Research Article

Bolton tooth size discrepancy among different malocclusion groups in two different ethnic groups of Nepalese population

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ABSTRACT

Introduction: The tooth size ratios may vary among different ethnic groups and different malocclusion groups. The objective of this study is to see the tooth size discrepancies in two major ethnic groups of Nepal; Indo-Aryans and Tibeto-Burmans and different malocclusion groups and compare it with the Bolton's study.

Materials and Method: The anterior and overall ratios were compared between Indo-Aryans and Tibeto-Burmans according to different malocclusion groups with Bolton's study with one sample t-test. The differences in ratios in ethnic groups and gender were seen with one sample t-test. The differences in mesio-distal tooth width amongst the two ethnic groups were seen. One sample ANOVA was used to see any correlation between the ethnic groups and the different malocclusion groups.

Result: The anterior ratio and overall ratio in Indo- Aryans and Tibeto-Burmans in all the malocclusion groups were greater than the Bolton's study but was not statistically significant. There was significant differences in anterior ratio between Indo-Aryans (77.63 + 2.74%) and Tibeto-Burmans (78.51 + 2.76%), p value= 0.024. There were no statistical significant differences in the anterior and overall ratio amongst males and females. The mesio-distal tooth size was greater in Tibeto-Burmans as compared to Indo-Aryans expect for maxillary right and left central incisors.

Conclusion: The Tibeto-Burmans had higher anterior ratio as compared to Indo-Aryans. The Tibeto-Burmans had broader teeth as compared to Indo-Aryans except for maxillary central incisors.

KEYWORDS: Bolton's study, Ethnic variation, Tooth size discrepancies

INTRODUCTION

Tooth size discrepancy is the disproportion between teeth sizes of same arch or between opposing arches in the anterior segment or both anterior and posterior segment.[1] In some cases during the finishing phase of the treatment it is difficult to co-ordinate the maxillary and mandibular arches due to tooth size discrepancies. Wayne Bolton in 1958 generated equation to determine the anterior and overall ratio for tooth size discrepancy between maxillary and mandibular arches from fifty-five dental casts with ideal occlusion.[2]

Researchers have shown that there are tooth size discrepancies in different malocclusion groups.[3,4] Araujo and Souki[5] found that Class I and Class III patients had greater tooth size discrepancy than Class II patients with mandibular tooth size excess and smaller maxillary teeth in Class III malocclusion groups.[5,6] Mahmoud NM et al.[4] found Class II Div 1 to have more tooth size materials in maxillary arch and Class II Div 2 to have more tooth size material in mandibular arch. Some other studies done by Uysal T and Sari Z,[7] Crosby

DR and Alexander CG,[8] Johe RS et al.[9] and Smith SS et al.[10] showed no differences in tooth size discrepancies in different malocclusion groups.

Studies have shown that there is variation in tooth size ratios in different ethnic group.[11,12] In contrary some other studies have shown no differences in tooth size ratio in various ethnic groups.[10,13] Broadly classifying Nepal is inhabited by three major ethnic groups based on place of origin and language; Tibeto-Burman, Indo-Aryan and Indigenous.[14] The major population groups of Gandaki Province of Nepal are Brahmins 21%, Magars 19%, Chettris 13% and Gurungs 11%.[15] These populations are grouped based on ethnic origin into Indo-Aryan and Tibeto-Burman. The Indo-Aryan includes Brahmins and Chettris and Tibeto-Burman includes Magars and Gurungs.[14, 16] Tooth size discrepancies in different ethnic groups and different malocclusion groups have not been studied in Nepalese population. This study attempts to find out any tooth size discrepancies prevalent in two different ethnic groups included in the study and different malocclusion groups.

MATERIALS AND METHOD

This was a hospital-based cross-sectional study conducted at College of Dental Surgery, Gandaki Medical College for a period of four months from May 2020 to Oct 2020 after obtaining ethical clearance from institutional review board (Ref no: 022/2076/2077). Sample size calculation was based on 80% power and significance level of 5%[17] and considering 0.75 as maximum tolerable error rate and based on standard deviation of 2.5.

