

Relationship between Dental Size and Normal Occlusion in Brazilian Patients

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The present study was performed on dental casts and lateral cephalometric films of 30 Caucasian Brazilian individuals (15 males and 15 females) aged 18 to 27 years and 4 months, all presenting normal occlusion and satisfactory facial profile. The aims were to investigate the existence of dental discrepancies according to Bolton's criteria, to obtain mean values for overbite, overjet, curve of Spee and interincisal angle, and to demonstrate any correlation among these parameters. A single calibrated operator measured each variable characteristics and the process was recorded twice with an accurate modified digital caliper. It was observed that the sample of normal occlusion did not present any dental discrepancy among the 12 teeth of opposite arches. The overall ratio (91.46) and anterior ratio (77.83) were in accordance with those proposed by Bolton. The mean values for normal occlusion in this Brazilian sample were defined as: 2.45 mm for overbite; 1.92 mm for overjet; 1.01 mm for curve of Spee and 129.57° for interincisal angle. A statistically significant correlation was found between overjet and overbite.

Key Words: Bolton discrepancy, normal occlusion, overbite/overjet, curve of Spee.

INTRODUCTION

Normal measurements for one group should not be considered normal for every race or ethnic group. Different racial groups must be treated according to their own characteristics (1). Orthodontists treating Brazilian patients, who have quite a rich ethnic diversity (2), should know their characteristics of normal occlusion pattern to be better prepared to diagnose and plan a more accurate treatment.

An esthetic and balanced occlusion can be considered normal, even presenting teeth with slight rotations, slightly increased or decreased overjet and overbite and mild incisor buccal or lingual tipping. The curve of Spee, cusp height, the relation of each tooth with its antagonist and other occlusal characteristics can vary considerably. Studies have shown that there is a discrepancy of dental volume between maxillary and

mandibular arches, even in patients with occlusion considered as normal (3,4).

It is necessary to measure the mesiodistal diameter of dental crowns to evaluate the proportion between dental size and space available in the arch. Dental dimension is essential to obtain the correct alignment, adequate overbite and overjet, intercuspation (1,5-7) and occlusal stability (8). Smith et al. (5) found significant differences in Bolton's overall, anterior and posterior interarch ratios between Caucasians, Blacks and Hispanics and suggested that population specific standards are necessary for clinical assessments.

Normal overbite is defined when the cutting edge of the maxillary incisors and canines cover a maximum of 1/3 of the crown length of the mandibular incisors (9). Some researches believe that overbite can be influenced by shape, tooth development, physical conformation and individual race (9), as well as by the

interincisal angle and curve of Spee (10).

The overjet is measured horizontally, from the buccal surface of the mandibular incisor to the buccal face of its antagonist, and the value considered as normal should be within 1 to 2 mm (11). Heynes (12) demonstrated that there is no numerical and significant difference related to the variation of overjet associated to overbite, although a positive statistically significant correlation has been shown between them.

Studies with patients with normal occlusion have reported mean values for the interincisal angle ranging from 119.2° to 136.1° and have stated that these values can vary according to the gender and, mainly, to the race (11,13,14). Adequate inclination of anterior crowns tends to contribute to a normal overbite and to an ideal posterior occlusion. When the maxillary and mandibular incisors have an accentuated palatal/lingual tipping, they lose function and can undergo extrusion (11).

One of the objectives of the curve of Spee is to establish a correct overbite in the anterior dental segment (11). Andrews (11) observed that the posterior intercuspation seems to be improved when the occlusal plane is leveled. When the curve of Spee is very deep, occlusion is likely to be compromised (7,11).

Although a large number of studies have addressed dental discrepancy, normal overbite, overjet, interincisal angle and curve of Spee, little data is available about the correlation among these variables. Therefore, the aims of this study were to investigate, in a sample of Brazilian patients, the existence of Bolton dental discrepancies, to compare values found in this study to those suggested by Bolton, to obtain mean values for overbite, overjet, curve of Spee and interincisal angle, and to evaluate the correlation among these parameters.

