

Survey on Bolton's Tooth Size Analysis as Applied to Artificial Teeth

C. L. Satish Babu · T. Sunil · M. S. Rani

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Abstract The presence of proportionate teeth size in either arch is a must to obtain an ideal occlusion with good alignment, ideal overjet, ideal overbite and Class I molar relationship. The above facts made us think and to know if this proportion between maxillary and mandibular teeth existed in artificial teeth also? Hence, a survey is undertaken to study the tooth size relation in commercially available artificial teeth. From the results of the present study it was concluded that the anterior and the overall ratios are slightly varied when compared to the standard Bolton's ratios. On comparison the difference between the study ratios and the standard Bolton's ratios were not statistically significant.

Keywords Bolton's tooth size ratio · Anterior ratio · Overall ratio

Introduction

Tooth size discrepancy assessment is very important in orthodontics. Many authors [1–4] studied tooth widths in relation to occlusion following Black's investigation [5]. Of all the studies the best known study was by Bolton [6] in 1958. Bolton [7] discussed the clinical application of his tooth size analysis in 1962. According to Othman and Harradine [8] specific dimensional relationship should exist between maxillary and mandibular teeth to ensure proper

interdigitation, overjet and overbite. Since similar objectives are desirable while arranging artificial teeth for edentulous patients, we undertook a study to determine if this proportion between maxillary and mandibular teeth existed in the commercially available artificial teeth also.

Aims and Objectives

Aim of this study was to assess the tooth proportion of, one of the commercially available artificial teeth sets.

The objective of this study was to assess the mean anterior and overall ratios of different moulds of commercially available artificial teeth using Bolton's tooth formula and also to compare these ratios with the standard Bolton's anterior and overall tooth size ratios.

Materials and Method

Twenty different moulds of artificial teeth sets of Acry Rock, manufactured by Ruthinium group (Italy) were included in the present study. All the teeth moulds were measured by three observers for Bolton's tooth size ratio. The total mesiodistal width of anterior teeth from canine to canine and the posterior teeth from molar to molar was measured for both maxillary and mandibular teeth using Vernier Calipers.

Anterior ratio was calculated by the following method:

Anterior ratio

$$= \frac{\text{Sum mesiodistal width of six mandibular anteriors}}{\text{Sum mesiodistal width of six maxillary anteriors}} \times 100$$

Mean value = 77.2%.

Overall ratio was calculated by the following method:

C. L. S. Babu
Department of Prosthodontics, V.S.Dental College and Hospital,
Bengaluru, India

T. Sunil (✉) · M. S. Rani
Department of Orthodontics, V.S.Dental College and Hospital,
Bengaluru, India
e-mail: dr.suneelgowda@gmail.com

Overall ratio

$$= \frac{\text{Sum mesiodistal width of the twelve mandibular teeth}}{\text{Sum mesiodistal width of the twelve maxillary teeth}} \times 100$$

Mean value = 91.3%

Results

Table 1 and Fig. 1 gives the descriptive statistics for the measurements made by three observers included in the study. The mean anterior ratio of the total samples made by Observer-1 was 77.08 ± 3.31 , the range varied between 72.09 and 85.94. The mean anterior ratio of the total samples made by Observer-2 was 77.55 ± 3.70 , the range varied between 70.60 and 86.57. The mean anterior ratio of the total samples made by Observer-3 was 77.97 ± 3.43 , the range varied between 73.00 and 87.26.

Table 2 and Fig. 2 gives the descriptive statistics for the measurements made by the three observers included in the study. The mean overall ratio of the total samples made by Observer-1 was 90.86 ± 2.42 , the range varied between 87.14 and 96.21. The mean anterior ratio of the total samples made by Observer-2 was 91.32 ± 3.07 , the range

Table 1 Descriptive statistics and comparison of anterior ratios between the three observers

Observer	Mean	Std dev	Min	Max	F	P-value
Observer 1	77.08	3.31	72.09	85.94	0.322	0.726
Observer 2	77.55	3.70	70.60	86.57		
Observer 3	77.97	3.43	73.00	87.26		

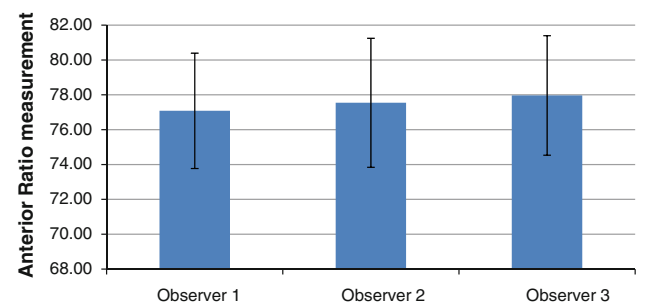


Fig. 1 Mean anterior ratio measurements recorded by the observers

Table 2 Descriptive statistics and comparison of overall ratios between the three observers

Observer	Mean	Std dev	Min	Max	F	P-value
Observer 1	90.86	2.42	87.14	96.21	0.170	0.844
Observer 2	91.32	3.07	87.38	98.83		
Observer 3	91.26	2.58	87.13	96.62		

