RESEARCH ARTICLE

A Comparative Evaluation of Tooth Size Discrepancies in Different Types of Malocclusions by using Bolton's Analysis: An Odontometric Study

Harshala S Patil[1], Amit S Handa[2], Uddhav Y Alane[3]

Abstract

Patients attending orthodontic clinics normally complain of crowding or spacing or both, which represents big esthetic and functional problems. The link between the upper and lower teeth sizes and its repercussions on the occlusal harmony of these dental arches is a cause of major concern in orthodontic treatment. Hence, this study is carried out to compare the anterior and overall ratios of tooth sizes in different types of Angle's malocclusions. For this study, we examined and selected 100 patients from the Department of Orthodontics and Dentofacial Orthopedics, Aditya Dental College, Beed, Maharashtra, India and divided into 4 malocclusion groups namely Angle's class I (n = 25), Angle's class II (n = 50) [class II division 1 (n = 25), class II division 2 (n = 25)], Angle's class III (n = 25). For all selected patients the impressions were taken, casts were poured and models were prepared. Then the greatest width of the teeth from the first molar to the contralateral first molar was measured by using a caliper on the study models. The anterior and overall ratios between the maxillary and mandibular teeth were evaluated by using Bolton's analysis. All the parameters were subjected to statistical analysis.

Keywords: Beed, Bolton's ratio, Tooth-size discrepancy.

Journal of Oral Health and Community Dentistry (2019): 10.5005/jp-journals-10062-0040

Introduction

Patients attending dental clinics normally complain of crowding or spacing or both—big esthetic and functional problems. Orthodontic diagnosis and treatment planning seems challenging for clinicians from their ability aspect to cater to the optimum results for the individual in a systematic manner.[1] Interarch tooth size discrepancy is the most common hindrance in treatment planning. In normal occlusion 28 teeth are present, are well arranged, following Jackson's triad of functional efficiency, structural balance, and esthetic harmony.[2] One of the methods the one most commonly used is the Bolton analysis.[3] Bolton facilitated the treatment planning of the functional and esthetic outcomes of orthodontic cases. Black measured a large number of human teeth and tables recording their mean dimensions were constructed.[4] Ballard measured 500 sets of casts, compared the mesiodistal diameters of each tooth on 1 side of the dental arch with the opposite side. Gilpatric total mesiodistal tooth diameters in the maxillary arch exceeded those in the mandibular arch by 8–12 mm and a value greater than this resulted in an excessive overbite.[5] Neff defined the "anterior coefficient" to simplify the determination of the intermaxillary tooth-size relationship.[6]

Materials and Methods

Importance of Tooth-size Discrepancies

Tooth-size discrepancies is often an ignored aspect when it comes to retention. The arch coordination is difficult to achieve if we are unaware of the widths of the upper and lower teeth. To attain normal occlusion, intercuspation, and interdigitation of teeth, ideal overjet and overbite are essential. The tooth size must accommodate within the arch size to allow a smooth uncrowded arch.[7-9]

Materials

The study was conducted on dental study models of 100 individuals selected from Aditya Dental College, Beed, Maharashtra, India.

[1]MDS Second Year Student [2]Reader, [3]Senior Lecturer

[1-3]Department of Orthodontics, Aditya Dental College, Beed, Maharashtra, India

Corresponding Author: Harshala S Patil, MDS Second Year Student, Department of Orthodontics, Aditya Dental College, Beed, Maharashtra, India, e-mail: Drharshalapatil@gmail.com

How to cite this article: Patil HS, Handa AS, Alane UY. A Comparative Evaluation of Tooth Size Discrepancies in Different Types of Malocclusions by using Bolton's Analysis: An Odontometric Study. J Oral Health Comm Dent 2019;13(1):14-16.

Source of support: Nil

Conflict of interest: None

Criteria for Selection

- *Inclusion criteria:* All teeth up to the first molars in functional occlusion.
- *Exclusion criteria:* Previous orthodontic treatment, eroded and abrased teeth, fractures, carious teeth, overhanging restorations.

