DIAGNOSIS OF SAGITTAL AND TRANSVERSAL ASYMMETRY IN DIGITAL ORTHODONTIC STUDY MODELS OF A STUDENT POPULATION BY THE KLO METHOD APPLIED IN DIGITAL SOFTWARE

DIAGNÓSTICO DE ASSIMETRIA SAGITAL E TRANSVERSAL EM MODELOS DE ESTUDO DE ORTODONCIA DIGITAL DE UMA POPULAÇÃO ESTUDANTIL PELO MÉTODO KLO APLICADO EM SOFTWARE DIGITAL

DIAGNÓSTICO DE ASIMETRÍA SAGITAL Y TRANSVERSAL EN ORTODONCIA DIGITAL MODELOS DE ESTUDIO DE UNA POBLACIÓN ESTUDIANTIL POR EL MÉTODO KLO APLICADO EN SOFTWARE DIGITAL

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ABSTRACT

Introduction: Effective diagnosis and treatment of orthodontic patients requires a number of essential ancillary tests. However, some difficulty arises when evaluating dental asymmetries in the hemiarcs of each dental arch. The correct appreciation of these asymmetries is crucial, according to several studies, for the proper final placement of the teeth in their arch at the end of the treatment. The current literature is limited in terms of methods to evaluate and diagnose alterations due to hemiarcs. The KLO method applied in digital software is useful for diagnosing sagittal and transverse asymmetries. Objective: To perform a descriptive cross-sectional study of digital models in STL format through the KLO method and its applicability in digital software, in order to identify the presence of dental alterations and asymmetries; to collect the information, key terms such as: Diagnosis; orthodontics; dental models; asymmetry; molar teeth; Software Application were used. To obtain the results, information was collected from 20 digital models in a Google Drive database, which are part of this study. Results: Seventy-five percent (n=15) of the students presented dental asymmetry, while 25% (n=5) presented dental symmetry. Conclusion: A proper diagnosis is essential to identify dental asymmetries. The KLO method and its application in a digital software allows to identify a dental asymmetry in a simpler way, besides allowing to store the information in a computer.


RESUMO

Introdução: O diagnóstico e o tratamento eficaz dos pacientes ortodonticos requer uma série de exames complementares essenciais. No entanto, surge alguma dificuldade na avaliação das assimetrias dentárias nos hemiarcs de cada arcada dentária. A correta apreciação dessas assimetrias é fundamental, segundo diversos estudos, para o correto posicionamento final dos dentes na sua arcada ao final do tratamento. A literatura atual é limitada em termos de métodos para avaliar e diagnosticar alterações decorrentes de hemiarcs. O método KLO, aplicado em software digital, é útil para o diagnóstico de assimetrias sagitais e transversais. Objetivo: Realizar um estudo transversal descritivo de modelos digitais em formato STL através do método KLO e sua aplicabilidade em softwares digitais, a fim de identificar a presença de alterações e assimetrias dentárias; coletar as informações, termos chaves como: Diagnóstico; ortodontia; modelos dentários; assimetria; dentes molares; Aplicação de Software foram utilizados. Para a obtenção dos resultados, foram coletadas informações de 20 modelos digitais em um banco de dados do Google Drive, que fazem parte deste estudo. Resultados: Setenta e cinco por cento (n=15) dos alunos apresentaram assimetria dentária, enquanto 25% (n=5)

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presented simetria dentária. Conclusions: A correct diagnosis is essential to identify dental asymmetries. The KLO method, through its application in digital software, allows for a simpler identification of dental asymmetry, in addition to allowing the storage of information in a computer.


INTRODUCTION

Facial asymmetry is the variation between the two halves of the face, being its etiology congenital, developmental and acquired as a result of injury or disease. (1)

Facial asymmetry is related to dental malocclusion. Bisahara et al. classifies malocclusions as dental, skeletal, muscular or functional; class III being the one that has the greatest association with facial asymmetry. (1)

Clinical examination, study models, radiographs, photographs, electromyogram are indispensable tools to make a good diagnosis of an asymmetry. Especially the study models for obtaining sagittal and transverse asymmetries. In this study we will analyze the KLO method using digital software for the evaluation of sagittal and transverse asymmetries of the canines and molars in the dental arches of the patients' study models. (1)
Anatomical references

Maxillary arch
- Line extending from the middle raphe at the level of the third crease of the palatine groove passing through the transition zone of the hard and soft palate to the end of the socket of the study model. (1)