MATERIAL AND METHODS

This study was performed on dental casts and lateral cephalometric films of 30 Caucasian Brazilian individuals, being 15 males (age range, 18 y 7 m to 27 y 4 m; mean age = 22 y 4 m) and 15 females (age range, 18 y to 24 y 1 m; mean age = 22 y 6 m). The records used belong to patients with normal occlusion of the Orthodontic Program of Rio de Janeiro State University (UERJ). The inclusion criteria were patients who had never received orthodontic treatment and had normal occlusion, including those who showed anterior crowding up to 3 mm associated with dental rotations.

Cast measurements were taken by a single calibrated operator and each variable characteristics were recorded twice to rule out intraoperator errors of measurement.

A digital caliper accurate to 0.01 mm (Digital SI, Tesa SA, Renens, Switzerland) was used to obtain the measurements. As the caliper's pointer was too thick, it was necessary to fabricate an acrylic pointer inlaid with a wire (0.9 mm, Unitek/3M; Unitek Dental Products, Monrovia, CA, USA) to make the measurements easier and more precise. Initially, the mesiodistal diameters of maxillary and mandibular teeth were measured on dental casts, from the first right molar to the left first molar, at contact point level, to detect dental size discrepancy using Bolton's method (8) (Fig. 1).

The overall and anterior ratios for each model pair was calculated using the following equations: Overall ratio = sum of the mesiodistal diameter of 12 mandibular teeth x 100/ sum of the mesiodistal diameter of 12 maxillary teeth; Anterior ratio = sum of the mesiodistal diameter of 6 mandibular teeth x 100/ sum of the mesiodistal diameter of 6 maxillary teeth. These ratios were taken from the records proposed by Bolton (8) and compared to the normal values.

The overbite degree was evaluated in all pairs of models by measuring (in mm) the vertical difference between the incisal edges of maxillary and mandibular central incisors. A mark was done with a 0.5-mm pencil on the buccal surface of the mandibular incisors exactly at the height of the maxillary incisors' edges. The measurement was made with a millimeter ruler (Kawasa)

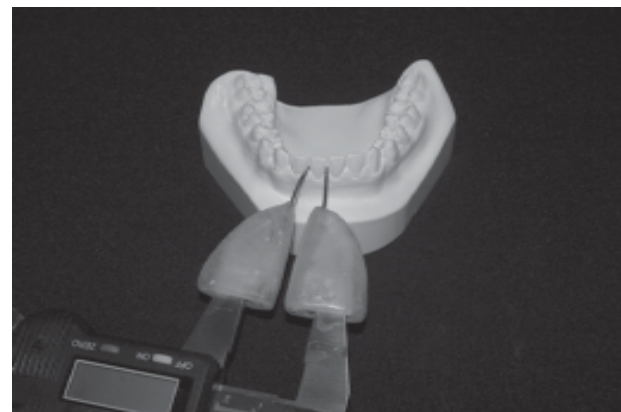


Figure 1. Digital pachymeter with an acrylic pointer inlaid with a wire to measure mesiodistal dental diameter.

from the pencil's mark to the incisal edge of the mandibular incisors. Overbite was classified according to the overlap degree, in such a way that the size of mandibular incisor did not influence the results: Class 0 (zero) - ideal overlap of 1/3 over mandibular incisor; Class 1 - slightly decreased overlap of 1/3 over mandibular incisor; Class 2 - slightly increased overlap of 1/3 over mandibular incisor. Overjet was measured with a millimeter ruler from the buccal surface of the mandibular central incisors to incisal border of the most projected maxillary central incisor.

The curve of Spee was obtained with digital caliper and only the greatest value was considered in each cast. The mandibular second molars were included in all cases. A ruler was placed passing over the cusps of the second molars and touching the incisal edge of the mandibular anterior teeth. The measured value was the vertical distance from the cusp of the second premolars to the ruler on both sides.

