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Correlation of Maxillary and Mandibular Base Lengths and Anterior Crowding in Class II Malocclusion

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Abstract

Introduction: In orthodontics dental crowding is more frequently present, causing malocclusion that require orthodontic treatment. Crowded dentition occurs when there is mismatch in tooth size and arch dimensions. The crowded dentition is the one in which tooth size is larger than the arch dimensions.[1] This study was conducted is to evaluate the correlation between maxillary and mandibular base lengths and dental crowding in the anterior region of dental arch in class II malocclusion.

Material and Methods: This cross sectional study was performed Orthodontics Department of Fatima memorial Hospital, Lahore in six months. Study included 70 participants, their chronological age is in range of 13-30 years, for skeletal II SNA, SNB, ANB, and Wits value need to be measured. The skeletal base lengths are measured by evaluating Co-A and Co-Gn and to calculate maxillary and mandibular crowding by measuring arch length discrepancy by single examiner. To correlate crowding and base length need Pearson's product moment correlation.

Results: Female strength were 33 (47.14%) while males strength were 37 (52.86%). Mean age of subjects was 21.66
± 4.81 years. So there is a significant, moderate and a negative correlation between base lengths and crowding in the maxillary arch ($r=-0.44$, $P<0.001$). Same is the case in lower arch, where there is also significant, moderate and inverse relation between lower base length and upper crowding ($r=-0.31$, $P=0.008$).

Conclusion: The correlation seen between skeletal base lengths and dental crowding in arches was statistically significant and are inverse relation.

Keywords: maxillary; mandibular; base length; crowding

Introduction

In orthodontics dental crowding occur more frequently, which results in malocclusion and is the reason for patients to seek orthodontic treatment. Dental crowding occurs when there is tooth size and arch dimensions mismatch. Dentition with crowding have mesio-distal tooth size more than arch dimensions.[1] A study has revealed that the prevalence of dental crowding in Pakistan is 57%.[2] Factors which are associated with dental crowding are growth direction of mandible, posture of the head, teeth inclination and oral musculature.[3] Maxillary base length(Co-A) is the length measured from condylion to point A While base length of mandible(Co-Gn) is the measured length from point on condyle called condylion to Gnathion.[4-7]

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Normal occlusion according to Foster et al[8](1990) is that occlusion that lie within the range of an ideal occlusion and there is no chances of functional and esthetics abnormalities. It is impossible to explain exactly the normal occlusion limits which clarify whether the irregularity is advantageous or disadvantageous to the patients. Ideal occlusion occurs infrequently in nature, The primary objective of orthodontic treatment is based on the ideal occlusion even today.[9] It is specifically termed as "Theoretical ideal". Although theoretical ideal arrangement is considered an important standard in orthodontics, regarding description and as a treatment goal. Lets consider a normal range of occlusal variations that is more realistic to describe dentofacial traits in certain aspects of treatment.[9] According to Houston[10] maximum intercuspation of the teeth is fundamental of ideal occlusion, there is centric relation position of the mandible, i.e. unstrained and retruded positions of condyles in the glenoid fossae.

Lawrence F Andrews presented "*The Six Keys to Normal Occlusion*" [11], by observing of 120 casts of non-orthodontic patients with normal occlusion. He played an important role in today's orthodontic treatment.

Whenever any change occurs from normal craniofacial development in any plane it will result in malocclusion in one of the three planes.[12-14] However, sagittal discrepancy are positioned on the top of the list because of the major esthetic, psychological and functional implications.[15] any discrepancy between maxillary and mandibular growth will result in Sagittal problems. When mandibular growth are more and mandibular position is more forward as compared to maxilla will result in concave bur when opposite occur in which maxillary growth are more and maxilla is positioned ahead of the mandible then it will result in convex profile. The skeletal problems are more perfectly seen on radiographs where one can find a relation of morphology and surrounding structures. The best radiograph in this scenario is lateral cephalograms in which one can find problems in skeletal, dental and soft tissues.[16-17]