Mandibular arch
- Lingual frenulum
- In occlusion, the line of the median raphe is projected to the lower arch with a ruler and joined to the lingual frenulum. (1)

MEASUREMENT METHOD USED

KLO method and its application in digital software

This process can be carried out using any software that has the ability to read digital models. For this purpose, NemoCast software was used in this study. Each model was scanned individually per arch and then in MIC. (2) (3)

To define the functional occlusal plane, the recommendation of Burstone and Marcotte (2000) is followed, which is that the plane should be drawn in relation to the premolars, so it is established from the distal occlusal contact point of the lower molars to the point that bisects the vertical overbite or to an occlusal contact point in the premolar region (Burstone and Marcotte 2000). Once this plane is obtained, the sagittal plane is defined from the medial raphe to the height of the third palatal crease and then extending distally from the second premolar. This line is prolonged passing through the area between the hard and soft palate to the end of the digital model socket (Luu et al, 2012) hoping to obtain a result that is perpendicular to the occlusal plane and in patients with facial symmetry that coincides with the mid-facial line (Melsen 2013), therefore, to obtain this result, the procedure is as follows. (3) (4) (5)

First, two lines should be drawn; the first one should arise from the central fossa of the molar and the other from the cingulum of the canine, with an angle of 90° to the median raphe. This point reports the closest point to the centroid point of the teeth. This, in order to obtain the different dental asymmetries (sagittal, vertical and transversal) of molars and canines. (3) (4) (5)

From the images acquired, two occlusal planes were obtained: the occlusal plane and the sagittal plane of the median raphe. Subsequently, the measurements of canines and molars were taken in each hemiarch, thus obtaining the measurements of the dental asymmetries. (3) (4) (5) (6)

METHODOLOGY

A cross-sectional descriptive observational study was carried out. The data collection was obtained through a database in Google Drive of digital models in STL format of 20 seventh semester students of the Dentistry course of the University of Cuenca, in the academic period 2023-2024, where
the quality of each of the STL files was evaluated. The seventh semester dental students at the
University of Cuenca were chosen because they are representative of the University, since some of
them had orthodontics for a period of time and others did not, which helps to diagnose the sagittal and
transversal asymmetries present.

As a data collection modality, students were asked to perform intraoral scans to obtain the digital
models in a respective dental office and then uploaded in STL format in the database in Google Drive,
to be later analyzed in the NemoCast software.

The sample size was set at 20 students who met the inclusion criteria: being of legal age, being
enrolled in Orthodontics I in the seventh semester of Dentistry at the University of Cuenca, presence of
the permanent dentition dental model scanned and in STL format; and those who met the exclusion
criteria: not being of legal age, presence of dental plaster models and students from other semesters
were rejected. This study has a confidence level (CN) of 95%.

Regarding the presentation of results, the study regrouped the studied models into symmetric
and asymmetric using the KLO method applied in a digital software (NemoCast) for a better
understanding.

RESULTS

Table 1. The measurements that were plotted from the cingulum of the canine to the medial raphe and
from the central fossa of the first molar in each hemiarch of the maxilla of the 20 study models are
shown

<table>
<thead>
<tr>
<th>Patient</th>
<th>Canine-rafe (Quadrant I)</th>
<th>Canino-rafe (Quadrant II)</th>
<th>Molar-rafe (Quadrant I)</th>
<th>Molar-raphe (Quadrant II)</th>
<th>Result</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>25mm</td>
<td>25mm</td>
<td>32mm</td>
<td>32mm</td>
<td>Symmetrical</td>
</tr>
<tr>
<td>2</td>
<td>22mm</td>
<td>21mm</td>
<td>30mm</td>
<td>32mm</td>
<td>Asymmetric</td>
</tr>
<tr>
<td>3</td>
<td>25 mm</td>
<td>28mm</td>
<td>32mm</td>
<td>39mm</td>
<td>Asymmetric</td>
</tr>
<tr>
<td>4</td>
<td>25mm</td>
<td>24mm</td>
<td>38mm</td>
<td>36mm</td>
<td>Asymmetric</td>
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</tbody>
</table>
### Diagnosis of Sagittal and Transversal Asymmetry in Digital Orthodontic Study Models of a Student Population by the KLO Method Applied in Digital Software

Mariam Gabriela Portocarrero Miranda, Manuel Estuardo Bravo Calderón, Kelly Tatiana Malla Bernal, Gianella Fernanda Malla Domínguez, Nathaly Adriana González Rodríguez, Yuliana Elizabeth Paladínez Carrion