Lateral cephalometric films were used to obtain the interincisal angle values of the sample. These radiographs were taken according to Broadbent standard at the Department of Radiology of Rio de Janeiro State University. The only traces marked were the axial trace of maxillary and mandibular incisors. The interincisal angle was measured with a protractor to evaluate the dental protrusion degree.

Means, standard deviations, minimum and maximum values and standard error were calculated for all studied variables. Kruskal-Wallis non-parametric test ($p < 0.05$) was used to compare the variables, and the Spearman's coefficient correlation was applied to determine whether there was a significant correlation among overbite, overjet, interincisal angle and curve of Spee.

Table 1. Minimum, maximum and mean values of occlusal characteristics from the studied population (n=30).

Measurement	Range	Mean (\pm SE)
Bolton's anterior ratio	73.9-82.8	77.83 (\pm 2.19)
Bolton's overall ratio	88.0-94.8	91.46 (\pm 1.63)
Overbite (mm)	1.0-4.0	2.45 (\pm 0.81)
Overjet (mm)	1.0-3.5	1.92 (\pm 0.63)
Curve of Spee (mm)	0.2-2.0	1.01 (\pm 0.42)
Interincisal angle	110.0°-145.0°	129.57° (\pm 8.90°)

RESULTS

Table 1 shows the minimum, maximum, means and standard errors of Bolton's anterior and total ratios, overbite, overjet, curve of Spee and interincisal angle.

The results of Spearman's coefficient correlation are given in Table 2. There was a positive correlation, although not so remarkable, between overbite and curve of Spee values, as well as a negative correlation between overjet and interincisal angle. No correlation was found between overbite and interincisal angle or overjet, as the r values were very close to zero.

Tables 3 and 4 present the comparison of the variables applying Kruskal-Wallis test ($\alpha=5\%$). Statistically significant differences were observed when

Table 2. Spearman's coefficient correlation.

Variables	r
Overbite x Curve of Spee	0.4916
Overbite x Interincisal Angle	0.1161
Overbite x Overjet	0.3379
Overjet x Interincisal Angle	-0.4275

Table 3. Correlation between the overbite, overjet, interincisal angle and curve of Spee means.

	Overbite			p value
	Ideal (n=6)	Increased 1/3 (n=5)	Decreased 1/3 (n=12)	
Overjet	13.54	9.20	20.25	0.026*
Interincisal angle	14.81	17.90	15.25	0.793
Curve of Spee	12.73	11.50	20.17	0.056

Table 4. Correlation between overjet and interincisal angle means.

	Overjet		p value
	Normal (n=23)	Increased (n=7)	
Interincisal angle	16.59	11.93	0.219

overbite was compared to overjet (Table 3), even though Spearman's correlation coefficient did not detect this correlation. There was a positive correlation between the values of overbite and curve of Spee (Table 2), and contradictorily, when these variables were compared in Table 3, there was no statistically significant difference between groups, although $p=0.056$ was slightly out of the 5% of probability.

DISCUSSION

The occlusion of the studied population was considered normal, although some patients presented anterior tooth crowding up to 3 mm, rotations and small alterations of overjet and overbite. The difficult to select individuals with normal occlusion has been reported elsewhere (15). Patient selection according to the concept of occlusal pattern can bring up a great variation because there are many definitions of normal occlusion (16).

The analyses of discrepancy showed values of anterior ratio (77.8) and overall ratio (91.4) very similar to those suggested by Bolton (8) (anterior ratio = 77.2 / overall ratio = 91.3) and by Uysal et al. (1) (anterior ratio = 78.26 / overall ratio = 89.88). These values were considered similar to the measurements of normal occlusion.

In the present study, only 5 cases showed anterior ratio slightly out of the normal variations suggested by Bolton (8), even though they were within the normal mean to the total ratio. This fact can be justified by posterior tooth size, arch shape compensations, thickness of incisal edge and axial inclinations (17).

