively address functional aspects such as occlusion and muscle function [44].

3.6.3 Purpose: Developed by Charles H. Tweed, it focuses on the evaluation of the anteroposterior position of the teeth in relation to the skull base [45]. It helps in the diagnosis of malocclusions and guides orthodontic treatment planning [46].

It is notable for its emphasis on dento-skeletal relationships, treatment planning guidance, and clinical reliability. Its advantages include accurate and reproducible measurements, consideration of facial esthetics, and early identification of potential orthodontic problems. However, it has disadvantages such as its two-dimensional approach, limitations in soft tissue evaluation and the need for experience in identifying cephalometric points. The lack of thorough consideration of functional factors and the possible subjectivity in esthetic evaluation are also aspects to be taken into account.

4. Conclusions

After an exhaustive review of the literature, it was determined that there was a need to study the different types of cephalometry in depth in order to optimize the individual study in pediatric dentistry patients. In this sense, the methods of Steiner, Ricketts, Downs, McNamara, Björk-Jarabak and Tweed were analyzed, evaluating their advantages, disadvantages and specific objectives. Based on this analysis, it was concluded that Steiner's analysis is positioned as the most suitable method due to its ease of use, measurement accuracy and measurement approach that yields the most reliable results.

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6. Author's Contribution

Not available

7. Conflict of Interest

Not available

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9. References

1. Jha MS. Cephalometric evaluation based on Steiner's analysis on adults of Bihar. Journal of Pharmacy and Bioallied Sciences. 2021 Nov;13(Suppl 2):S1360-S1364.
2. Li B, Zhang Z, Lin X, Dong Y. Sagittal cephalometric evaluation without point nasion: Sagittal G-triangle analysis. Journal of Craniofacial Surgery. 2022 Mar-Apr 01;33(2):521-525.
3. Prameswari N, Herniyati H, Sucahyo B, Brahmanta A, Syahdinda MR. Cephalometric analysis, severity malocclusion, and orthodontic treatment need using IOTN in deaf children. European Journal of Dentistry. 2022 Jul;16(3):599-605.
4. Subramanian AK, Chen Y, Almalki A, Sivamurthy G, Kafle D. Cephalometric analysis in orthodontics using artificial intelligence: A comprehensive review. BioMed Research International. 2022 Jun 16;2022:1880113.
5. Schwendicke F, Chaurasia A, Arsiwala L, Lee JH, Elhennawy K, Jost-Brinkmann PG, *et al*. Deep learning for cephalometric landmark detection: Systematic review and meta-analysis. Clinical Oral Investigations. 2021 Jul;25(7):4299-4309.
6. Mamedov AA, Timoschenko TV, Slynko AY. Tsefalometricheskii analiz prosveta verkhnikh dykhatel'nykh putei s pomoshch'yu konusno-luchevoi komp'yuternoi tomografii [Cephalometric CBCT analysis of the upper airways]. Stomatologiia (Moskva). 2022;101(5):31-36.
7. Kotuła J, Kuc AE, Lis J, Kawala B, Sarul M. New sagittal and vertical cephalometric analysis methods: A systematic review. Diagnostics. 2022 Jul 15;12(7):1723.
8. Tanna NK, AlMuzaini AAAY, Mupparapu M. Imaging in orthodontics. Dental Clinics of North America. 2021 Jul;65(3):623-641.
9. Kiełczykowski M, Kamiński K, Perkowski K, Zadurska M, Czochrowska E. Application of artificial intelligence (AI) in a cephalometric analysis: A narrative review. Diagnostics. 2023 Aug 10;13(16):2640.
10. Özel HE, Pala Mutlu B, Özel MB. Cephalometric analysis in adults with tympanic membrane atelectasis. Cranio. 2023 Sep 21:1-7.
11. Serafin M, Baldini B, Cabitza F, Carrafiello G, Baselli G, Del Fabbro M, *et al*. Accuracy of automated 3D cephalometric landmarks by deep learning algorithms:

Systematic review and meta-analysis. Radiologia Medica. 2023 May;128(5):544-555.
12. de Queiroz Tavares Borges Mesquita G, Vieira WA, Vidigal MTC, Travençolo BAN, Beaini TL, Spin-Neto R, Paranhos LR, *et al*. Artificial intelligence for detecting cephalometric landmarks: A systematic review and meta-analysis. Journal of Digital Imaging. 2023 Jun;36(3):1158-1179.
13. Kishore Bhat HH, Anehosur V, Upadya VH, Kumar N, Madhur V. Cephalometric analysis of parents of patients with cleft lip and/or palate. Journal of Orofacial Orthopedics. 2022 Dec 7.
14. Storniolo-Souza JM, Seminario MP, Pinzan-Vercelino CRM, Pinzan A, Janson G. McNamara analysis cephalometric parameters in White-Brazilians, Japanese and Japanese-Brazilians with normal occlusion. Dental Press Journal of Orthodontics. 2021 Mar 22;26(1):e2119133.
15. Torres HR, Morais P, Fritze A, Oliveira B, Veloso F, Rudiger M, *et al*. 3D facial landmark localization for cephalometric analysis. Annual International Conference of the IEEE Engineering in Medicine and Biology Society. 2022 Jul;2022:1016-1019.
16. Telich-Tarriba JE, Amador-Lara A, Quiroz-Barrios J, Cardenas-Mejia A. Cephalometric analysis of the craniofacial morphology in patients with Moebius syndrome. Journal of Craniofacial Surgery. 2021 Oct 1;32(7):2446-2448.
17. Sarkar D, Seth S, Jyoti D, Hasan M, Pattanayak A, Ojha M. Establishment of cephalometric norms using tetragon analysis in Bengali population. Journal of Pharmacy and Bioallied Sciences. 2023 Jul;15(Suppl 2):S1244-S1249.
18. Silva TP, Hughes MM, Menezes LDS, de Melo MFB, Freitas PHL, Takeshita WM. Artificial intelligence-based cephalometric landmark annotation and measurements according to Arnett's analysis: Can we trust a bot to do that? Dentomaxillofacial Radiology. 2022 Sep 1;51(6):20200548.
19. YA, Salman AR, Nabbat SA. The accuracy and reliability of WebCeph for cephalometric analysis. Journal of Taibah University Medical Sciences. 2021 Sep 22;17(1):57-66.
20. Guinot-Barona C, Alonso Pérez-Barquero J, Galán López L, Barmak AB, Att W, Kois JC, *et al*. Cephalometric analysis performance discrepancy between orthodontists and an artificial intelligence model using lateral cephalometric radiographs. Journal of Esthetic and Restorative Dentistry. 2024 Apr;36(4):555-565.
21. Bao H, Zhang K, Yu C, Li H, Cao D, Shu H, *et al*. Evaluating the accuracy of automated cephalometric analysis based on artificial intelligence. BMC Oral Health. 2023 Apr 1;23(1):191.
22. Lu G, Zhang Y, Kong Y, Zhang C, Coatrieux JL, Shu H. Landmark localization for cephalometric analysis using multiscale image patch-based graph convolutional networks. IEEE Journal of Biomedical and Health Informatics. 2022 Jul;26(7):3015-3024.
23. Luca L, Francesca C, Daniela G, Alfredo SG, Giuseppe S. Cephalometric analysis of dental and skeletal effects of Carriere Motion 3D appliance for Class II malocclusion. American Journal of Orthodontics and Dentofacial Orthopedics. 2022 May;161(5):659-665.
24. Rathod R, Devadoss VJ, Jadav B, Ninan RL, Kanagasabapathy B, Ramshad AR, *et al*. Linear cephalometric analysis of pharynx at the level of epiglottis among snorers and nonsnorers: A cross-sectional study. Asian Journal of Neurosurgery. 2022 Jun 1;17(1):38-42.
25. Jeon S, Lee KC. Comparison of cephalometric measurements between conventional and automatic cephalometric analysis using convolutional neural network. Progress in Orthodontics. 2021 May 31;22(1):14.
26. Hwang HW, Moon JH, Kim MG, Donatelli RE, Lee SJ. Evaluation of automated cephalometric analysis based on the latest deep learning method. The Angle Orthodontist. 2021 May 1;91(3):329-335.
27. Londono J, Ghasemi S, Hussain Shah A, Fahimipour A, Ghadimi N, Hashemi S, *et al*. Evaluation of deep learning and convolutional neural network algorithms accuracy for detecting and predicting anatomical landmarks on 2D lateral cephalometric images: A systematic review and meta-analysis. Saudi Dental Journal. 2023 Jul;35(5):487-497.
28. Kazimierczak N, Kazimierczak W, Serafin Z, Nowicki P, Lemanowicz A, Nadolska K, *et al*. Correlation analysis of nasal septum deviation and results of AI-driven automated 3D cephalometric analysis. Journal of Clinical Medicine. 2023 Oct 19;12(20):6621.
29. Messaoudi Y, Kiliaridis S, Antonarakis GS. Craniofacial cephalometric characteristics and open bite deformity in individuals with amelogenesis imperfecta: A systematic review and meta-analysis. Journal of Clinical Medicine. 2023 Jun 2;12(11):3826.
30. Chung EJ, Yang BE, Park IY, Yi S, On SW, Kim YH, *et al*. Effectiveness of cone-beam computed tomography-generated cephalograms using artificial intelligence cephalometric analysis. Scientific Reports. 2022 Nov 29;12(1):20585.
31. Doberschütz PH, Schwahn C, Krey KF. Cephalometric analyses for cleft patients: A statistical approach to compare the variables of Delaire's craniofacial analysis to Bergen analysis. Clinical Oral Investigations. 2022 Jan;26(1):353-364.
32. Chuang AD, Yang CK, Chang CC, Lin ET, Tsai LC, Huang YH, *et al*. Cephalometric analysis following combined Sub-SMAS hyaluronic acid injection and subdermal and supraperiosteal poly-L-lactic acid injections in Asian women. Journal of Cosmetic Dermatology. 2022 Jun;21(6):2429-2436.
33. Clemente MP, Moreira A, Morais C, Amarante JM, Ferreira AP, Mendes J. Tooth position in wind instrument players: Dentofacial cephalometric analysis. International Journal of Environmental Research and Public Health. 2021 Apr 19;18(8):4306.
34. Pérez-Rodríguez LM, Diéguez-Pérez M, Millón-Cruz A, Arcos-Palomino I. Airways cephalometric norms from a sample of Caucasian children. Journal of Clinical and Experimental Dentistry. 2021 Sep 1;13(9):e941-e947.
35. Rauniyar S, Jena S, Sahoo N, Mohanty P, Dash BP. Artificial intelligence and machine learning for automated cephalometric landmark identification: A meta-analysis previewed by a systematic review. Cureus. 2023 Jun 25;15(6):e40934.
36. Mi JP, He P, Shi K, Feng SY, Chen XZ, He QQ, *et al*. Cephalometric craniofacial features of patients with Sagliker syndrome: A primary analysis of our experience. Annals of Translational Medicine. 2021 Jun;9(12):963.
37. Choi JW, Park H, Kim B, Kim N, Kwon SM, Lee JY. Surgery-first orthognathic approach to correct facial