Methods

The patients were examined for the malocclusions and categorized into Angle's classes I, II (divisions 1 and 2) and III. Alginate impressions of the arches were taken, casts poured and study models prepared (care was taken that there were no voids or bubbles which would hamper the record taking process). A caliper with a precision error of 0.02 mm (Aerospace) was used to measure the greatest widths of the casts (Figs 1 and 2). Bolton formula for calculation of tooth size discrepancy was:

- Overall ratio = (Sum of mesiodistal widths of 12 mandibular teeth)/(Sum of mesiodistal widths of 12 maxillary teeth) × 1004
- Anterior ratio = (Sum of mesiodistal widths of 6 mandibular teeth)/(sum of mesiodistal widths of 6 maxillary teeth) × 1004
- The overall and anterior ratios of all malocclusions were compared with the ratios recommended by Bolton: 91.3 + 1.91 and 77.2 + 1.65 for overall and anterior ratio, respectively.[4]

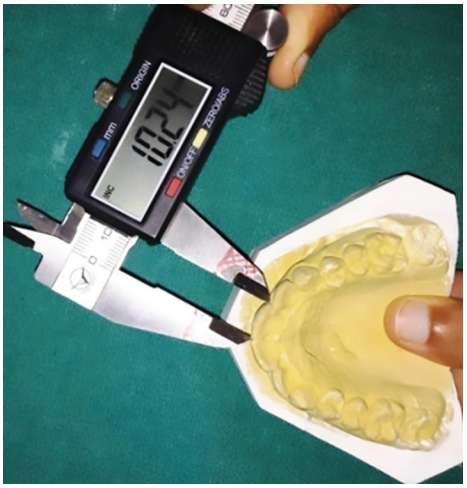

Fig. 1: Measurement at contact points on proximal surface parallel to occlusal surface

Fig. 2: Measurement at contact points on proximal surface parallel to vestibular surface

Statistical Analysis

The analysis of variance (one-way ANOVA) was used to compare the overall and anterior ratios among the malocclusion groups.

All statistical analysis was performed using statistical package for social sciences software (SPSS Inc. IBM Corporation, Chicago, IL, USA), with the level of significance of $p < 0.05$.

Results

The descriptive statistics of mean and standard deviation the three malocclusions are presented in the subsequent tables. Descriptive statistics of overall ratio, comparison of the anterior and overall ratio of each group with Bolton's ratio (77.2 + 1.65) and (91.3 + 1.91), respectively by independent t-test. Comparison of the anterior and overall ratios of tooth size discrepancies among malocclusion groups by one-way ANOVA test, post hoc test-Bolton's anterior and overall ratio (Table 1). The anterior and overall ratios of the three malocclusion groups exhibited no significant differences ($p > 0.05$) compared with the ratios recommended by Bolton4 (Tables 2 and 3). However, no significant differences were seen between the anterior and overall ratios (Tables 4 and 5). In Tables 6 to 9, each malocclusion group was independently compared with the remaining three malocclusion groups, and certain significant differences were found.

Table 1: Descriptive statistics of mean, standard deviation and amplitude for the three malocclusions are presented in the subsequent tables

Group	*N*	*Range*	*Min.*	*Max.*	*Mean*	*S.D.*	*S.E.*
Class I	25	18.37	67.34	85.71	78.9448	4.71688	0.9433
Class II Div 1	25	10.25	73.46	83.71	78.2820	3.08725	0.6174
Class II Div 2	25	10.53	73.91	84.44	79.1280	3.48065	0.6961
Class III	25	12.02	76.77	88.79	82.1440	2.94954	0.5899

