Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2021;11:2s:188-192.

Palatal Depth and Arch Parameter in Class I Open Bite, Deep Bite and Normal Occlusion: In Vitro study

Samir Jain[1] Abhishek Sinha[2*] Nikita Raman[3] Kumar Manish[4] Amar Kumar[5] Ramesh Kumar[6]

[1]Professor and Head, Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.
[2]Assistant Professor, Department of Dentistry, Patna Medical College and Hospital, Patna, Bihar, India.
[3]Senior Resident, Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.
[4]Senior Resident, Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.
[5]Senior Resident, Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.
[6]Senior Resident, Department of Dentistry, Anugrah Narayan Magadh Medical College and Hospital, Gaya, Bihar, India.

ABSTRACT

Background: This study is on the basic measurement of the palatal depth, maxillary and mandibular arch widths and circumferences in three groups: class I open bite, class I deep bite and class I normal occlusion, and to compare the results among the three groups.

Material and methods: Seventy two sets of casts divided into 3 groups (class I open bite malocclusion, class I deep bite malocclusion and class I normal occlusion) were used. Palatal depth, maxillary and mandibular arch widths and arches circumferences were measured using a sliding gauge caliper, readouts were rounded to 0.1 mm.

Result: Palatal depth was the highest in open bite followed by normal and then in deep bite. The intermaxillary widths were the highest in normal occlusion followed by deep bite and then open bite. No significant differences were seen in the mandibular widths among the three groups. Correlation coefficient among variables expressed considerable variation.

Keywords: Palatal depth, open bite, deep bite.

INTRODUCTION

The vertical overlap of maxillary and mandibular central incisors measured perpendicular to the occlusal plane is called as incisor overbite, open bite or *opertognathia* is a negative value while deep bite is an excessive overbite.[1]Overbite is used generally as a basic measurement by the clinician before, during and after treatment, inspite of the fact that it is most difficult to predict in the growing child. [2,3] Overbite is most difficult to correct orthodontically and is most common cause of relapses following orthodontic treatment. The factors which has keyroles in vertical malocclusion include growth of the maxilla and mandible, function of the lips and tongue and dentoalveolar development with the eruption of teeth.[4] It can be divided into those that are dentoalveolar in origin and these that are predominantly skeletal due to the growth patterns of the jaws.[5] Many studies have investigated the skeletal features of subjects with anterior open bite and deep bite, most of them were cephalometric in nature. Although in orthodontic treatment, a wealth of information obtained from dental casts plays a significant role in diagnosis, treatment planning and evaluation a little work has been done with study casts.[6,7,8] The human craniofacial skeleton and its associated dental arches undergo visible alterations as they grow,

Received: Nov. 9, 2020**: Accepted**: Jan. 12, 2021
*Correspondence **Dr. Abhishek Sinha.**
Department of Dentistry, Patna Medical College and Hospital, Patna, Bihar, India.
Email: drsinhaabhi@gmail.com

pISSN 2278-0076
eISSN 2321-9270

adopt, and age.[9] Changes in the size and shape of skeletal dental - craniofacial complexes do not cease with the attainment of biologic maturity.[10]The patterns of facial growth development in subjects with open bite and deep bite faces and found that, the female open bite subjects were earliest in the timing of adolescent growth spurt,followed in succession by deep bite female subjects, open bite male subjects and finally the deep bite male subjects.[11] The vertical difference between open bite and deep bite subjects and found that there was a greater maxillary alveolar height in open bite than in deep bite.[12] The comparison of palatal dimensions (width, length and depth) in adult occlusion and malocclusions (class I crowded, class II div 1, class II div 2, and class III) and found that class II div 1 palates were narrowest in width and class II div 2 plates were shortest in length, class III and class I crowded subjects had the deepest palates and class II div 2 had the shallowest palates.[13] The relationship between changes in the dental arch perimeters dental arch widths (intercanine, interpremolar, and intermolar distances) resulting from rapid palatal expansion and found an increase in dental arch perimeters.[14] But a poor correlation between the palatal vault depth and maxillary arch circumference and widths was also been detected in many subjects .[15]

The aim of the present study was to analyse the palatal depth and maxillary and mandibular dental arches parameters including arch circumferences, intercanine, interpremolar, and intermolar widths in Class I open bite, deep bite and normal occlusion and to compare the measurements among the three groups. The measurements also detects the correlation coefficient among the different variables in each group separately to identify the possible relations among palatal depth, arches widths and circumference.

