

# Correlation between mandibular base length and dental crowding in patients with class II malocclusions

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## Abstract

**Introduction:** Etiology of malocclusion is fundamental to Orthodontics, since a problem can only be corrected once its source is known. Various predictors and correlations have been found between the two. Hence the purpose of this study was to determine the correlation between mandibular base length and dental crowding in patients with Class II malocclusion.

**Material and Methods:** A total of 124 consecutive patients (ages 14-25 years) were included in the sample. Lateral Cephalograms and casts were obtained and a correlation was derived between the mandibular base length and crowding.

**Results:** Patients with Class II malocclusion had significantly smaller mandibular base length. A weak correlation was also found between mandibular base length and mandibular dental crowding.

**Conclusions:** Mandibular base length was larger in males as compared to females. The results showed a positive correlation between dental crowding and mandibular base length. It was found to be a weak correlation meaning there by that it can be one of the contributing factors associated with dental crowding in patients with Class II malocclusion.

**Keywords:** Arch length discrepancy, Lateral cephalometric analysis, Malocclusion

## Introduction

Crowding is one of the most common Orthodontic problems that can motivate patients to seek orthodontic treatment. Many factors have been evaluated and found to be related to dental crowding, including dental arch width and length, mesiodistal tooth diameter and base lengths.<sup>1</sup> Dental crowding is identified as a disparity between tooth size and arch size that causes teeth to rotate, impact or otherwise erupt in improper positions.<sup>1</sup> However, dental crowding is not only influenced by tooth and arch size discrepancy but a multitude of factors are responsible for its development and severity.<sup>2,3</sup> Although, it was established that

dental crowding can be the result of changes in human evolutionary trends<sup>4</sup> as well as certain hereditary and environmental factors<sup>5</sup>, the importance of investigating the various clinical characteristics that contribute to it should be emphasized during the overall orthodontic treatment planning.<sup>6</sup> These factors could be of skeletal, dental or soft tissue origin. These include tooth size, tooth shape, dental arch dimensions, oral and perioral musculature, mandibular and maxillary body lengths and direction of growth of jaws etc.<sup>1,2</sup> Different treatment modalities have been employed in orthodontic correction of dental crowding such as extractions of permanent teeth, interproximal reduction, arch expansion and distalization.<sup>7</sup> Identification of the existing contributing factors of dental crowding will help us in employing appropriate treatment strategy as well as achieving stable post-treatment results.<sup>7,8</sup>

Besides dental arch dimensions, some cephalometric features are also associated with a greater amount of dental crowding e.g. linear measurements from Condylion - Point A (Co-A) and Condylion - Gnathion (Co-Gn)

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which show base lengths of the maxilla and mandible. Sakuda et al<sup>9</sup> found that patients with crowding in the permanent dentition had a smaller mandibular body length. Leighton and Hunter<sup>10</sup> observed a smaller mandibular body length in patients with severe crowding in the mixed and permanent dentition. Berg<sup>11</sup> compared a group of subjects with normal occlusion and a group of patients with dental crowding of at least 3.5 mm in the permanent dentition and found that the group with dental crowding showed a significantly smaller mandibular length compared to the sample with normal occlusion. None of these studies specified the type of malocclusion of the sample. Turkkahraman and Sayin<sup>2</sup> compared patients with and without anterior crowding who presented with Class I facial pattern in the early mixed dentition. They observed that patients with incisor crowding showed a shorter maxillary and mandibular length.

In previous studies, it has been shown that patients with crowding in the permanent dentition had a smaller mandibular body length.<sup>1</sup> Similarly patients with class II malocclusion had a smaller mandibular length ( $r = -0.317$ ) than subjects with normal occlusion and class I occlusion.<sup>1,9,12</sup>

The significance of this study was that it considered base length correlation with the amount of dental crowding in local population and the results obtained can help us in determining treatment protocols for specific etiologies.

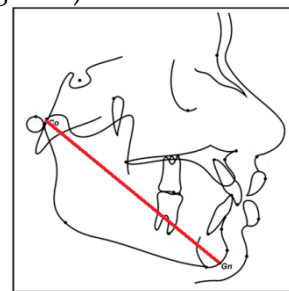
## Material and Methods

A cross sectional descriptive study was conducted at Department of Orthodontics, Khyber college of Dentistry, Peshawar. 124 subjects comprised the sample. Correlation coefficient was found between mandibular base length and dental crowding at a 95% confidence level and power of study kept at 95%. Sampling Technique was consecutive (Non-probability).

Patients with permanent dentition up to first molars (ages 14-25 years) with bilateral Class II molar relationship and all teeth fully erupted to the occlusal plane were included in the sample. Patients with mesiodistal loss or excess of tooth material as a result of caries and restorations, abnormal dental conditions such as impaction, transposition and congenitally missing teeth, prosthetic replacement, previous or ongoing orthodontic treatment, transverse discrepancies such as cross-bite or scissor bite were excluded from the study.

Approval of the hospital's ethical committee was taken. Subjects referred from the OPD, fulfilling the inclusion criteria were included in the study and informed written consent was taken. Complete history and clinical examination was done, upper and lower impressions were taken in Alginate (Lygin Chromatic, Dentamerica), poured in dental stone and casts were made for each patient. Patients were sent to the Radiology Department to obtain a lateral cephalogram by a single operator with K8000 c Kodak machine (film size 10x14 inches). Measurements were performed on pretreatment dental casts and lateral cephalograms.

Mandibular base lengths were measured on the lateral cephalograms by taking linear measurements from Condylion - Gnathion (Co-Gn, Figure 1).



