ORIGINAL ARTICLE

Arch perimeter - A Comparative Study

Anju Loomba[1], Preeti Agarwal[1], Utkarsh Upadhyay[1], Ashish Goel[1], Vishal Sohal[1]

ABSTRACT

This study was undertaken to find if any correlation existed between the dental arch perimeter of samples with: Normal occlusion, Bimaxillary protrusion and Class 1 molar relation with anterior crowding. Digital vernier caliper (Mitutoyo) was used to measure each cast in four separate segments. This study evaluated the mean arch perimeter by measuring the pre-treatment upper and lower study models of 30 patients having two different types of malocclusion and a third control group. In the present study mean arch perimeter for upper arch with normal occlusion was 75.79mm (SD=2.32) and the mean arch perimeter for the lower arch was 66.97 mm (SD=2.67). Arch perimeter in class I bimaxillary and crowding cases was significantly more in both upper and lower arch.

Keywords : Arch perimeter, Bimaxillary protrusion, Crowding

INTRODUCTION

Arch perimeter is the distance from the mesial contact of one first permanent molar to its antimere as measured through the contact points or buccal cusp tips of all of the intervening teeth, ignoring those teeth that are malpositioned or blocked out so that the measurement represents an ideal arch form[1].

The circumference or perimeter is one of the most important dimension of the dental arch and changes according to age and gender. The need for meaningful measurements of dental arch dimensions and their importance for diagnosis and treatment planning have been recognized since the early days of Angle. It was not until 1923 that the relationship of apical base and dental arch form began to be understood, as well as the realization that one of the most important diagnostic dental arch dimensions was dental arch perimeter.

There are various direct; brass wire or hanging chain methods, and indirect methods like scanned models to calculate the dental arch perimeter. A digital caliper was used by X Antoniazzi,[2] short in 2007 for measurement of arch perimeter in maxillary and mandibular cast.

This study was undertaken to find if any correlation existed between the dental arch perimeter of samples with: Normal occlusion, Bimaxillary protrusion and Class 1 molar relation with anterior crowding.

MATERIALS AND METHOD

This study was designed to evaluate the arch perimeter by measuring the pre treatment upper and lower study models of 30 patients having two different types of malocclusion and a third control group consisting of 15 upper and lower study models of individuals with normal occlusion from the Department of Orthodontics and Dentofacial Orthopedics, Saraswati Dental College and Hospital, Lucknow in 2010.

Digital vernier caliper (Mitutoyo) with an resolution of 10 μm and an accuracy of 30 to 40 μm was used for measuring arch perimeter on selected study models.

SELECTION CRITERIA:

Group A: Class I Bimaxillary Protrusion – Angles' class I molar relationship, mild crowding (<3mm) in upper and lower arch, inter-incisal angle less than 124^0; upper incisor protrusion (U1-APog) more than 7.7 mm; lower incisor protrusion (L1-APog) more than 3.0 mm.

Group B: Class I Crowding - Angle's Class I molar relationship. Crowding moderate (3-6mm) to severe (>6mm) in upper and lower arch. Angle's Class I molar relationship.

Group C: Class I normal occlusion - Angle's Class I molar relationship, normal overjet and overbite, mild crowding (<2mm) in upper and lower arch no spacing, rotations or cross bite in upper and lower arch not undergone any prior orthodontic treatment.

