Original

Study and Comparison of Tooth Size and Arch Length in Angle Class III Malocclusion Between Nepalese and Chinese Population

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Abstract: Angle class III malocclusion are very hard to treat only by orthodontic method for most adults. So in this study we have measured The mesio-distal tooth size and arch length on the dental casts of total 39 pairs (17Chinese,22Nepalese) of Angle class III malocclusion, Upper lateral incisor, upper canine and upper second premolar shows significant difference between Nepalese and Chinese (P=0.02, P=.01, P=.003). Lower teeth show no significant difference between Nepalese and Chinese. Among Nepalese male and female lower lateral incisors, second premolar molar show significant difference (P=0.035, P=0.032, P=0.049), second premolar shows significant difference between Nepalese male and female (P=0.020). Among Chinese male and female shows no significant difference between upper teeth while lower first molar shows significant difference (P=0.041, P=0.00). For Nepalese OR 90.42 and AR 78.76 while for Chinese OR 89.58 and AR 78.16. No significant difference between Chinese and Nepalese OR and AR. Upper arch length for Nepalese male and female having angle class III malocclusion are 79.5 and 77 respectively. Lower arch length for Nepalese male and female with Angle class III malocclusion are 73.8 and 69.25. Among Nepalese upper arch length between male and female (P<0.05) shows significant difference but no significant difference between male and female in lower arch length (P>0.05). For Nepalese male the space lack for upper jaw is 3.7mm and for lower jaw 6.6mm.

key words: Arch length, Bolton ratio, Class III malocclusion, Tooth size.

Introduction

The occurance of class III malocclusion is believed to be hereditary although environmental factors such as habits and mouth breathing may play a important role[1,2]. The prevalence of class III malocclusion varies among different ethnic groups. In Asian societies the frequency of Class III malocclusion is higher due to a larger percentage of patients with maxillary deficiency[3]. The incidence of Class III malocclussion ranges between 4 to 13 percent among the Japanese [4] and 4 to14 percent among the Chinese[5]. Early detection of all types of malocclusion is very essential. El Mangoury[6] in his study of epidemiological panorama of dental occlusion on 501 Caucasoid sample resident of Egypt found that a great number of general dentist fail to detect the Angle class III malocclusion. Anterior crossbite is not a sole diagnostic criteria for class III malocclusion because Angle class III type 1 (edge to edge) is more common than Angle class III type 2 (normal anterior overbite) and Angle class III type 3 (anterior cross bite).With this findings he stated that early detection of all malocclusion helps in preventive, interceptive orthodontic and dentofacial orthopedic for young patient to avoid or to minimize the occurrence of class III malocclusion at the adult stage[6]. There are 3 type Angle class III malocclusion s : (1)Dental (2)functional (3) skeletal

Angle class III dental and functional type of malocclusion are easier one to treat than skeletal malocclusion[7]. Children usually will have dental and functional type, so if not treated on time the condition will be worse and it may turn into skeletal type, which is the most difficult and challenging one to treat. The facial profile seems concave which may need surgery[8]. Preventive orthodontics by its vary nature requires a continuous, long range approach. Without preventive treatment the complex time table of growth, development, tissue differentiation, reabsorbing eruption all under the influence of

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continuous functional force that can't be assure. Preventive orthodontics means a dynamic ever constant vigilance, a routine, a discipline for both doctor and patient[8] Interceptive orthodontics deal with the malocclusion as a faith accomplice, at least to minor degree. if this proper service is given with dispatch, autonomous adjustment it will restore normal occlusion.. If not treated immediately then corrective orthodontic treatment is needed. This study was done to find out the tooth size discrepancy in anterior ratio and overall ratio for class III malocclusion patients by comparing with the normal values for both Nepalese and Chinese subjects and also to find whether mandibular teeth size are larger and maxillary teeth are smaller than that of maxillary and mandibular teeth of class I normal occlusion subjects. This study was also done to compare among class III subjects of Nepalese and Chinese population to see whether any significant difference in the overall ratio and anterior ratio for these two races.