Table 3: Descriptive statistics of overall ratio

Group	*N*	*Range*	*Min.*	*Max.*	*Mean*	*S.D.*	*S.E.*
Class I	25	15.84	81.62	97.46	91.3400	3.48284	0.6965
Class II Div 1	25	15.01	82.69	97.70	91.8152	3.73125	0.7462
Class II Div 2	25	10.28	87.36	97.64	93.1248	3.16352	0.6327
Class III	25	8.02	91.76	99.78	95.7952	2.37731	0.4754

Discussion

No statistically significant differences were found when comparing the anterior and overall of ratio each malocclusion group with Bolton's ratio. No statistically significant differences were observed in the mean anterior and mean overall ratio of the teeth between class I, class II (divisions 1 and 2), and class III malocclusion groups (mean anterior = 78.94, 78.28, 79.12, 82.14) and (mean overall = 91.34, 91.81, 93.12, 95.79). Although statistically significant differences were found between the malocclusion groups when comparing the anterior and overall ratios of tooth size discrepancies. Significant differences were found between Bolton's anterior of class I and III, class II divisions I and III, class II division 2 and III and Bolton's overall class I and III, class III division 1 and III, class II division 2 and III which were similar to the findings of Lavelle and Sperry which showed that patients with class III malocclusion have a greater tendency to present tooth size discrepancy than those with classes I and II.

Table 2: Descriptive statistics of anterior ratio

Gender	*Class I*	*Class II DIV 1*	*Class II Div 2*	*Class III*
	n (%)	n (%)	n (%)	n (%)
Male	12 (48)	12 (48)	14 (56)	13 (52)
Female	13 (52)	13 (52)	11 (44)	12 (48)
Total	25 (100)	25 (100)	25 (100)	25 (100)

Table 4: Comparison of the anterior ratio of each group with Bolton's ratio (77.2+1.65) by independent t-test

Group	*N*	*Min.*	*Max.*	*Mean*	*S.D.*	*t*	*p value*
Class I	25	67.34	85.71	78.9448	4.71688	0.011	0.991
Class II Div 1	25	73.46	83.71	78.2820	3.08725	0.135	0.893
Class II Div 2	25	73.91	84.44	79.1280	3.48065	0.566	0.577
Class III	25	76.77	88.79	82.1440	2.94954	1.854	0.076

Table 5: Comparison of the overall ratio of each group with Bolton's ratio (91.3+1.91) by independent t-test

Group	*N*	*Range*	*Min.*	*Max.*	*Mean*	*S.D.*	*t*	*p value*
Class I	25	15.84	81.62	97.46	91.3400	3.48284	0.363	0.720
Class II Div 1	25	15.01	82.69	97.70	91.8152	3.73125	0.344	0.734
Class II Div 2	25	10.28	87.36	97.64	93.1248	3.16352	0.543	0.592
Class III	25	8.02	91.76	99.78	95.7952	2.37731	1.644	0.113

Table 7: Post hoc test-Bolton's anterior ratio

Group		*Mean diff*	*S.E.*	*Sig.*
Class I BA	Class II Div 1 BA	0.66820	1.02562	0.917
	Class III BA	–3.19920*	1.02562	0.013
	Class II Div 2 BA	–0.18320	1.02562	0.998
Class Ii Div 1 BA	Class I BA	–0.66280	1.02562	0.917
	Class III BA	–3.86200*	1.02562	0.002
	Class II Div 2 BA	–0.84600	1.02562	0.843
Class II Div 2 BA	Class I BA	0.18320	1.02562	0.998
	Class II Div 1 BA	0.84600	1.02562	0.843
	Class III BA	–3.01600*	1.02562	0.021
Class III BA	Class I BA	3.19920*	1.02562	0.013
	Class II Div 1 BA	3.86200*	1.02562	0.002
	Class II Div 2 BA	3.01600*	1.02562	0.021

(BA = Bolton's anterior ratio)