Each cast was measured in four separate segments with the help of the digital caliper. The first segment was measured

[1]Department of Orthodontics & Dentofacial Orthopedics, Saraswati Dental College & Hospital, Lucknow, India
Address for Correspondence:
Dr. Anju Loomba,
Saraswati Dental College & Hospital, 233 Tiwari Ganj,
Faizabad Road, Off Chinhat, Lucknow-227 105 (UP), India
Contact No: +919936062063 Email: al_loomba@yahoo.co.in
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Figure 1: Arch Perimeter measurement in posterior segment

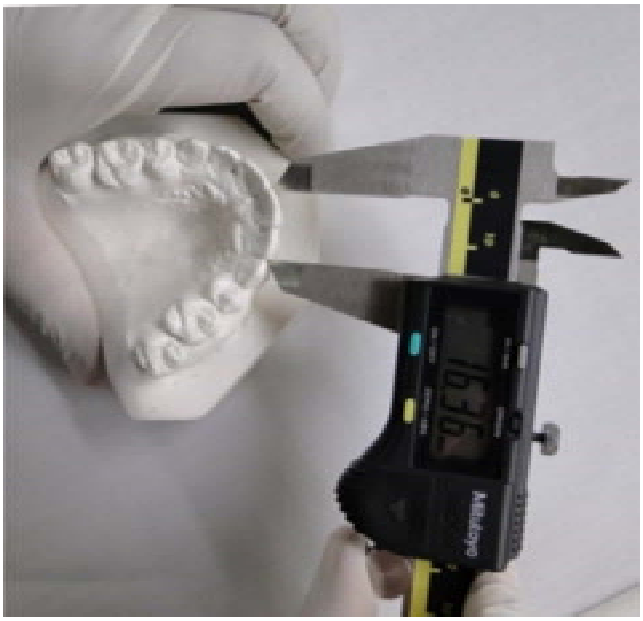

Figure 2: Arch Perimeter measurement in anterior segment

from the mesial contact point of one side of first molar to the mesial contact point of the canine (Fig 1). The second segment is measured from the mesial contact point of the canine to the mesial contact point of the two central incisors (Fig 2). The third segment is measured from the mesial contact point of the two central incisors to the mesial contact point of the canine of the opposite quadrant (Fig 2). The last segment is measured from the mesial contact of the canine to the mesial contact point of the first molar (Fig 1). To minimize the error of the method, all measurements were repeated by the same investigator twice and the mean values were used for comparisons.

RESULTS

For upper arch, the mean arch perimeter of Group C (Normal Occlusion) was minimum 75.79 (SD = 2.32) and that of Group A (Bimaxillary Protrusion) was maximum 78.12 (SD = 3.01). For lower arch the minimum value was observed for Group C (Normal Occlusion) 66.97 (SD = 3.67) group while maximum value was observed for Group A (Bimaxillary Protrusion) 67.79 (SD=3.42). Analysis of variance (ANOVA) revealed significant inter group differences for both upper and lower arches (Table 1).

Table 1: Upper and Lower Arch Perimeter in different groups

		Upper Arch		Lower Arch	
		Mean	**SD**	**Mean**	**SD**
Group A	Bimaxillary protrusion	78.12	3.01	67.79	3.42
Group B	Crowding	78.01	2.81	64.91	2.36
Group C (Control)	Normal	75.79	2.32	66.97	3.67
	F (ANOVA)	3.478		3.222	
	"p"	0.040		0.050	

Comparative statistical analysis (Table 2) of all the groups revealed that Group C (Normal) had significantly shorter upper arch perimeter as compared to both Group A and Group B (p=0.025); though no significant difference (p=0.925) was observed between groups A and B (Bimaxillary protrusion and Crowding groups).

Table 2: Comparative group statistics

Comparison	Upper Arch		Lower Arch	
	"t"	**"p"**	**"t"**	**"p"**
Group C Vs Group A	2.370	0.025	0.637	0.529
Group C Vs Group B	2.363	0.025	1.825	0.079
Group A Vs Group B	0.095	0.925	2.684	0.012

Student "t"-test

For lower arch (Table 2), no significant difference was observed between Group C and either of two study groups (p>0.05). However, the difference between groups A and B was observed to be statistically significant (p=0.012).