Prevalence of class III malocclusion in Nepalese is 8%[9] and for Chinese from 0-6 years is 14.94%, for 6-12 years is 9.65 % and from 12-18 years1is 4.98%[7]. Mesio–distal tooth width has an anthropological significant because it provides valuable information on human evolution with technological and dietary changes[10]. On a clinical level mesio-distal tooth width is correlated to the arch aliment and large tooth associated with crowded dental arches. The size and form of dental arches can have considerable implication in orthodontic diagnosis and treatment planning, affecting the space availability, dental esthetic and stability of dentition [11]. G V Black [12] conduct on most classical investigation on the subject of tooth size. Investigators have strongly recommended the early detection of all classes of malocclusion [6]. Furthermore the endorse preventive, interceptive orthodontics and dentofacial orthopedic for young patient to avoid or at least to minimized the occurrence of class III malocclusion at the adult stage. The prevalence of class III malocclusion report to be 16.8 percent by Garner and Butt [1]children in the region of Kenya, and a 3.5 percent incidence of class III malocclusion was found in Turkey[13] . Braun at al[14] indicated that the mandibular dental arch associated with class III malocclusion are wider than class I mandibular arches beginning in premolar area .

Factors causing variation in tooth size

Nutrition was discussed as main cause of retarded growth during World War II[15].

Vitamin deficiencies in pregnant rats shows 2 to 8 percent reduction in mesio-distal tooth size of offspring's[16].

Protein deficiency or calorie deficiency shows that tooth size was affected. Experiment was done in pigs[17]

Orthodontic treatment should result in appropriate point of contact between neighboring teeth. Proportions in tooth sizes are needed to achieve this [18,19] However some discrepancies between tooth size are not apparent until the final stage of orthodontic treatment[18,19]. Correct tooth size relationship between maxillary and mandibular teeth is an important factor to achieve a proper occlusal interdigitation[20]. Several methods have been describe to evaluate interact tooth size relationship such as Kesling's diagonistic setup[21], Neff's anterior coefficient[22, 23]

and Boltons anterior ratio for six anterior teeth and overall ratio for 12 teeth[20, 24] Many factors such as heredity, growth of the bone, eruption and inclination of the teeth, external influence, function and ethnic background would affect the size and shape of dental arches [25 – 28] Bolton analysis is the most widely used method[24] Bolton in 1958 analyzed the relationship between the mesiodistal tooth width of maxillary and mandibular teeth by studying 55 Caucasian subjects with excellent occlusion[29]. Bolton in 1958 develop a method of analyzing the mesiodistal tooth size ratio between maxillary and mandibular teeth. He conduct that it would be difficult for proper occlusal interdigition or coordination of arches in the finishing stage of treatment with out a proper mesiodistal tooth size ratio between the maxillary and mandibular teeth[30] .

Materials and Methods

1. Sample

A samples of total 39 subjects (17 Chinese and 22 Nepalese) with angle class III malocclusion were selected from the patient's record files.17 Chinese (10 male and 7 female) subjects were collected from faculty of Dentistry, Department of Orthodontics, Dalian Medical University, China. 22 Nepalese (12 male and 10 female) subjects were collected from Department of Orthodontics, faculty of Dentistry, Samaj Dental Hospital, Orthodontic Centre Kathmandu Plaza, Nepal.. The subjects age range from 15 to 24 years for both Chinese and Nepalese .

The inclusion criteria

(1) Bilateral class III molar relationship in centric occlusion with the cups tip of the maxillary second premolar from the buccal groove of the mandibular first molar.

(2) Class III permanent canine relationship.

(3) All subjects having all anterior teeth overlapped by lower anterior teeth.

(4) All teeth were present except third molar.

(5) All permanent teeth fully erupted to the occlusal plane.

(6) No history of trauma, any maxillofacial surgery, any previous orthodontics or any post-orthodontic treatment.

(7) No medical history.

(8) All casts were of good quality with no evidences of air bubbles, no tooth fractures, no abnormal shape.

(9)No caries, and no attritions.

2. Materials

(1) Dental stone (Nepalese) made in India (Densply), Dental stone (Chinese) made in China (Heraeus).

(2) Vernier caliper (made in Germany, 0.1mm accuracy).

(3) SPSS version 11.5 (software package for the social science).

(4) Computer (made in China, HP Compaq).

(5) Brass wire of 0.25 inch diameter.

3 .Cast measurement

Measurements were made directly on plaster casts. The following

variables were measured.

(1) Mesiodistal tooth width

The caliper beaks were insert from the facial aspect of the tooth and held perpendicular to the long axis of the tooth. The beaks were then closed until gentle contact with the predetermined contact point of the tooth was made The measurements included the mesiodistal width of all twelve maxillary and twelve mandibular teeth from right first permanent molar to the left first permanent molar on 39 pairs of casts.

(2) Arch length: (with brass wire of 0.25 inch diameter)

The distance from the distal surface of the second premolar to the distal surface of the lateral incisor and from there to the midline. This was repeated on both sides. These values were computed to determine the arch length in each arch.

4. Bolton analysis

(1) AR = Sum of the mesiodistal width of mandibular six (canine to canine) ×100/Sum of the mesiodistal width of maxillary six (canine to canine) .

