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ORIGINAL RESEARCH

Bolton's index efficacy with manual vs digital measurements

Eficacia del índice de Bolton por medición digital vs manual

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ABSTRACT

Objective: To assess whether there is a variation in the values of Bolton index, making measurements manually or digitally. **Material and methods:** 70 pairs of study models were analyzed and measured on two occasions: one using a compass and a millimeter rule, and the other using an electronic vernier. **Results:** No statistically significant difference was found between the two measurements. **Conclusion:** Both ways to perform mesiodistal dental measurements are good choices for Bolton analysis.

RESUMEN

Objetivo: Evaluar si existe una variación en la medición del índice Bolton, realizando las medidas de manera manual y de manera digital. **Material y métodos:** Se analizaron 70 pares de modelos de estudio; los cuales fueron medidos en dos ocasiones; mediante el uso de un compás y una regla milimetrada, y mediante el uso de un vernier electrónico. **Resultados:** No se encontró diferencia estadísticamente significativa entre ambas mediciones. **Conclusión:** Las dos formas de realizar la medición dental mesiodistalmente son buenas opciones para el análisis de Bolton.

Key words: Mesiodistal width, bolton analysis, measurement.
Palabras clave: Ancho mesiodistal, análisis de Bolton, medición.

INTRODUCTION

The size ratio of maxillary and mandibular teeth, specifically mesiodistal dental width, is an important aspect in diagnosis and treatment planning for an individual. Discrepancies in tooth size should be identified early during diagnosis and initial treatment in order to obtain an ideal result. Tooth size relationships represent a valuable diagnostic tool that may provide a prediction of the results of treatment and may also limit the need for diagnostic configurations in complex cases.[1-3]

Wayne A. Bolton in 1958 formulated a total analysis and an anterior analysis to estimate the discrepancy in the size of the teeth by measuring and comparing the mesiodistal widths of the dental arches including the distal surfaces of the first molars, as well as the anterior segment (from canine to canine). This analysis is often referred to as «analysis of Bolton», for he investigated the relationship between the mesiodistal diameters of the upper and lower tooth crowns on the basis of 55 patients with excellent occlusion, including 44 treated with orthodontics (without extractions) and 11non-treated subjects.[4-8]

Bolton introduced two indexes. The anterior Bolton index is obtained by dividing the mesiodistal size of the 6 mandibular anterior teeth (canine to canine) by the mesiodistal size of the 6 upper anterior teeth; the total Bolton index is obtained by dividing the mesiodistal size of the 12 mandibular teeth (first molar to first molar) by the mesiodistal size of the 12 maxillary teeth.[9]

However, extrinsic factors such as sexual dimorphism, race and ethnic variation, type of malocclusion, anterior teeth inclination, incisal edge and arches thickness and smile may affect this proportion which usually requires adjustments in the anterior relationship as Bolton described. In other words, a high or low Bolton ratio does not necessarily reflect the actual discrepancy and an ideal index does not guarantee an ideal occlusion.[10]

Through this research it is sought to know if there is a variation in the total Bolton index or the anterior Bolton index by performing the mesiodistal width

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measurement of each tooth manually (through the use of a compass and rule in millimeters) or using an electronic Vernier.

MATERIAL AND METHODS

A comparative study was conducted in which 70 pairs of study models were analyzed. The models were obtained from patients who attended the Post-graduate Orthodontics and Dentomaxillofacial Orthopedics Program of the UASLP of whom 50% were female patients and 50% male patients.

The criteria for model selection were: 1) permanent dentition from first molar to first molar, 2) good quality of the casts (models without negative or positive bubbles that may alter the mesio-distal dental diameter), 3) models that do not present teeth with extensive restorations that may modify mesiodistal dental width.

In each model the dental crowns were measured mesiodistally from first molar to first molar. Such measurement was performed on two occasions: the first through the use of a compass and a rule in millimeters, the second using a digital caliper *(Figures 1 and 2)*.

The sum of the diameters of the lower teeth was divided by the sum of the diameters of the upper teeth and the result was multiplied by 100 to obtain the total Bolton index. The sum of the diameters of the anterior teeth, from canine to canine, was also obtained and then the sum of the lower was divided by the upper and the result multiplied by 100 to obtain the anterior Bolton index.[3,4]

The statistical analysis was obtained using the MINITAB software (version 16). The normality of the variables was analyzed and a «t» test was performed to determine the significance.

RESULTS

No significant differences were found in the total or the anterior Bolton index when comparing digital measurement vs manual measurement or between the group of male patients and the group of female patients.

Through the manual measurement a total Bolton index of 0.91762 was obtained; with a standard deviation of 0.02527; while digitally, a total Bolton index of 0.91931 was obtained with a standard deviation of 0.02060 resulting in a difference of 0.00169 between both. An anterior Bolton index 0.78073 was obtained manually with a standard deviation of 0.02960 and digitally it resulted in 0.78491 with a standard deviation of 0.02477 thus having a difference of 0.00418 *(Table I)*.

In the female group, the Bolton total index difference was -0.00535, while that of the anterior Bolton index was -0.00609 *(Table II)*. For the male group the differences were of 0.00198 and -0.00228 in the total and anterior Bolton, respectively *(Table III)*.

In tables 4 and 5 an analysis by dental organ is shown. In *table IV* a comparison is made of the data obtained according to the type of measurement while *Table V* shows the comparison of the «P» values

Figure 1. Measurement of the mesio-distal width using a compass and a ruler.

Figure 2. Mesiodistal width measurement using a digital caliper.