Numerous cephalometric analyses have been reported for the diagnosis and evaluation of the skeletal abnormalities in sagittal plane. Downs utilized convexity angle and AB plane angle to evaluate discrepancies of jaw in antero posterior plane. Steiner and Riedel concluded that ANB angle is subjected to changes in position of sella turcica and nasion , cranial base length and vertical growth pattern of the patient.[18] This variability in position of these landmarks and limitation was overcome by Jacobson who prescribed Witts value to consider occlusal plane reference. However, another problem with Witts appraisal is the difficulty and subjectivity of the functional occlusal plane identification which leads to questions about the reproducibility and reliability of Wits appraisal.[18] The W angle and Beta angle are some other parameters to evaluate antero posterior jaw discrepancies. To countercheck the ANB angle, the AXD angle was introduced -intersection of the lines extending from points A and D at point X constitutes the interior angle. (X is point of intersection of perpendicular from point A to SN plane). The point D is considered as center of symphysis of the bone instead of point B which is not affected by chin prominence and incisor position changes. Witts value was proposed to overcome the shortcoming of ANB angle. On a lateral cephalogram tracing, to evaluate the severity of the jaw disharmony draw a perpendicular line from points A and B on the maxilla and mandible, respectively, extending to functional occlusal plane denoted as AO and BO respectively and noting down straight distance between them. In normal Class I females, AO and BO should coincide whereas in Class I males BO is ahead of AO by 1 mm according to Jacobson.[17]

Khan et al, revealed an inverse correlation between base length of the maxilla (Co-A) (r value 0.28, p=0.02) and base length of mandible (Co-Gn) (r value -0.20, p value 0.02) with crowding in maxilla and mandible. The

length of maxillary and mandibular bases and crowding between mandibular and maxillary arches have positive correlation. (rvalue 0.566, p value 0.000) and (r value 0.408, p value 0.000).[2] Leighton et al, found insignificant inverse correlation between the amount of base lengths and arch length discrepancy.[4] Singh et al, found an inverse correlation (r value -0.377, p value 0.001) between lower arch crowding and upper jaw base length and (r value 0.247, p value 0.028) between lower arch crowding and lower base length in population of India .[4, 5] Khoja et al, found that males had greater mandibular arch base lengths than females and more the severity of crowding was not strongly associated with smaller skeletal bases in Pakistani population.[5]

A study conducted by Ijaz et al, in class II malocclusion the severity of dental crowding increases with smaller jaw base lengths in the population of Pakistan. They further concluded that lower jaw base length is one of the factor that contribute to the crowding in dentition.[6]

As literature shows little ambiguity in finding regarding correlation of anterior dental crowding with upper and lower skeletal bases. Moreover, the deficiency exist in such study to measure the correlation between dental crowding and skeletal bases in Pakistani population, so a need arises to further clarify the facts. The aim of the study is to correlate upper and lower jaw base lengths with crowding in anterior dentition in population of Pakistan having class II malocclusion. This will help to find the cause of dental crowding for better treatment plaining in orthodontics.

Material and Methods

The study conducted at department of Orthodontics, Fatima memorial Hospital, Lahore was cross sectional. The Time duration was six months and estimated ample size was 70 individuals having A-erros as 5% and β-erros as 10% and r= -0.377 correlation of mandibular crowing and maxillary base . It is based on a non-probability consecutive sampling technique. Seventy subjects were taken for the study with age limit from 13 to 30 years. The data was collected by using lateral cephalograms and dental casts from patient's pre-treatment records from orthodontic department, Fatima Memorial Hospital Lahore. Inclusion criteria includes age limit of 13-30 years, presence of all permanent teeth including first molar, without impactions of supernumerary teeth, skeletal class II malocclusion patients and subjects without any previous history orthodontic treatment. Exclusion criteria includes cases with crossbites and open bites, patients with oral habits like thumb sucking and digit sucking, craniofacial syndromes, patients with facial asymmetries and other dental abnormalities of size and number and patients with history of dentofacial trauma.

Seventy subjects who fulfill inclusion criteria were selected from orthodontics department of Fatima Memorial Hospital, Lahore. Ethical clearance was taken from institutional review board (IRB), inform consent was taken from all patients. Following the tracing of lateral cephalograms of all patients, Sagittal skeletal values (Figures 1,2) like SNA, SNB, ANB and Witts appraisal were recorded as in Figure 3. Maxillary and mandibular base lengths were recorded by estimating the linear values of Co-A and Co-Gn respectively with 0.5mm interpolation. A single examiner measured the dental crowding or arch length discrepancy in millimeters by recording the difference between arch perimeter and sum of mesiodistal widths of teeth mesial to 1st molars on both sides (Figure 4). To address bias in the study, the measurements were performed by two different operators and then took average of that. All the information was recorded.