$$N=[Z+(1-ß)]^2 X\ SD^2/L^2=\frac{(1.96+0.84)^2 X 2.5^2}{0.75x0.75}=87.11$$

Where, Z=Confidence interval (95%, CI=1.96), ß=probability of type II error= 0.16 , Standard Deviation= 2.5, L= tolerable error=0.75 and N=Sample size. The sample size came to be 87.11. The sample consisted of 200 patients, 100 in each group. The patients visiting outpatient department of College of Dental Surgery, Gandaki Medical College were screened after getting the informed consent. The inclusion criteria were 1) Individuals of specified ethnic origin Brahmins, Chettris, Magars and Gurungs of Nepalese origin which was supported with surname, place of origin and with no inter-ethnic mixing with inter-caste marriage which was assessed for two generations from history taking. 2) Age group 12-35 years; considering the most common age group visiting department of orthodontic[18] 3) All set of permanent teeth should be erupted excluding third molars. The exclusion criteria were 1) Individuals with over-retained deciduous teeth 2) Individuals with proximal caries, abnormal morphology of teeth, missing teeth. 3) Individuals with history of orthodontic treatment. After the clinical examination alginate impressions of maxillary and mandibular arches were made for individuals meeting the inclusion criteria. The impressions were poured with dental stone to make study models. The mesio-distal width of 12 teeth from first molar to first molar on both maxillary and mandibular arches were measured with digital vernier caliper with accuracy of 0.01mm by a single operator who is an orthodontist. To avoid examiner fatigue only 10 study models were be measured in a day.

Bolton's anterior and over all tooth size ratio was calculated. The individuals were grouped according to Angle's molar relations into Angle Class I, Class II and Class III.

Twenty percentages of the samples that is 40 study models were re-measured by same investigator after two weeks and intra-class coefficient correlation was used to see for intra-examiner reliability. The data management was performed using SPSS software (version 20; SPSS Inc., Chicago, IL, USA). Bolton's anterior and overall tooth size ratios were calculated. The distribution of individuals according to Angle's molar relationship into Angles Class I, Class II and Class III was calculated. One sample *t*-test was used to compare the tooth size discrepancies in Class I, Class II and Class III malocclusion groups in Indo-Aryans and Tibeto-Burmans with Bolton's norms. The comparisons of tooth size discrepancies between two ethnic groups was done with one sample *t*-test and were compared with Bolton's study with one sample *t*-test. The difference in tooth size discrepancies between males and females in the two ethnic groups was also seen with one sample *t*-test. The mesio-distal tooth size of maxillary 12 and mandibular 12 teeth were compared between the two ethnic groups with one sample t-test. Correlation between tooth size discrepancies and angles malocclusion groups in Indo-Aryans and Tibeto-Burmans was seen with one way ANOVA. The results were considered significant at the 5% uncertainty level ($p<0.05$).

RESULT

Study models of 200 patients with average age 17.77±5.11 years were analyzed in the study. Out of them 100 were Indo-Aryans and 100 were Tibeto-Burmans. Ninety three (46.50%) were females and 107(53.50%) were males. The distribution of patients according to Angles malocclusion was Class I 105 (52.50%), Class II 62 (31%) and Class III 33(16.50%). Intra-examiner reliability was seen with intra-class coefficient correlation, which showed the intra class correlation ranged from 95.1 to 99.6 suggesting reliability in intra-examiner measurements. The anterior ratio and overall ratio in Indo-Aryans and Tibeto-Burmans in all the malocclusion groups were greater than the Bolton's study but was not statistically significant (Table 1).There was significant differences in anterior ratio between Indo-Aryans 77.63±2.74% and Tibeto-Burmans 78.51±2.76%, *p*-value=0.024 (Table 2). The overall ratio of Tibeto-Burmans 92.22±2.42% was slightly greater than the Indo-Aryans 92.19±2.30% with no statistical significance (Table 2). There were no significant differences in anterior ratio and overall ratio of both ethnic groups when compared with the Bolton's study (Table 2). There were no statistical significant differences in the anterior and overall ratio amongst males and females of both ethnic groups but the males had higher anterior and overall ratios (Table 3).

The mesio-distal tooth size was greater in Tibeto-Burmans as compared to Indo-Aryans expect for maxillary right and left central incisors which was greater in Indo-Aryans (Table 4). The mesio-distal width of maxillary right canine, first premolar ,second premolar, maxillary left first premolar, second premolar, first molar, mandibular left canine, first premolar, first molar, mandibular right canine, first premolar and first molar were significantly greater in Tibeto-Burmans as compared to Indo-Aryans (Table 4). One way ANOVA showed no correlation in the ratios between the Indo-Aryans and Tibeto-Burmans when compared with Class I, Class II and Class III malocclusion groups (Table 5).