MATERIALS AND METHODS

The sample consisted of 72 sets of upper and lower arch casts of the patients in the private clinic in Patna and Gaya Bihar which were divided into 3 groups:

1. Group one: casts of subjects had Class I deep bite malocclusion consisted of 24 sets (12 males and 12 females).

2. Group two: casts of subjects had Class I open bite malocclusion, 24 sets (12 males and 12 females).

3. Group three (control group): casts of subjects with Class I normal occlusion 24 casts (12 males and 12 females). The inclusion criteria for the patients with deep bite are the following:

1. Full dentition with no extraction or impaction (except for the third molar).

2. Angle class I molar relation.

3. No gross facial deformity.

4. No history of orthodontic treatment.

5. Overbite ≥ 5mm.

The cast of the patients with open bite, comprises the same inclusion criteria except point 5 where opening between upper and lower anterior teeth > zero. The same criteria were used for control group but normal overbite 1 – 4 mm . The patients of the 3 groups had no breathing disorder. The patient age ranged from 12.6 – 18.8 years with average of about 13.2 for group one, 15.1 for group two and 16.4 for group three.

The overbite was measured by marking the extent of overlap of the upper incisor on the lower and the distance from the incisal edge of the lower incisor to the mark represents the overbite.

The following landmarks were demarcated on the cast using 0.5 mm HB pencil for better identification:

1. The cusp tips of the right and left upper and lower canines.

2. The cusp tips of the buccal cusp of the right and left upper and lower first premolars.

3. The cusp tips of the mesiobuccal cusp of the right and left upper and lower first molars.

4. The cusp tips of the distobuccal cusp of the right and left upper and lower first molar.

Linear measurements of arch dimensions and palatal depth were made with sliding callipers; readouts were rounded to 0.1 mm. These measurements include:

1. Maxillary intercanine width: the distance between upper canines cusp tips.

2. Mandibular intercanine width: the distance between lower canines cusp tips.

3. Maxillary interpremolar width: the distance between upper first premolar buccal cusp tips.

4. Mandibular interpremolar width: the distance between lower first premolar buccal cusp tips.

5. Maxillary intermolar width: the distance between mesiobuccal cusp tips of the upper first molars.

6.Mandibular intermolar width: the distance between mesiobuccal cusp tips of the lower first molar.

7. Maxillary arch perimeter: the distance from distobuccal cusp tips of the upper first molar to the distobuccal cusp tip of the upper first molar at the opposite side.

8. Palatal depth: the distance from the palatal vault opposite the canines, first premolars and first molars to the occlusal plane, measured perpendicular to a rigid template resting on the occlusal surfaces of the maxillary teeth.

Statistical Analysis

Statistical analysis was performed including descriptive statistics (mean and standard deviation). ANOVA and Duncan tests were used to determine the presence of significant differences between the groups. Pearson's correlation coefficient was determined between all combinations of variables for each group separately

RESULTS

For males subjects the statistical analysis using F-value at $p<0.05$ significance level gives a comparable differences in the interpremolar palatal depth between the three groups (open bite, normal and deep bite) with the largest depth for open bite followed by normal occlusion and then by deep bite (Tables 1).In females a significant differences were seen between the three groups which includes the intercanine and palatal depth with the highest value for open bite followed by normal occlusion and then by deep bite, also a highly significant difference between the three groups were seen in the maxillary intercanine and interpremolar width. The total sample of 72 casts (males and females) demonstrated a highly significant difference between the three groups in the intercanine and interpremolar palatal depth, intercanine and interpremolar maxillary width. A significant correlation between variables related to arch width and arch perimeters in each arch and between the two arches.

Table 1: Descriptive (mean ±SD) and ANOVA test for males with open bite, deep bite and normal occlusion

Type of occlusion	Mandibular Widths			Maxillary width			Palatal Depth			Arch circumference
	Intermolar	Interpremolar	intercanine	Intermolar	Interpremolar	intercanine	Intermolar	Interpremolar	intercanine	
Normal occlusion	22.46 ±1.04	16.8 ±1.75	7.73 ±1.48	52.46 ±3.26	42.56 ±4.50	36.43 ±2.17	47.03 ±4.19	36.6 ±2.31	28.06 ±1.39	99.55 ±4.47
Deepbite	20.12 ±1.91	11.27 ±1.60	8.5 ±0.33	51.35 ±4.27	40.89 ±2.67	35.32 ±2.79	47.26 ±3.41	36.78 ±1.87	28.39 ±1.59	100.17 ±8.05
Open bite	19.93 ±9.63	14.12 ±3.87	9.55 ±1.28	51.72 ±4.54	40.72 ±2.84	33.94 ±2.89	45.00 ±2.34	37.05 ±3.25	28.88 ±1.29	97.33 ±4.02

DISCUSSION

On evaluation of palatal depth reveals a significant difference between the three groups: open bite casts demonstrated the highest depth in the intercanine and interpremolar region followed by normal occlusion while the deep bite casts showed the lowest depth. The differences between the parameters can be insignificantly related to the various rates of posterior dentoalveolar growth. The posterior dentoalveolar overgrowth is responsible for the anterior open bite, while its undergrowth is the cause of deep bite. Although, most studies agrees with our finding.[13, 14] Some of them found no significant difference in palatal depth between open bite and normal occlusion.[5] In the maxillary casts the distances (intermolar, interpremolar and intercanine) between the three groups shows the narrow maxillary arch and widened mandible in patients with open bite in compare to the large tongue due to airway obstruction and breathing problems which usually accompany open bite. [16] However the samples did not have any breathing problems this might explain our findings. Comparatively to the results obtained by Hsu,[6] who reported that patients with open bite had a significant wider mandibular intermolar and interpremolar width than those of control group, no significant difference were seen between the three groups. This can give the impression that tongue position in the three groups is