asymmetry: Artificial intelligence-based cephalometric analysis. Plastic and Reconstructive Surgery. 2022 Mar 1;149(3):496e-499e.
38. Perez PI, Hendershot K, Teixeira JC, Hohman MH, Adidharma L, Moody M, *et al*. Analysis of cephalometric points in male and female mandibles: An application to gender-affirming facial surgery. Journal of Craniofacial Surgery. 2023 Jun 1;34(4):1278-1282.
39. Thet PH, Kaboosaya B. Reproducibility of computerized cephalometric analysis software compared with conventional manual tracing for analyzing skeletal stability after orthognathic surgery. Journal of Maxillofacial and Oral Surgery. 2023 Dec;22(4):833-840.
40. Yoshikawa H, Tanikawa C, Ito S, Tsukiboshi Y, Ishii H, Kanomi R, *et al*. A three-dimensional cephalometric analysis of Japanese adults and its usefulness in orthognathic surgery: A retrospective study. Journal of Craniomaxillofacial Surgery. 2022 Apr;50(4):353-363.
41. Sharab L, Jensen D, Hawk G, Kutkut A. A cephalometric analysis assessing the validity of Camper's plane to establishing the occlusal plane in edentulous patients. Dent Journal (Basel). 2023 Mar 15;11(3):81.
42. Girhe V, Borle R, Datey P, Shirivastav S, Bhola N. Cephalometric norms for the North Indian population: A systematic review. National Journal of Maxillofacial Surgery. 2022 May-Aug;13(2):172–179.
43. Wu Y, Yu Q, Xia Y, Wang B, Chen S, Gu K, *et al*. Does mandibular advancement with clear aligners have the same skeletal and dentoalveolar effects as traditional functional appliances? BMC Oral Health. 2023 Feb 2;23(1):65.
44. Williams MCG, Almeida M, Alper DP, Allam O, Shah J, Craver A, *et al*. Technique for cephalometric analysis of the craniofacial skeleton following facial feminization surgery. Journal of Craniofacial Surgery. 2023 Nov 13.
45. Gokdeniz ST, Kamburoğlu K. Artificial intelligence in dentomaxillofacial radiology. World Journal of Radiology. 2022 Mar 28;14(3):55–59.
46. Shrestha A, Song SH, Aung HN, Sangwatanakul J, Zhou N. Three-dimensional cephalometric analysis: The changes in condylar position pre- and post-orthognathic surgery with skeletal Class III malocclusion. Journal of Craniofacial Surgery. 2021 Mar-Apr 1;32(2):546–551.

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