Table 1.Comparison of tooth size discrepancies in Class I, II and III malocclusion groups in Indo-Aryans and Tibeto-Burmans with Bolton's study

Ethnic Groups	Angle's Malocclusion	n	Anterior ratio Mean±SD		p-value	Overall ratio Mean±SD		p-value
			Present Study	Bolton's Study		Present Study	Bolton's Study	
Indo-Aryans	I	47	77.41±2.54	77.2±1.65	0.935	91.94±2.22	91.3±1.91	0.776
	II	41	77.93±2.44		0.768	92.42±2.22		0.621
	III	12	77.42±4.25		0.962	92.40±2.98		0.730
Tibeto-Burmans	I	58	78.41±2.52		0.634	92.02±1.99		0.721
	II	21	78.16±2.15		0.667	91.93±2.43		0.802
	III	21	78.99±3.83		0.653	92.92±3.32		0.639

Table 2.Comparison of tooth size discrepancies between Indo-Aryans and Tibeto-Burmans and with Bolton's study

Ethnic Groups	Anterior ratio		p-value	Overall ratio		p-value
	Present Study Mean±SD	Bolton's Study Mean±SD		Present Study Mean±SD	Bolton's Study Mean±SD	
Indo-Aryans	77.63±2.74	77.2±1.65	0.877	92.19±2.30	91.3±1.91	0.701
Tibeto-Burmans	78.51±2.76		0.638	92.22±2.42		0.705
p-value	0.024*			0.928		

*Significant p<0.05

Table 3.Comparison of tooth size discrepancies in males and females in Indo-Aryans and Tibeto-Burmans

Ethnic Groups	Anterior ratio		p-value	Overall ratio		p-value
	Male Mean±SD	Female Mean±SD		Male Mean±SD	Female Mean±SD	
Indo-Aryans n=100	77.84±2.69	77.39±2.80	0.422	92.49±2.33	91.86±2.26	0.166
Tibeto-Burmans n=100	78.95±2.72	77.97±2.75	0.079	92.56±2.52	91.81±2.24	0.121

Table 4. Comparison of mesio-distal tooth size between Indo-Aryans and Tibeto-Burmans values are presented as mean±standard deviation

Quadrant	Tooth	Indo- Aryans Mean±SD	Tibeto-Burmans Mean±SD	*p*-value
Maxillary right	11	8.90±0.54	8.84±0.64	0.448
	12	7.22±0.64	7.34±0.59	0.168
	13	7.99±0.45	8.13±0.46	0.034*
	14	7.16±0.46	7.52±0.52	0.001*
	15	6.79±0.44	6.97±0.56	0.009*
	16	10.18±0.51	10.31±0.59	0.085
Maxillary left	21	8.89±0.54	8.84±0.64	0.235
	22	7.12±0.58	7.28±0.65	0.064
	23	7.93±0.46	8.06±0.46	0.058
	24	7.19±0.44	7.58±0.50	0.001*
	25	6.74±0.46	6.96±0.53	0.002*
	26	10.09±0.48	10.29±0.54	0.008*
Mandibular left	31	5.56±0.35	5.58±0.38	0.635
	32	6.15±0.42	6.24±0.46	0.158
	33	6.99±0.42	7.22±0.46	0.001*
	34	7.32±0.49	7.50±0.50	0.009*
	35	7.19±0.54	7.32±0.53	0.099
	36	11.28±0.59	11.47±0.65	0.037*
Mandibular right	41	5.54±0.36	5.58±0.39	0.448
	42	6.13±0.39	6.23±0.45	0.099
	43	6.92±0.44	7.18±0.44	0.001*
	44	7.27±0.56	7.43±0.49	0.032*
	45	7.17±0.59	7.27±0.57	0.250
	46	11.18±0.67	11.43±0.65	0.009*

*Significant p<0.05

Table 5.Correlation between anterior ratio and overall ratio and Angle's malocclusion groups in two ethnic groups

Ethnicity	TSD	Class I Mean±SD	Class II Mean±SD	Class III Mean±SD	Total	p-value
Indo-Aryans (n=100)	Anterior ratio	77.41±2.54	77.93±2.44	77.42±4.25	77.63±2.74	0.650
	Overall ratio	91.94±2.22	92.42±2.22	92.40±2.98	92.19±2.30	0.595
Tibeto-Burmans (n=100)	Anterior ratio	78.41±2.52	78.16±2.15	78.99±3.83	78.51±2.76	0.616
	Overall ratio	92.02±1.99	91.93±2.43	92.92±3.32	92.22±2.42	0.325