<table>
<thead>
<tr>
<th>5</th>
<th>24mm</th>
<th>25mm</th>
<th>34mm</th>
<th>36mm</th>
<th>Asymmetric</th>
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</thead>
<tbody>
<tr>
<td>6</td>
<td>24mm</td>
<td>26mm</td>
<td>35mm</td>
<td>37mm</td>
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<td>39mm</td>
<td>39mm</td>
<td>Symmetrical</td>
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<tr>
<td>8</td>
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<td>27mm</td>
<td>36mm</td>
<td>39mm</td>
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</tr>
<tr>
<td>9</td>
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<td>25mm</td>
<td>26mm</td>
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<td>10</td>
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<td>20mm</td>
<td>35mm</td>
<td>35mm</td>
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</table>
In this study carried out in a group of 20 students of the Faculty of Dentistry of the University of Cuenca, 75% (n=15) presented dental asymmetry, while 25% (n=5) presented dental symmetry (Fig 1) (Tab 2).

<table>
<thead>
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<th>Number of patients</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Symmetry</td>
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<tr>
<td>Asymmetry</td>
<td>15</td>
</tr>
<tr>
<td>TOTAL</td>
<td>20</td>
</tr>
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</table>

Table 1. Summary of results
DISCUSSION

Ahmad Hasan et al. consider that the asymmetry of the canine and molar relationship is related to the coincidence of the dental midlines and asymmetry. They analyzed the dental asymmetry of 177 models and concluded that 39.5% presented molar asymmetry and 23.2% presented a non-coincident midline. (2)

This study aims to find out what is the prevalence of asymmetrical and symmetrical occlusion existing in the mentioned population. The best way forward with orthodontics is symmetry, having clinical and diagnostic implications. (8)

In order to prevent possible transverse malocclusions with maxillary expansion, it is essential to perform an early analysis of the transverse dimension of the models, since there must be a transverse alveolar width with optimal dental inclinations for an ideal functional occlusion. (1) (7)

Study models and postero-anterior cephalograms are the most commonly used tools for diagnosis and treatment planning of transverse asymmetries, but both have limitations. Nowadays CBCT tomography has become the standard tool for the diagnosis of transverse problems. (9) (6)

Don-Soon Choi mentions that plaster models have been a fundamental part of the diagnosis in orthodontic treatment, and in the study of 3D digital models, the surface of the palate should be taken as a reference to measure tooth movements, since it is considered that the palate and the wrinkles are
formed in the 12th and 14th week of intrauterine life and are maintained during the growth of the person, being the third wrinkle the most maintained. (4)

The KLO method allows the quantification of the lack of dental symmetry in each arch in an easy and reproducible way to be stored in a file. (9)

Nowadays, esthetics requires an accurate diagnosis of a malocclusion, considering that molars and canines play a fundamental role in the molar and canine key. The molar helps as an anchor in the treatments and the canine is important in the conformation of the arch contour, that is why this method is proposed to have an adequate location of the molar and canine in relation to the middle raphe (from the third palatal groove) which in symmetrical patients coincides with the facial midline. But, when the upper midline is displaced to one side, the mid raphe line in the premaxilla is affected. (5)

Finally, Sawchuk assures that all the indexes that study cross-sectional problems are necessary to demonstrate the expansion required in each case, considering that they are inaccurate, biased and clinically invalid for planning and diagnosis. (3)

CONCLUSIONS

Orthodontics allows us to establish in the patient a functional, esthetic, stable occlusion and a symmetrical smile, so we must give a very detailed approach in the diagnostic stage with the help of study models to identify dental asymmetries.

Thanks to advances in technology such as the use of digital models and the NemoCast software, it has been possible to measure the dental asymmetry of an arch by the KLO method in a faster, easier, reproducible and simple way with computer storage.

The purpose of this study was to identify dental asymmetries in a group of 20 students, in which it was concluded that 75% presented such asymmetries. Therefore, we can evidence a high prevalence of asymmetries in the group of students.

REFERENCES


8. Ahmad HADMRCAD. Effect of asymmetric molar and canine relationship on dental midlines in orthodontic patients. 2017,37(1). Available at: https://search.proquest.com/openview/6da57c8b6b6bf4b2037a93b090759c4ec9/1?pq-origsite=gscholar&cbl=616533