Collected data were entered and analyzed in R Package 4.2.1. Quantitative variables like age, Co-A, Co-Gn, SNA, SNB, ANB and Witts appraisal were measured and recorded as mean $\pm$ standard deviation. Qualitative data such as gender was measured in the form percentages and frequency. Correlation

between skeletal base lengths and crowding was assessed by Pearson's product moment correlation. Analysis was stratified among gender and age group to see effect modifiers. Post stratification Pearson's product moment correlation was run. Statistically significant P-value is 0.05 or less.

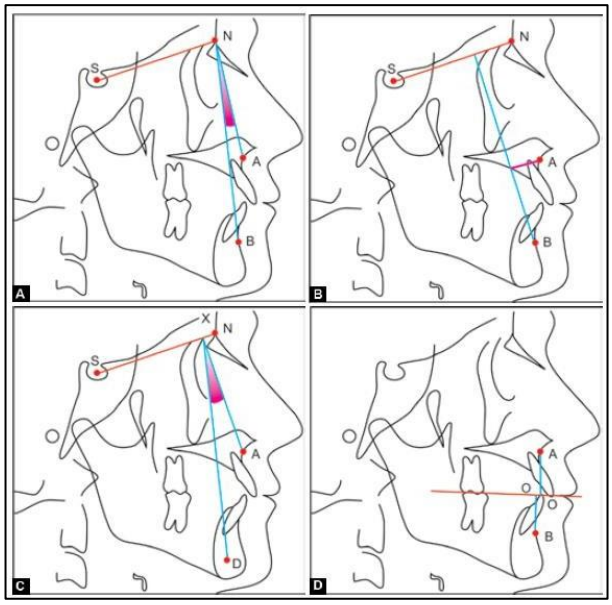

Figure 1: A = Angle ANB, B = AB distance, C = AXD angle and AD distance, and D = Witts appraisal

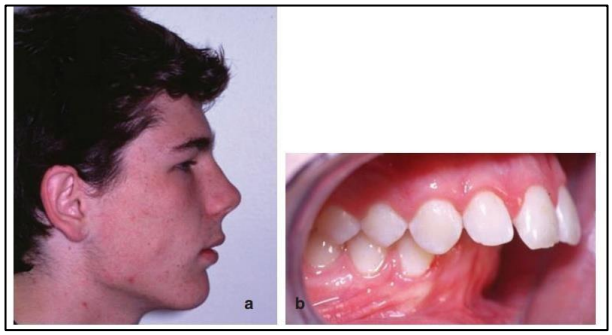

Figure 2: Skeletal Class II malocclusion

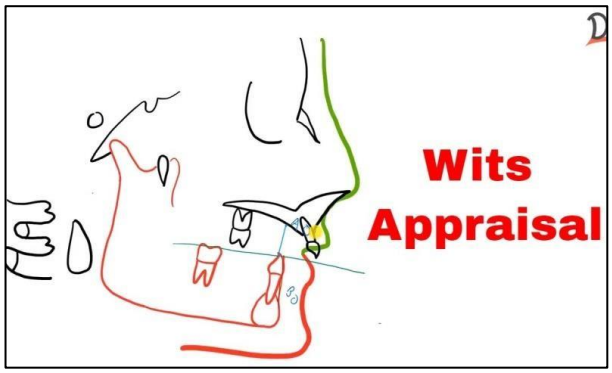

Figure 3: Wits Appraisal

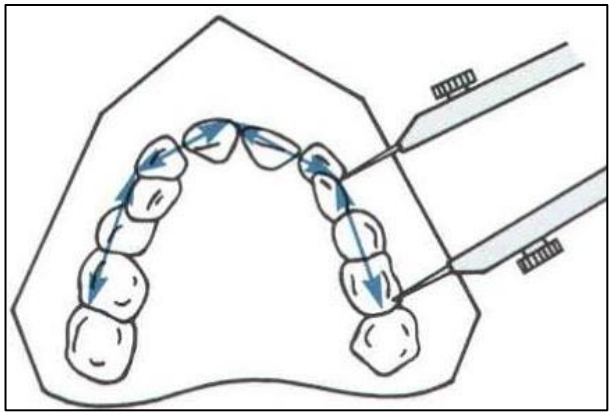

Figure 4: Space available measurements

Results

The number of male subjects were 37 (52.86%) while female subjects were 33 (47.14%). Most of patients belonged to age group. (Table I). P Participants included have mean age were 21.66±4.81 years, maxillary base length 79.49 ± 4.13mm and mandibular base length was 102.10±4.90mm. Crowding in maxilla and mandible were 9.00±2.81mm and 4.83±1.9mm respectively. (Table II)