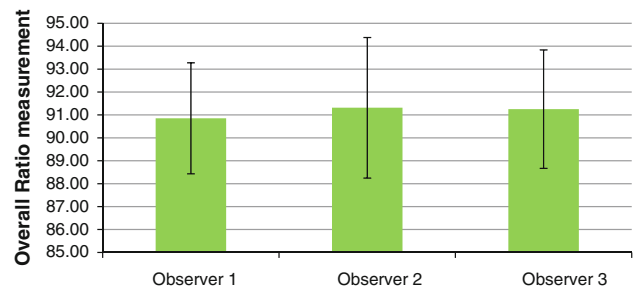


Fig. 2 Mean overall ratio measurements recorded by the observers

varied between 87.38 and 98.83. The mean anterior ratio of the total samples made by Observer-3 was 91.26 ± 2.58 , the range varied between 87.13 and 96.62.

Discussion

Smith et al. [9] stated that specific dimensional relationships must exist between the maxillary and mandibular teeth to ensure proper interdigitation, overbite and overjet at the end of orthodontic treatment. This much can be readily accepted, but the important question remains as to what size of discrepancy is clinically significant in making an acceptable occlusion unachievable unless tooth size is altered by interdental stripping or restorative addition and in case of artificial teeth by suitably modifying it.

The difference in the measurements made by the three different observers was not statistically significant, either for the anterior ratio or the overall ratio ($P > 0.05$) as in Tables 1 and 2.

Though a marginally higher mean value of the anterior ratio of the artificial teeth moulds was observed as compared to the standard Bolton’s anterior ratio value, but the difference was not significant statistically ($P > 0.05$) Table 3 and Fig. 3.

Similarly, a marginally higher mean value of the overall ratio of the artificial teeth moulds was observed as compared to the standard Bolton’s overall ratio value, but the difference was not significant statistically ($P > 0.05$) Table 4 and Fig. 4.

The limitation of the present study was that only twenty moulds of Acry Rock teeth manufactured by Ruthinium Company were included in the study. Further studies can be carried out using a larger samples by including all the other popular moulds available in the market.

Table 3 Comparison of mean anterior ratio with the standard ratio

Group	Mean	Std dev	Mean difference	t	P-value
Standard value	77.20	1.65	-0.330	-0.820	0.413
Study value	77.53	3.44			

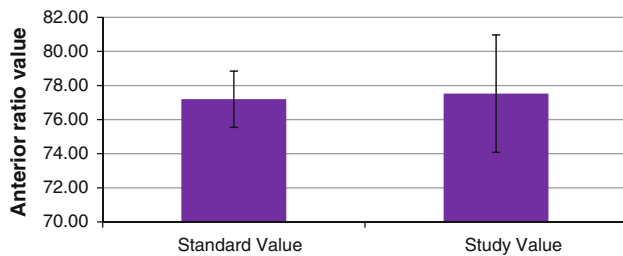


Fig. 3 Comparison of mean anterior ratio with the standard ratio

Table 4 Comparison of mean overall ratio with the standard ratio

Group	Mean	Std dev	Mean difference	<i>t</i>	<i>P</i> -value
Standard value	91.30	1.91	0.160	0.460	0.644
Study value	91.14	2.67			

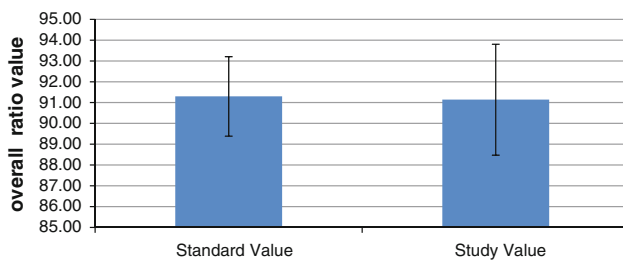


Fig. 4 Comparison of mean overall ratio with the standard ratio

Summary and Conclusion

The natural or artificial teeth with proportionate size relative to the either arches is necessary to obtain an ideal occlusion with good alignment, ideal overjet, ideal overbite and Class I molar relationship. Disproportionate tooth size may lead to difficulty in achieving the desirable occlusion. This study was undertaken to determine if the Bolton's tooth size ratio was present in the commercially available artificial teeth. Twenty different moulds of artificial teeth sets were used in this study. The measurements were made by three different observers using Vernier Calipers. The

comparison of the mean proportions (anterior and overall ratios) of the artificial teeth as compared with the Bolton's standard values was not significant statistically. Following conclusions were drawn from this study:

1. The mean anterior ratio (77.53) was marginally higher than the Bolton's standard anterior tooth size ratio (77.2), but the difference in mean anterior ratios between these two groups was not significant statistically ($P > 0.05$).
2. The mean overall ratio (91.14) was marginally higher than the Bolton's standard overall tooth size ratio (91.3), but the difference in mean overall ratios between these two groups was not significant statistically ($P > 0.05$).

Further studies using a larger sample size by including all the other popular moulds available in the market is desirable to determine if the desired proportion exists in other commercially available artificial teeth also.

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