(2) OR = Sum of the mesiodistal width of mandibular twelve (first molar to first molar) ×100/Sum of the mesiodistal width of maxillary twelve (first molar to first molar).

5. Descriptive statistic

The data of the present study were subjected to statistical analysis utilizing a computer program SPSS, Statistical Package for the Social Science, version 11.5. The mean and standard deviation for each tooth in both races (Chinese and Neplease) were calculated. Mesiodistal tooth width comparison between Chinese and Neplease were made for each tooth using Statistical analysis were performed with a software package (Version 11.5, SPSS). Mean, standard deviation, minimum, maximum, coefficient of correlation, independent t-test were calculated.

Table 1: Mean and SD of upper teeth Nepalese. (SD: Standard deviation)

Teeth	Gender	Mean	SD	Significance
U1	M	8.70	1.18	0.541
	F	8.83	0.61546	
U2	M	7.30	0.63246	0.121
	F	6.75	0.86603	
U3	M	7.95	0.79757	0.861
	F	7.37	0.82916	
U4	M	7.20	0.67495	0.901
	F	7.12	0.74239	
U5	M	6.75	0.58926	0.064
	F	7.20	1.09665	
U6	M	11.05	0.55025	0.235
	F	10.71	0.72169	

1. Tooth size

Upper lateral incisor, upper canine and upper second premolar shows significant difference between Nepalese and Chinese ($P=0.02$, $P=01$, $P=0.03$ respectively). Lower teeth show no significant difference between Nepalese and Chinese. Among Nepalese male

Table 2: Mean and SD of lower teeth Nepalese (SD: Standard Deviation)

Teeth	Gender	Mean	SD	Significance
L1	M	5.7000	0.42164	0.119
	F	5.5000	0.56408	
L2	M	6.3000	0.53748	0.229
	F	5.9583	0.45017	
L3	M	7.0500	0.72457	0.694
	F	6.4167	0.46872	
L4	M	7.3000	0.58689	0.336
	F	6.7083	0.86493	
L5	M	7.2500	0.54006	0.057
	F	7.3333	1.00755	
L6	M	11.4000	0.56765	0.163
	F	10.8333	0.44381	

Table 3: Mean and SD of upper teeth Chinese (SD :Standard Deviation)

Teeth	Gender	Mean	SD	Significance
U1	M	8.9318	0.52549	0.603
	F	8.6667	0.51640	
U2	M	7.0000	0.38730	0.267
	F	6.7917	0.45871	
U3	M	8.0227	0.50565	0.259
	F	7.8333	0.76920	
U4	M	7.5455	0.85013	0.102
	F	7.2917	0.40052	
U5	M	7.0682	0.65279	0.038
	F	7.0417	0.24580	
U6	M	11.5455	0.72300	0.011
	F	11.0833	0.20412	

and female lower lateral incisors, second premolar and lower molar show significant difference ($P=0.035$, $P=0.032$, $P=0.049$) (table 2). Upper second premolar shows significant difference between Nepalese male and female ($P=0.020$) (table 1). Among Chinese male and female show no significant difference between upper teeth (Table 3), while lower canine and lower first molar shows significant difference ($P=0.041$, $P=0.001$) (Table 4).

2. Arch length

Mean upper arch length for Nepalese male and female having Angle

Table 4: Mean and SD of lower teeth Chinese (SD: Standard Deviation)

Teeth	Gender	Mean	SD	Significance
L1	M	5.8409	0.55083	0.514
	F	5.3333	0.60553	
L2	M	6.0000	0.48734	0.335
	F	5.9167	0.68313	
L3	M	6.8636	0.58485	0.274
	F	6.9667	0.38297	
L4	M	7.2500	0.60208	0.642
	F	7.1667	0.7692	
L5	M	7.2500	0.62249	0.746
	F	7.5000	0.63246	
L6	M	11.4545	0.90704	0.095
	F	11.0833	0.37639	

Table 5: arch length mean of Nepalese and Chinese male and female.