DISCUSSION

Tooth size a discrepancy is based on ethnicity.[13] Our study showed that there was significant greater anterior ratio in Tibeto-Burmans 78.51±2.76% as compared to Indo-Aryans 77.63±2.74%, p= 0.024. The overall ratio was greater in Tibeto-Burmans 92.22±2.42% as compared to Indo-Aryans 92.19±2.30% but was not statistically significant. Similar results were seen in study done by Mulimani et al.,[3] the Chinese ethnic group had greater anterior tooth size ratio 78.1±2.23% than the Malay and Indian. The overall ratio amongst the Chinese, Malay and Indian in the Malaysian orthodontic patients was comparable which is in agreement with the present study.[3] The greater anterior ratio amongst the Tibeto-Burmans could be attributed to the greater number of patients with Class III malocclusion (n= 21, 21%) in this ethnicity as compared to Indo-Aryans (n= 12,12%). Strujic et al.[19] and Mahmound NM et al.[4] Sudanese in their study also showed there was increase in the ratio amongst Class III malocclusion groups.[4]

The anterior and overall ratios of both the ethnic groups as compared to Bolton's norms was higher but showed no significant differences (Table 2). The finding for the overall ratio was consistent with a study done in Nepalese population by Mishra et al.[20] but the finding for anterior ratio was contradicting. The anterior ratio in the study done by Mishra et al. showed significant greater ratio as compared to Bolton's norms. This difference could be attributed to the differences in ethnic inclusion in samples of two studies.

In our study there were no significant differences in anterior and overall ratio in between different malocclusion groups within the two ethnic groups when compared to the Bolton's study but the ratios were slightly higher than the Bolton's study which is in accordance to the findings by Machado V et al.[21] in their systematic review and meta-analysis (Table 1). This is in accordance to the study done by O' Mahony et al.[22] and Uysal and Sari[7]. This is also in accordance to study done by Mishra et al.[20] in Nepalese population who compared the tooth size discrepancies in normal occlusion, Class I malocclusion and Class II malocclusion groups. Our study showed that there was no difference in both anterior and overall ratio as compared between males and females (Table 3). This is in agreement with the study done by Mishra et al.[20] and Hong et al.[23] in Nepalese population, M.A Ismail et al.[24] and Mahmound NM et al.[4] in Sudanese population, Endo et al.[25] in Japanese population. This finding is in contrary to the study done in Nepalese population by Jaiswal A et al.[26] They found the males have significantly higher anterior ratio as compared to females. This difference again could be attributed to ethnic distribution in the sample size considered.

The Tibeto-Burmans in this study had greater mesio-distal tooth dimension as compared to Indo-Aryans except for the maxillary central incisors. The mesio-distal width of maxillary right canine, first premolar, second premolar, maxillary left first premolar, second premolar, first molar, mandibular left canine, first premolar, first molar, mandibular right canine, first premolar and first molar showed statistically greater value in Tibeto-Burmans as compared to Indo-Aryans (Table 4). The variation of tooth size with ethnic group is in concordance with study done in Nepalese population by Shrestha RM,[27] in Saudi Arabian patients by Togoo RA et al.[28]

The greater anterior ratio in Tibeto-Burmans in this study indicates that this group of patients might need inter-proximal reduction of tooth size material in mandibular anterior region in order to achieve optimal overjet, overbite and midline relationship. This consideration during the diagnosis and treatment planning stage might help clinician achieve good treatment results.

CONCLUSION

There were no significant differences in anterior ratio and overall ratio in Indo-Aryans and Tibeto-Burmans in different malocclusion groups as compared to Bolton's original ratio. The Tibeto-Burmans had higher anterior ratio as compared to Indo-Aryans. There were no significant differences in anterior and overall ratio in between males and females. There were statistical differences in mesio-distal tooth size as compared between Indo-Aryans and Tibeto-Burmans.

CONFLICTS OF INTEREST

No potential conflict of interest relevant to this article was reported.

ACKNOWLEDGEMENTS

We would like to thank Dr. Ima Gurung for helping with collection and compilation of data in this study.

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