the same as long as no breathing problems is existed in any of the three groups, as the tongue position is lowered in habitual mouth breathers. The arch perimeter demonstrated a highly to strong positive correlation is seen in the arch perimeter maxillary interpremolar width, mandibular interpremolar width and maxillary intermolar width in all the three groups, which means that with the increase of arch perimeter the maxillary interpremolar, mandibular interpremolar and maxillary intermolar widths will increase and vice versa. This can be explained by the fact that the transverse growth in the maxillary intermolar and interpremolar region will increase the arch circumference. With the increase in the mandibular interpremolar width, a compensatory increase in the opposing arch width will occur leading to increase in its perimeter. In deep bite and open bite groups a strong positive correlation was noticed between interpremolar palatal depth and intercanine palatal depth as the two variables are related to the maxilla, their growth will be simultaneous. A strong positive correlation was seen in the maxillary and mandibular interpremolar widths in both normal and open bite groups compensatory growth between the two opposing arches can give an explanation for this strong positive correlation and to a similar correlation noticed between the following:

Maxillary and mandibular intermolar widths: open bite and normal occlusion.

Maxillary interpremolar and mandibular intercanine widths in open bite and normal occlusion. • Maxillary intercanine and mandibular interpremolar widths in open bite and normal occlusion. • Maxillary and mandibular intermolar in normal and deep bite. A positive correlation varied from strong to highly strong was noticed between the following:

Maxillary intercanine width and maxillary interpremolar width in the three groups.

Mandibular interpremolar and mandibular intercanine width in open bite and normal occlusion.

Maxillary intermolar width with both maxillary interpremolar and maxillary intercanine widths in both normal and deep bite.

As the above correlation variables related to the same structure either maxilla or mandible, their growth will be simultaneous. A poor correlation were noticed between palatal depth and arch widths in open bite, deep bite and normal occlusion which simulate the findings of Salman,[15] who reported a poor correlation between palatal depth and maxillary arch width in class I normal occlusion.

CONCLUSIONS

The palatal depth was the highest in open bite followed by normal and then in deep bite. The intermaxillary widths were the highest in normal occlusion followed by deep bite and then open bite. There was no significant differences were seen in the mandibular widths among the three

groups and the correlation coefficient among variables expressed considerable degrees of variation.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

REFERENCES

1. Baume LJ, Bailit HL. Variation in dental occlusion and arches among Melanesians of Bougainville Island, Papua New Guinea. Am J Phys Anthropol 1977; 47: 195-208.

2. Richmond S. Recording the dental cast in three dimensions. Am J Orthod Dentofac Orthop 1987; 92: 199- 206.

3. Bergersen EO. A longitudinal study of anterior vertical overbite from eight to twenty years of age. Angle Orthod 1988; 3: 237-56.

4. Skieller V. Cephalometric analysis in the treatment of overbite. Trans Eur Orthod Sos 1967; 147-57.

5. Nielsen IL. Vertical malocclusion: etiology, development, diagnosis and some aspects of treatment. Angle Orthod 1991; 4: 247-60.

6. Hsu BS. The nature of arch width differences and palatal depth of anterior open bite. Am J Orthod Dentofac Orthop 1998; 113: 344-50.

7. Hayashi K, Uechi J, Mizoguchi I. Three dimensional analysis of dental casts based on a newly defined palatal reference plane. Angle Orthod 2002; 37(5): 539-44.

8. Iwasaki LR, Haack JE, Nickel JC, Morton J. Human tooth movement in response to continuous stress of low magnitude. Am J Orthod Dentofac Orthop 2000; 117: 175- 83.

9. Carter GA, McNamara JR. Longitudinal dental arch changes in adults. Am J Orthod Dentofac Orthop 1998; 114: 88-99.

10. Harris EF. A longitudinal study of arch size and form in untreated adults. Am J Orthod Dentofac Orthop 1997: 111: 419-27.

11. Nanda SK. Pattern of vertical growth in the face. Am J Orthod Dentofac Orthop 1988; 93: 103-16.

12. Sassouni V, Nanda S. Analysis of dentofacial vertical proportions. Am J Orthod 1964; 50: 801-23.

13. Johnson JG, Kuntz TR, Staley RN, Jakobsen JR. Comparison of palatal dimensions in adult normal occlusion and malooclusion. J Dent Res 1994: 73-83.

14. Adkin MD, Nanda RS, Currier GF. Arch perimeter changes on rapid palatal expansion. Am J Orthod Dentofac Orthop 1990; 97(3): 323-35.

15. Salman KA. The relationship between the maxillary dental arch width, depth and circumference. Al-Rafidain Dent J 2001; Sp Issue: 401-10.