Country/gender	Upper arch length mean(mm)	Lower arch length mean(mm)
Nep m	79.5000	73.8
Nep f	77.0000	69.25
Ch m	76.1818	64.3636
Ch f	76.5000	65.1667
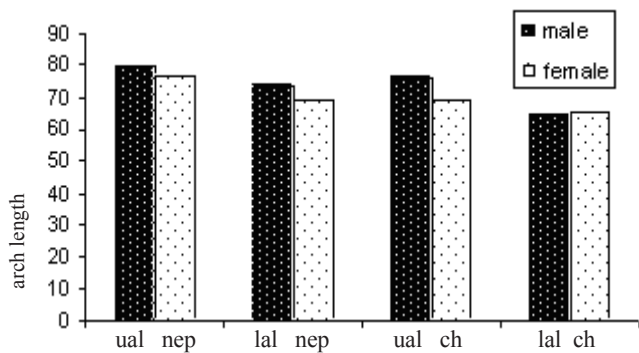
Fig.. 1 upper and lower arch length of Nepalese and Chinese male and female (ual: upper arch length, lal: lower arch length, nep: Nepalese, Ch: Chinese)

Table 6: AR and OR Mean, SD of Nepalese male and female

OR/AR	Gender	Mean	SD	Significance
OR	M	91.9573	3.54637	0.074
	F	89.1332	2.27851	
AR	M	79.6357	5.36973	0.023
	F	78.0328	3.18585	

(OR : Overall Ratio , AR : Anterior Ratio, m : male, f : female , SD : Standard Deviation)

Table 7: OR and AR, Mean , SD of Chinese male and female.

OR/AR	Gender	Mean	SD	Significance
OR	M	89.2339	4.98998	0.302
	F	90.2285	3.74757	
AR	M	78.1045	3.92927	0.182
	F	78.2862	6.15238	

(m : male , f : female , OR : Ovreall Ratio , AR : Anterior Ratio, SD : Standard Deviation)
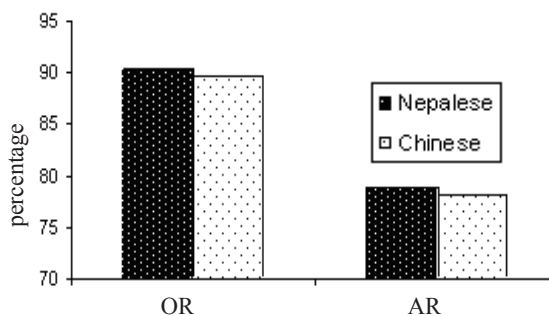

Figure 2. Diffference in OR and AR between Neplese and Chineses (OR and AR mean for Nepalese and Chinese)
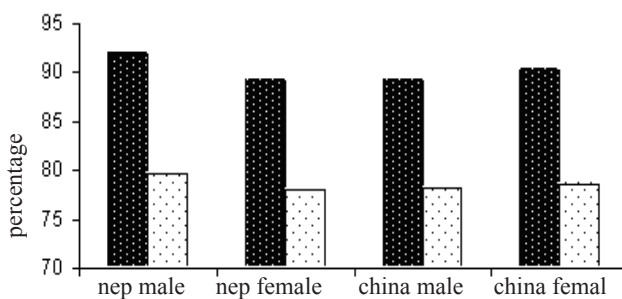

Figure3. Diffference in OR and AR between Neplese and Chineses (OR and AR mean for Nepalese and Chinese male and female)

class III malocclusion are 79.5mm and 77mm respectively (Table 5). Mean lower arch length for Nepalese male and female with Angle class III malocclusion are 73.8mm and 69.25mm. Mean upper arch length for Chinese male and female having Angle class III malocclusion are 76.18mm and 69.25mm respectively. Mean lower arch length for Chinese male and female with Angle class III malocclusion are 64.36mm and 65.16mm (Fig .1). Correlation between upper arch length and lower arch length of both Nepalese male and female are low (r=0.163, r=o.5 respectively).Upper arch length for Chinese male and female having angle class III malocclusion are 76.18 and 69.25 respectively. Lower arch length

for Chinese male and female with angle class III malocclusion are 64.36 and 65.16. The correlation between upper and lower arch length is high with correlation coefficient, r=0.608, r=0.898 respectively for Chinese male and female. No statistically significant diffrence in upper and lower arch length between Nepalese and Chinese. Among Nepalese significant difference in upper arch length between male and female but no significant

difference between male and female in lower arch length.

3. Bolton ratio

For Nepalese (Table 6)OR 90.42 and AR 78.76 while for Chinese (Table 7) OR 89.58 and AR 78.16 (Fig .2). No significant difference between Chinese and Nepalese OR and AR. Nepalese class III malocclusion subject's OR out of 2 SD from the Bolton standard was 14% (outside -2 SD 0% and outside +2 SD 14%). AR outside Bolton 2 SD was 45.4% (outside -2 SD 13.6% and outside +2 SD 31.8%). For Chinese class III malocclusion OR outside Bolton 2 SD 70.6% (outside -2 SD 29.4% and outside +2 SD 41.2%) and AR outside 2 SD are 40.8% (outside -2 SD 29% and outside +2 SD 11.8%). No significant difference between OR and AR for normal occlusion and class III malocclusion of Nepalese (P=0.251, P=0.438). No significant difference between OR and AR for normal occlusion and class III malocclusion for Chinese (P=0.09, P=0.58). No significant difference in OR between Nepalese male (OR=91.95, AR=79.63) and female (OR=89.13,AR=78.03) but AR is significantly different (P=0.02). No significant difference between Chinese male (OR=89.23, AR=78.28) and female (OR=90.22, AR=78.50) (Fig.3) .