Table 9: Post hoc test-Bolton's overall ratio

Group		*Mean diff*	*S.E.*	*Sig.*
Class I BO	Class II Div 1 BO	-0.47520	0.91337	0.954
	Class III BO	–4.45520*	0.91337	0.000
	Class II Div 2 BO	–1.78480	0.91337	0.213
Class II Div 1 BO	Class I BO	0.47520	0.91337	0.954
	Class III BO	–3.98000*	0.91337	0.000
	Class II Div 2 BO	–1.30960	0.91337	0.482
Class II Div 2 BO	Class I BO	1.78480	0.91337	0.213
	Class II Div 1 BO	1.30960	0.91337	0.482
	Class III BO	–2.67040*	0.91337	0.022
Class III BO	Class I BO	4.45520*	0.91337	0.000
	Class II Div 1 BO	3.98000*	0.91337	0. 000
	Class II Div 2 BO	2.67040*	0.91337	0.022

(BA = Bolton's anterior ratio)

Based on these results, we can conclude that class III malocclusion patients require tooth size discrepancy adjustments in order to achieve a harmonious relationship.

Tooth size discrepancy in the lower front area many a time compromises the treatment stability due to delayed crowding thereby hampering the final orthodontic treatment outcome.

Table 6: Comparison of the anterior ratios of tooth size discrepancies among malocclusion groups by one-way ANOVA test

Group	*N*	*Mean*	*S.D.*	*95% Confidence interval for mean*		*F*	*p value*
Class I	25	78.9448	4.71688	76.997	80.891	5.614	0.001
Class II Div 1	25	78.2820	3.08725	77.007	79.556		
Class II Div 2	25	79.1280	3.48065	77.691	80.564		
Class III	25	82.1440	2.94954	80.926	83.361		

Table 8: Comparison of the overall ratios of tooth size discrepancies among malocclusion groups by one-way ANOVA test

Group	*N*	*Mean*	*S.D.*	*95% Confidence interval for mean*		*F*	*p value*
Class I	25	91.340	3.482	89.902	92.777	9.579	0.000
Class II Div 1	25	91.815	3.731	90.275	93.355		
Class II Div 2	25	93.124	3.163	91.819	94.430		
Class III	25	95.795	2.377	94.813	96.776		

Conclusion

The difference in the upper and lower teeth size can be different in different populations.[10] Therefore, Bolton analysis should not be taken for granted during chalking out diagnosis and treatment modalities. Two treatment modalities in crowding cases are generally available for us that is an expansion of the arch or extraction. Thus, it is an orthodontist's concern to see to it that before wrapping up of the orthodontic treatment, patients have normal settled occlusion so that the result would satiate the orthodontist as well as the patient.

References

1. Hajar A. Tooth size discrepancy as a diagnostic tool for orthodontic treatment planning. Int Arab Jr of Dent 6(2):88-92.
2. Radrigo HC, Waldir GJ, Fabricio PV, et al. Association between Bolton discrepancy and Angle malocclusions Braz Oral Res 2015; 29(1):1-6.
3. Black GV. Descriptive anatomy of human teeth 4th ed. Philadelphia: SS White; pg.169.
4. Bolton WA. Disharmony in tooth size and its relation to the analysis and treatment of malocclusions Angle Orthod 1958;28(3):113-130.
5. Fattahi HR, Pakshir HR, Hedayati Z. Comparison of tooth size discrepancies among different malocclusions Eur J Orthod 2006;28(5):491-495.
6. Neff CW. Tailored occlusion with the anterior coefficient. Am J Orthod 1949 Apr;35(4):309-313.
7. Lundstrom A. Intermaxillary tooth width ratio and tooth alignment and occlusion Acta Odontol Scand 1955 Feb;12(3-4):265-292.
8. Bolton WA. The clinical application of a tooth-size analysis Am J Orthod 1962;48:504-529.
9. Hasija N, Bala M, Goyal V. Estimation of tooth size discrepancy among different malocclusion group Int J Clin Pediatr Dent 2014;7(2):82-85.
10. Crosby DR, Alexander CG,. The occurrence of tooth size dicrepancies in different malocclusion groups Am J Orthod 1989; 95(6):457-461.