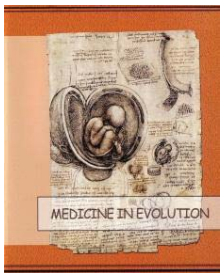
Frequency analysis of Bolton's discrepancy in a group of patients with orthodontic treatment need



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Abstract

Objectives: This study evaluates the frequency of the Bolton discrepancy in a group of patients with orthodontic treatment need, establishing the existence or the absence of any correlations between this discrepancy and its location as well as the sex of the patient.

Materials and method: A total of 40 patients were included in the present study. Measurement of the mesiodistal widths (between contact points) located at the equator of the dental crown, have been performed using a precision digital caliper. The measurements were taken on the study models.

Results and conclusions: The measurements performed on the study models, before the orthodontic treatment was applied, identified that 15 (37.5%) of the 40 participants in the study have Bolton discrepancy. No significant differences were reported when comparing the arches or the anterior and overall ratio.

Keywords: Bolton's Discrepancy, malocclusion, orthodontic treatment, dental adhesive technique

INTRODUCTION

With regards to the size of dental arches, it is known that the diameter of the superior arch is greater than the diameter of the inferior arch by 8-12 mm [1]. In 1958, Bolton determined the ideal ratio of the mesiodistal width of the upper teeth to the lower teeth for an optimal occlusion [2]. This analysis should be performed only in the permanent dentition, where there is an Anterior Ratio (from 1.3 to 2.3) and an Overall Ratio (from 1.6 to 2.6).

The Bolton Discrepancy in the superior arch is caused by narrow lateral incisors, localized macrodontia, increased overbite and overjet, crowding of upper teeth, retrusion and protrusion of the superior incisors. Whereas in the inferior arch it is caused by decreased overbite and overjet, inferior teeth crowding, inferior incisor retrusion [2].

This disharmony can be managed in different ways: tooth stripping to reduce volume (reducing the mesiodistal width in the case of crowding or increased volume), increasing the volume through direct and indirect restorations, modifying dental angulation and torque [2-4].

As a result of a self-study, Bolton analyzed the need to reduce tooth dimensions through stripping, or adding volume with dental composite materials [3] and reported similar results as John et al. in their study [4].

The difference in teeth dimensions depends on different factors, such as race (the black race higher values for maxillary canines, premolars and molars than the white race, with no differences in the incisor group [5], sex [6]. Sperry et al [7] reported a size excess with the inferior teeth among patients with Angle class III malocclusion. The study was conducted on a group of men and women diagnosed with Angle class I, class II or class III malocclusion [7]. In a similar research Crosby and Alexander [8], excluded patients diagnosed with Angle Malocclusion class III, no statistically significant differences were found.

This study analyses the frequency of Bolton's Discrepancy (DB) among a group of patients with orthodontic treatment need. It is also aimed to determine any correlations between this discrepancy, its localization and patients' gender.

MATERIALS AND METHODS

The sample consisted of 40 subjects, patients at Natural Smile Dental Clinic, referred to the clinic for orthodontic treatment between 2015 and 2018.

Patients were selected for the study according to the following criteria:

- fully erupted permanent dentition and present on the arch
- no prior orthodontic treatment
- absence of attrition, abrasion, abfraction and erosion lesions
- absence of restorations (and dental caries lesions) on proximal points.
- absence of dental prosthetic restoration

Method

Measurement of the mesiodistal widths (between contact points) located at the equator of the dental crowns, have been performed using a precision digital caliper. The measurements were taken on the study models (Fig. 1, Fig.2, Fig.3) of the patients.

The anterior ratio was determined using the following formula:

Anterior ratio= sum of the mesiodistal width of 6 mandibular anterior teeth/ sum of the mesiodistal width of the 6 maxillary anterior teeth x100

Overall ratio was determined using the following formula:

Overall ratio= the sum of mesiodistal widths of the 12 mandibular teeth/ mesiodistal width of the 12 maxillary teeth x100

Figure 1. Study model

Figure 2. Study model

Figure 3. Study model

The same examiner performed the measurements twice. When differences greater than 0.2mm were found, a third measurement was done, and it was taken into account. In the case where differences were less than 0.2mm, the value of the first result prevailed.