Table I: Frequency of gender and age group

Variable	Characteristic	n(%)
Gender	Female	33 (47.14)
	Male	37 (52.86)
Age group	13-20	27 (38.57)
	21-30	43 (61.43)

Table II: Mean and SD of age, upper and lower base length and crowding and cephalometric parameter

Characteristic	Mean ±SD
Age (years)	21.66 ± 4.81
Co-A (mm)	79.49 ± 4.13
Co-Gn	102.10 ± 4.90
ALD in maxilla	9.00 ± 2.81
ALD in mandible	4.83±1.9
SNA^0	86.51 ± 3.81
SNB^0	74.83±4.9
ANB^0	8.00 ± 2.61
Witts (mm)	3.83±2.1

Statistically significant, but moderately weak and inverse correlation was found between maxillary jaw base length and maxillary arch crowding (r=-0.44, P<0.001). In mandibular arch, statistically significant but a moderately weak and inverse correlation was found between mandibular crowding and mandibular base length (r value -0.31, P value 0.008). (Table III)

Table III: Correlation between upper and lower base length with crowding

variables	R	p-value
Co-A vs maxillary crowding	-0.44	<0.001
Co-Gn vs mandibular crowding	-0.31	0.008

Figures 5 & 6 shows scatter plot along with regression equation, coefficient of correlation and co-efficient of determination between upper and lower arches base length and crowding in the respective jaws.

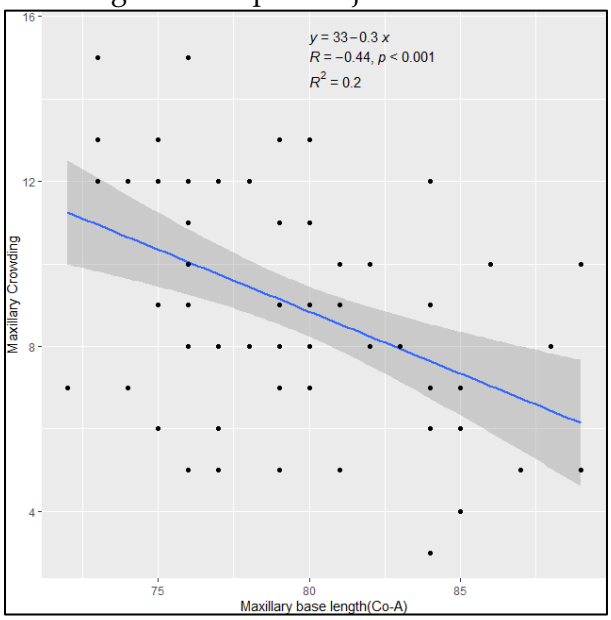

Figure 5: Correlation between maxillary base length with crowding

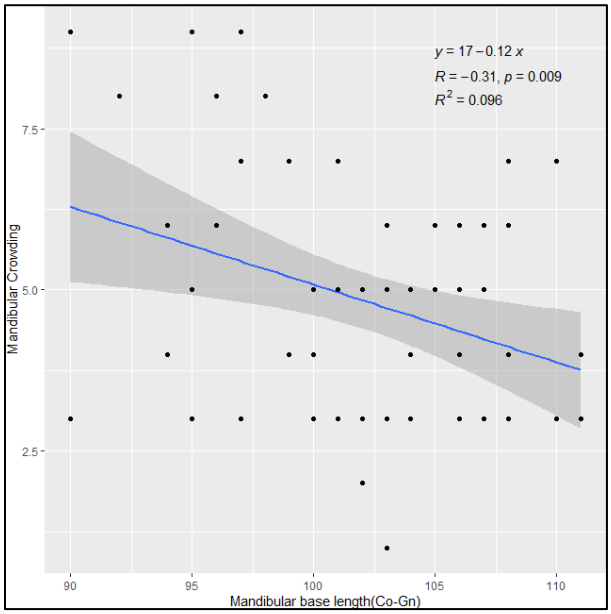

Figure 6: Correlation between mandibular base length with crowding

Correlation between upper and lower base length with crowding stratified by gender shows that significant and -ve correlation was recorded for maxillary arch crowding and base length among males (r value -0.63, p value 0.015) and females (r value-0.51, 0.002). (Table IV)

Table IV: Correlation between upper and lower arch base length with crowding stratified by gender

Gender	variables	R	p-value*
Male	Co-A vs maxillary crowding	-0.63	0.015
	Co-Gn vs mandibular crowding	-0.107	0.527
Female	Co-A vs maxillary crowding	-0.51	0.002
	Co-Gn vs mandibular crowding	-0.23	0.19