The mean value of overbite was 2.45 mm, which is close to that found by Kim (18) (2.8 mm). It could not be compared to Bolton's overbite mean value (8) because this author measured overbite as percentage of mandibular incisor covered by maxillary incisor.

The mean value of overjet was 1.92 mm, which was similar to the mean value reported by Björk (19) and was greater than the mean value measured by Bolton (8) (0.74 mm).

The behavior of overjet according to overbite indicated a statistically significant relation ($p=0.026$), although there was a weak direct correlation between these two variables, as previously reported by Björk (19). Table 3 shows that a great percentage of overbite

corresponded to increased overjet.

Regarding the cephalometric analyses of the interincisal angle, the literature have shown different values. The mean value found in this study (129.27°) was similar to that obtained by Cerci (20). This value indicates a more accentuated incisor protrusion when compared to those of previous studies (13,14) and a less accentuated incisor protrusion when compared to those of other investigations (15,16). Bolton (8) found a value of 177° for the interincisal angle; however, this value cannot be compared to those of other studies because it was obtained from dental casts rather than from cephalometric films.

Andrews (11) stated that the ideal inclination of maxillary and mandibular incisors contributes significantly to a normal overbite. In this study, the comparison between these two variables did not indicate a correlation and the values did not differ significantly ($p=0.793$). In Table 4, the same behavior was found between interincisal angle and overjet ($p=0.219$).

Andrews (11) also suggested that 1 of the 6 keys to normal occlusion is the existence of a leveled occlusal plane or a mild curve of Spee, which was observed in the present study, with a mean value of 1.01 mm to the curve of occlusal plane. When the curve of Spee was compared to overbite, it was observed a weak correlation. Even though the values did not differ significantly, the p value ($p=0.056$) was close to the adopted 5% level of probability. An excessive overbite can be an indication of incorrect curve of Spee; in the same way, an exaggerated curve of Spee can be accompanied by an increased overbite (10).

The diversity of the Brazilian ethnical background is probably responsible for different characteristics from those observed in studies performed with Caucasian patients from other countries (2,6). The findings of this study give evidence of some characteristics of normal occlusal in the Brazilian population, which can be useful for future research in this field.

In conclusion, no Bolton discrepancy was found among the studied population, the values obtained to total and anterior ratios being very close to the normal values suggested by Bolton. Mean values of the characteristics for normal occlusion in Brazilians were as follows: overbite: 2.45 mm; overjet: 1.92 mm; curve of Spee: 1.01 mm and interincisal angle: 129.57° . A significant correlation was found between overjet and overbite.

RESUMO

O presente estudo foi realizado em modelos de gesso e radiografias cefalométricas laterais de 30 indivíduos brasileiros, leucodermas, sendo 15 do sexo feminino e 15 do sexo masculino, com idades variando de 18 anos a 27 anos e 4 meses, todos portadores de oclusão excelente e bom perfil facial. Os objetivos foram verificar a existência de discrepância dentária de Bolton, obter valores médios para a sobremordida (overbite), sobressaliência (overjet), curva de Spee e ângulo interincisivo e verificar a existência de correlação entre essas variáveis. As medições foram realizadas por um único avaliador e o procedimento realizado duas vezes com auxílio de um paquímetro digital modificado de alta precisão. Observou-se que a amostra de oclusão normal não apresentou discrepância dentária entre os doze dentes dos arcos opostos e as razões total (91,46) e anterior (77,83) foram próximos aos dos propostos por Bolton. Os valores médios encontrados como padrão para a amostra de oclusão normal de indivíduos brasileiros foram determinados em: 2,45 mm para a sobremordida; 1,92 mm para a sobressaliência; 1,01 mm para a curva de Spee e 129,57° para o ângulo interincisivo, havendo apenas correlação significativa entre sobressaliência e as classes de sobremordida.

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