DISCUSSION

In the present study mean arch perimeter for upper arch with normal occlusion was 75.79mm(SD=2.32) and the mean arch perimeter for the lower arch was 66.97mm (SD=2.67). Mok and

Cooke[3] measured the upper and lower arch perimeters including first molar and found the mean upper arch perimeter is 98.41mm (SD=4.11) and lower arch mean arch perimeter is 89.99mm (SD=4.05).

This study was performed to compare and compute the dental arch perimeter of samples with different malocclusions: Group A (Bimaxillary protrusion), Group B (Class I crowding), Group C (Normal occlusion). Statistically significant difference was observed in the upper arch perimeter of different Group C and Group B, statistically significant difference was observed between Group C and Group A. However there is no statistical difference between Groups B and C. This suggests that the upper arch perimeter is increased in bimaxillary protrusion cases as well as cases with crowding. The lower arch perimeter is increased only in bimaxillary protrusion cases (Fig 3). Our study is in agreement with Howe[4]; they found that the arch perimeter of upper arch was more in crowded group (including molars). In lower arch the arch perimeter was not significantly larger in crowded group. Significant difference in dental arch perimeter of the crowded and non crowded groups was observed in both the maxillary and mandibular arches. Howere, there is very less literature about the arch perimeter in bimaxillary cases.

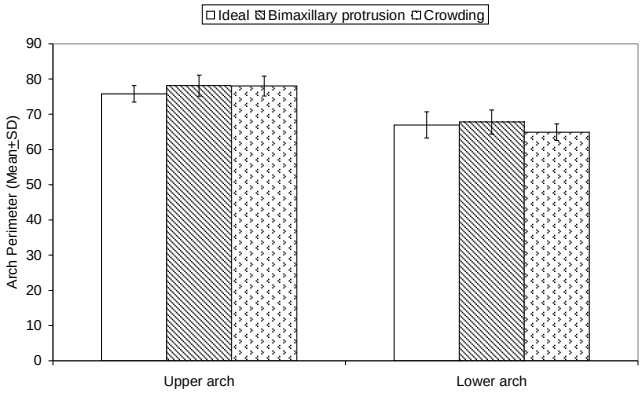

Figure 3: Upper and lower arch perimeter in different groups

According to Ricketts, the functional balance or homeostatic position of the denture is produced by combinations of the lip and tongue conditions. However, the variations in size, position, form, and proportions composing the dento-facial complex are so narrow that it is difficult, if not impossible, to discriminate between the important and secondary factors which influence dental occlusion. The origin of disproportions leading to malocclusion, however, can be traced to genetic and/or environmental factors. Thus, there could be some disproportional development to cause a less important tongue thrust which, in turn, may cause bimaxillary protrusion.

The causes of crowding or spacing are, however, still not fully understood. Hooton suggested that crowding was probably the result of an evolutionary trend toward a reduced facial skeletal size without a corresponding decrease in tooth size. Brash said that crowding was hereditary, the result of interbreeding in ethnic groups who were physically dissimilar. Other investigators such as Barber and Moore, Lavelle and Spence suggested that environmental factors (soft diet and loss of arch length caused by caries) were more important than genetic factors, especially when ethnic groups were compared[5, 6].

Rivera *et al.* suggested that the dimensions of arch width are genetically determined in a more specific way than the dimensions of arch length. The increases in the arch are more related to the events underlying tooth development and somewhat less to skeletal growth.

Orthodontists rightly emphasize the importance of clinical, cephalometric and model analysis in the diagnostic process. Too often; however, the clinician will consider only those diagnostic criteria which are designed to forecast skeletal and functional change with treatment mechanics. Our data candidly point out the relationship between arch perimeter amongst Class I bimaxillary protrusion, Class I crowding and normal occlusion.

CONCLUSION

Arch perimeter in class I bimaxillary and crowding cases was significantly more in upper and lower arches when compared to normal occlusion; so it can be concluded that the increase in arch perimeter is more related to the underlying dentition. It seems to be a functional compensation in relation to the malocclusions.

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