*Pearson correlation test

Correlation between upper and lower jaw base length with crowding stratified by age groups shows that significant and -ve correlation was recorded for maxillary arch crowding and base length among13-20 years (r value -0.53, p value 0.004) and 21-30 years (r value -0.38, 0.01). (Table V)

Table V: Correlation between upper and lower arch base length with crowding stratified by age group

Age group	Variables	R	p-value*
13-20	Co-A vs Maxillary crowding	-0.53	0.004
	Co-Gn vs Mandibular crowding	-0.34	0.078
21-30	Co-A vs Maxillary crowding	-0.38	0.01
	Co-Gn vs Mandibular crowding	-0.3	0.05

*Pearson correlation test

Discussion

One the most common reasons for which the patients undergo orthodontic treatment is irregular teeth in anterior segments. Dental crowding appears due to mismatch between arch size and teeth size which result in malalignment and/or tooth rotation. Factors that affect anterior dental crowding includes arch perimeter and sum of mesio-distal dimension of teeth, and tooth proportions.[7]

There are some cephalometric characteristics that have an association with large amount of crowding in dental arch. Study by Sakuda et al.[8] reveal that patients having crowded permanent dentition result in a smaller mandibular base length. Leighton and Hunter[5] revealed that crowded mixed and permanent dentition have smaller skeletal base lengtha smaller mandibular body length.

Berg[9] study comparison between two groups one with normal occlusion and the other have dental crowding of at least 3.5 mm in permanent dentition , he reveled that the group with crowding have smaller base length as compared to normal occlusion group. Turkkahraman and Sayin27 made a comparison between patients having anterior crowding with those have no crowding with class I facial pattern during early mixed dentition They found that smaller maxillary and mandibular base lengths in patients with incisor crowding.

Generally smaller mandibular base length are found in patients with Class II malocclusion as compared to those having normal and class I occlusion.[10] As it is not yet clearly understood the relation between arch length discrepancy and base lengths in skeletal class II malocclusions. Therefore, the aim of this study was to find the association in complete class II malocclusion patients between maxillary and mandibular base lengths and the amount of anterior dental crowding.

Our study revealed that there is an inverse and significant correlation between base lengths and crowding in anterior segments of maxillary and mandibular arches. A previous study on Peshawar population based on gender there were no significant changes observed for maxillary and mandibular crowding. Besides , our study revealed a significant decrease in maxillary base length in moderate to severe mandibular crowding group (p=0.000). there is a significant and reverse correlation found between maxillary (r=-0.28, p =0.02) and mandibular base lengths(r=-0.20, p=0.02) and respective dental crowding shown by the Pearson's correlation.[11] Variations seen in patients was due to genetic and ethnic factors.

According to Khan et al, there is a negative correlation between the upper jaw base length(Co-A)(r=-0.28, p=0.02) and lower jaw base length(Co-Gn) (r=-0.20, p=0.02) with upper and lower dental crowding.[2] Singh et al, reported a negative association (r=-0.377, p = 0.001) between upper dental crowding and upper jaw base length and (r=-0.247, p = 0.028) between lower dental crowding and lower jaw base length in the people of india.[4, 5] A study conducted by Ijaz et al, in class II malocclusion showed that quantity of dental crowding increases with decreasing upper and lower jaw base lengths in population of Pakistan.[6]

Future recommendations for further researchers to overcome limitations of this study is that to include a larger samplenumber from every hospital across the country to assess correlation of upper and lower jaw base lengths with anterior crowding in dental arches at larger scale sample size having class II malocclusion. This will help to find the cause of dental crowding for better treatment plaining in orthodontics.

Conclusion

Study reveal that patients with crowded dentition have smaller base lengths and patients with spacing or no crowding have either normal or larger base lengths.

The correlation of base lengths of maxilla and mandible with arch length discrepancy revealed moderate and inverse correlation which was statistically significant.

Ethical Approval

The study was approved by Institutional Review Board of Fatima Memorial College of Medicine and Dentistry, Lahore.

Conflict of Interest

No conflict of interest

Authors' Contribution

AA: Conception and design of work, data collection, critical revision and final approval of the version to be published.

AR: Data collection, data interpretation and drafting the article.

NAC: Data analysis and drafting the article.

MIR: Data collection, data analysis and drafting the article.

MSS: Data analysis and drafting the article.

SS: Data analysis and drafting the article.

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