The descriptive and comparative statistical analysis was performed using the student t test with at statistical significance of $p<0.05$.

RESULTS

Measurements performed on the study models, showed that 15 of the 40 participants in the study recommended for orthodontic treatment, respectively 37.5% have Bolton Discrepancy. Regarding the patients gender, 40 participants, 7 females (17.5%) and 8 males (20%) of the sample presented the discrepancy. When analyzing the sample of Bolton Discrepancy diagnosed patients by gender, the results show that 46.6% were female and 53.4% were male. From the total of female participant patients (20), 35% presented the discrepancy, and out of the total of male participant patients (20), 40% presented the discrepancy.

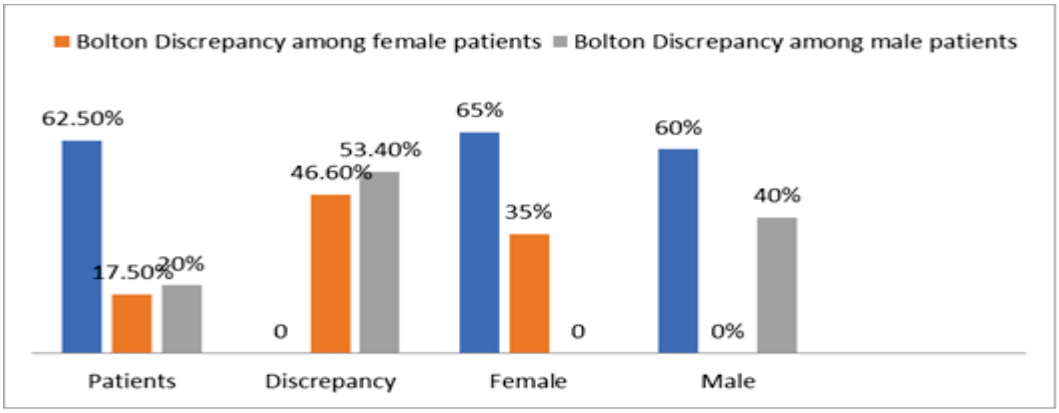

Figure 4. Systematizing ratio distribution according to amount and gender

Table I details the comparison of mean values in mm for the mesiodistal width of the individual teeth in the superior dental arch in female and male patients. As observed the values do not present statistically significant differences.

Table I. Average width, standard deviation and *p*-value of maxillary teeth

Upper Arch	Male	Female	*p*-value	Difference Significance
IC	8,57±0,52	8,45±0,55	>0,05	IS
IL	6,93±0,53	6,73±0,58	>0,05	IS
C	7,73±0,38	7,63±0,42	>0,05	IS
PM1	6,85±0,40	6,78±0,48	>0,05	IS
PM2	6,39±0,42	6,34±0,43	>0,05	IS
M1	10,47±0,53	10,35±0,52	>0,05	IS

IC-central incisor, IL-lateral incisor, C-canine, PM1- first premolar, PM2-second premolar, M1- first molar, IS-Insignificant

Figure 5 details the comparison of mean values in mm for the mesiodistal width of the individual teeth in the superior dental arch. Similar results were present on the inferior arch, with no significant differences (table II).

Table II. Average width, standard deviation and *p*-value of mandibular teeth

Lower arch	Male	Female	*p*-value	Difference Significance
IC	5,15±0,58	5,16±0,42	>0,05	IS
IL	5,79±0,43	5,76±0,51	>0,05	IS
C	6,81±0,41	6,60±0,44	>0,05	IS
PM1	6,86±0,40	6,96±0,44	>0,05	IS
PM2	6,82±0,45	6,73±0,45	>0,05	IS
M1	10,97±0,58	10,62±0,64	>0,05	IS