Discussion

1. Tooth size difference

Upper lateral incisor, upper canine and upper second premolar shows significant difference between Nepalese and Chinese (P=0.02, P=.01, P=.003). Lower teeth show no significant difference between Nepalese and Chinese. Xia and Wu [31] studied on 1173 Han nationality and found no significant difference for the tooth size ratio between class III malocclusion group and other malocclusions as well as normal occlusion .Lavelle [31], Nielin[32],shows class III cases with smaller maxillary tooth dimensions and bigger mandibular tooth.

2. Tooth size difference between the sex

Among Nepalese male and female lower lateral incisors, second premolar and lower molar show significant difference (P=0.035, P=0.032, P=0.049). Upper second premolar shows significant difference between Nepalese male and female (P=0.020). Among Chinese male and female shows no significant difference between upper teeth while lower canine and lower first molar shows significant difference (P=0.041, P=0.001).

Tancan[33] in his study found that the mesiodistal tooth size, OR and AR are lager in male than in female in class III malocclusion group but found no significant sexual dimorphism for AR and OR among all malocclusion groups. Susan N.[10] in class III malocclusion several teeth were significantly smaller in females than in male, these teeth were maxillary first molar, mandibular 2nd premolar, mandibular 1st molar, canine and sum of mandibular and maxillary 12 teeth..

3. Bolton ratio

For Nepalese OR 90.42 and AR 78.76 while for Chinese OR 89.58 and AR 78.16. No significant difference between Chinese and

Nepalese OR and AR. No significant difference between OR and AR for normal occlusion and class III malocclusion of Nepalese (P=0.251, P=0.438). No significant difference between OR and AR for normal occlusion and class III malocclusion for Chinese (P=0.09, P=0.58) [7]. No significant difference in OR between Nepalese male and female but AR is significantly different (P=0.02). No significant difference in AR and OR between Chinese male and female. Susan [10] found no statically significant difference in Bolton AR and OR between class III and other different occlusion categories. Nie Q lin[32] shows that AR and OR of class III malocclusion were greater than that of other malocclusion.

4. Arch length

Upper arch length for Nepalese male and female having angle class III malocclusion are 79.5 and 77 respectively. Lower arch length for Nepalese male and female with angle class III malocclusion are 73.8 and 69.25. Upper arch length for Chinese male and female having angle class III malocclusion are 76.18 and 69.25 respectively. Lower arch length for Chinese male and female with angle class III malocclusion are 64.36 and 65.16. Correlation between upper arch length and lower arch length of both Nepalese male and female are low(r=0.163, r=0.5 respectively). Upper arch length for Chinese male and female having angle class III malocclusion are 76.18 and 69.25 respectively. Lower arch length for Chinese male and female with angle class III malocclusion are 64.36 and 65.16.The correlation between upper and lower arch length is high with correlation coefficient, r=0.608, r=0.898 for Chinese male and female respectively. No statistically significant difference in upper and lower arch length between Nepalese and Chinese. Among Nepalese significant difference in upper arch length between male and female but no significant difference between male and female in lower arch length. Susan [10] found that mandibular arch length in class III was significantly larger than class II division I and division II .

Conclusion

1. No significant differences were found in overall ratio and anterior ratio between Nepalese and Chinese having angle class III malocclusion 53% of the subjects were out of 2 SD of Bolton's OR, while 36% were out 2 SD of Bolton's AR.

2. No significant difference found between Chinese and Nepalese in AR and OR. And also no significance difference between Nepalese male and female as well as Chinese male and female between AR and OR. So this indicates that Nepalese tooth size discrepancy is similar to that of Chinese for class III cases.

3. Low correlation was found between upper and lower arch length for Nepalese Male and female. Significant difference in upper arch length between Nepalese male and female with class III malocclusion. Lower arch length for Nepalese and both upper and lower arch length for Chinese showed no significant difference between male and female.

4. Maxillary teeth showed higher variability than mandibular teeth for Nepalese while lower first molar showed higher variability in Chinese.

Acknowledgement

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