IC-central incisor, IL-lateral incisor, C-canin, PM1- first premolar, PM2-second premolar, M1- first molar, IS-Insignificant

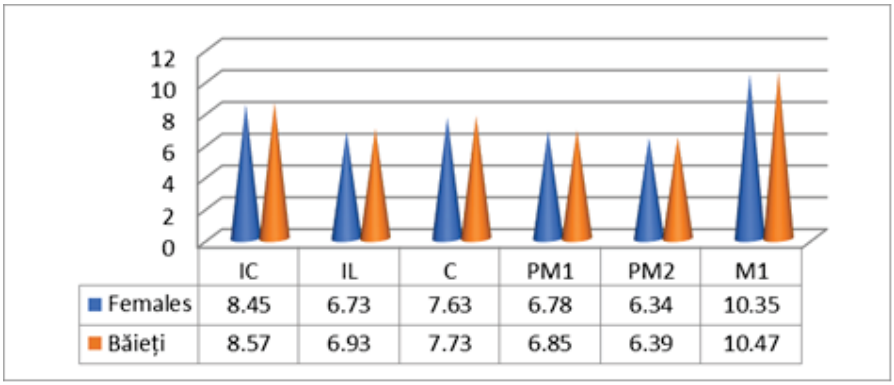

Figure 5. The average width of individual teeth in upper arch- females and males

The results regarding the two dental arches determined that the sum of mesiodistal tooth-widths in male participants (92,96 mm and 84,8 mm, respectively) is greater than the sum for female participants (91,69 mm and 83,65mm, respectively) on both dental arches. However, the results do not present significant statistical differences (p>0,05).

Table III details the mean, deviation and width ratio for mandibular-maxillary teeth. Although the anterior ratio and overall ratio have been slightly greater in female patients than in male patients, the difference is statistically insignificant.

Table III. Anterior and Overall ratio in males and females

Ratio	Males	Females	Value *p*	Difference
Anterior	76,44±4,14	76,80±2,91	>0,05	IS
Total	91,24±2,87	91,25±2,36	>0,05	IS

IS- insignificant

DISCUSSIONS

The results of the study indicate that 37.5%of the participants present Bolton discrepancy. This percentage is smaller than the 60% resulted in Crosby's study. The difference is explained by the different race type of the sample group on which the study was performed.

The first inferior molar reported the maximum variability, while the superior canine reported the minimum variability in the maxillary and mandibular teeth.

On the upper arch, the lateral incisor reported a maximum variability in female patients, while in the case of male patients it was the first molar and lateral incisors that presented a maximum variability. Maximum variability was observed on the central incisor

and prime molar in male patients, while in the case of female patients the prime molar on the inferior dental arch recorded maximum variability. The mesiodistal widths on both arches presented similar distribution for both male and female patients, the measurements being greater in male patients, however the differences were statistically insignificant.

These results are in agreement with the study conducted on the population of South America, study performed by Santoro et al [9], but in disagreement with the conclusions in the study conducted by Lavelle et al. [6] and Moorees et al [10]. A similar study conducted on the population of North India concluded that teeth tend to be larger in male participants, however the study did not analyze their significance.[11] Similar to numerous authors, the studies performed by Ary et al [12] and Lavelle et al [6] show that there are difference in teeth size based on gender.

The anterior ratio and overall ratio have been compared on both genders. The results show that there is no significant difference. This can be referable to the similar distribution of mesiodistal tooth widths in male and female population. Similar results were recorded in a study conducted on the population of Southern China.[13]

CONCLUSIONS

After the analysis of 40 study models, the following have been identified:

- 15 patients, representing a total of 37.5% of the sample group, presented Bolton Discrepancy.
- Among those with Bolton Discrepancy, a slightly higher percentage belonged to the male sample group (53.4%).
- No significant differences were reported when comparing the arches or the anterior and overall ratio.

The presence of a mesiodistal discrepancy in the dental arches interferes with an optimal occlusion. The orthodontic positioning of teeth in correct intercuspation can result in interdental spacing, which in turn will need restorative treatments.

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