**Figure 1: Cephalometric Land Marks And Linear Measurement**

**Co:** Condylion

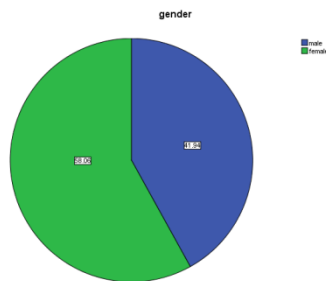
**Gn:** Gnathion

**Co-Gn:** Condylion to Gnathion

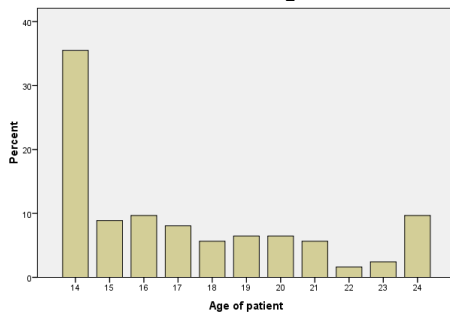
Arch length discrepancy (ALD) was calculated as the difference between the arch perimeter and the sum of tooth widths. The space available was measured as the arch perimeter from the mesial aspect of the permanent first molar to its antimere with a brass wire. Similarly, space required was measured as the sum of the individual tooth widths starting from the mesial aspect of the first permanent molar to its antimere using a digital vernier caliper with sharpened points. Negative values indicate crowding and vice versa. Spearman's RANK correlation test was applied to see the relationship between mandibular base length and dental crowding. P value of  $\leq 0.05$  was considered significant.

**Results**

Out of 124 patients, 52 (41.94%) were males whereas 72 (58.06%) were females (Figure 2,) with age range of 14-25 years (Figure 3).



**Figure 2: Gender distribution of patients in a sample**



**Figure 3: Age distribution of sample**

There was a statistically significant difference between mandibular base length and mandibular dental crowding (Table I). Mean dental crowding in both genders was slightly higher in females as compared to males

(Table II). Mean mandibular base length in males was 105.04 mm  $\pm$  9.92 mm whereas in

**Table I: Comparison between mandibular dental crowding and mandibular base length**

|                 | T      | df  | Sig. (2-tailed) | Mean Difference | 95% Confidence Interval of the Difference |          |
|-----------------|--------|-----|-----------------|-----------------|---|----------|
|                 |        |     |                 |                 | Lower                                     | Upper    |
| Dental crowding | -6.338 | 123 | .000            | -2.30081        | -3.0194                                   | -1.5822  |
| Base length     | 86.807 | 123 | .000            | 102.55645       | 100.2179                                  | 104.8950 |

**Table II: Dental crowding gender wise**

| Gender |                    | Dental crowding |
|--------|--------------------|-----------------|
| Male   | Mean               | -2.21           |
|        | Standard Deviation | 4.30            |
|        | Variance           | 18.49           |
|        | Valid N            | 52              |
| Female | Mean               | -2.37           |
|        | Standard Deviation | 3.87            |
|        | Variance           | 15.01           |
|        | Valid N            | 72              |

**Table III: Mean Mandibular base length gender wise**

| Gender | Mandibular base length |       |         |         |                    |
|--------|------------------------|-------|---------|---------|--------------------|
|        | Mean                   | Count | Maximum | Minimum | Standard Deviation |
| Male   | 105.04                 | 52    | 129.00  | 84.00   | 9.92               |
| Female | 99.51                  | 72    | 121.00  | 71.00   | 10.13              |

**Table IV: Correlation between mandibular dental crowding and mandibular base length gender wise**

| Gender   |                    |                      | Value | Asymp. Std. Error <sup>a</sup> | Approx. T <sup>b</sup> | Approx. Sig.      |
|--|--------------------|----------------------|-------|--------------------------------|------------------------|-------------------|
| Male   | Ordinal by Ordinal | Spearman Correlation | .148  | .132                           | 1.059                  | .295 <sup>c</sup> |
|  | N of Valid Cases   |                      | 52    |                                |                        |                   |
|  | Ordinal by Ordinal | Spearman Correlation | .199  | .111                           | 1.698                  | .094 <sup>c</sup> |
| N of Valid Cases   |                    |                      | 72    |                                |                        |                   |
| Female   |                    |                      |       |                                |                        |                   |
| a. Not assuming the null hypothesis.                                 |                    |                      |       |                                |                        |                   |
| b. Using the asymptotic standard error assuming the null hypothesis. |                    |                      |       |                                |                        |                   |

| Gender                               |                    | Value | Asymp. Std. Error <sup>a</sup> | Approx. T <sup>b</sup> | Approx. Sig.      |
|--------------------------------------|--------------------|-------|--------------------------------|------------------------|-------------------|
| Male                                 | Ordinal by Ordinal | .148  | .132                           | 1.059                  | .295 <sup>c</sup> |
|                                      | N of Valid Cases   |       | 52                             |                        |                   |
| Female                               | Ordinal by Ordinal | .199  | .111                           | 1.698                  | .094 <sup>c</sup> |
|                                      | N of Valid Cases   |       | 72                             |                        |                   |
| a. Not assuming the null hypothesis. |                    |       |                                |                        |                   |
| c. Based on normal approximation.    |                    |       |                                |                        |                   |

**Table V: Correlation between mandibular dental crowding and mandibular base length in a sample**

|  |                      | Value | Asymp. Std. Error <sup>a</sup> | Approx. T <sup>b</sup> | Approx. Sig.      |
|--|----------------------|-------|--------------------------------|------------------------|-------------------|
| Ordinal by Ordinal   | Spearman Correlation | .176  | .087                           | 1.978                  | .050 <sup>c</sup> |
| N of Valid Cases   |                      | 124   |                                |                        |                   |
| a. Not assuming the null hypothesis.                                 |                      |       |                                |                        |                   |
| b. Using the asymptotic standard error assuming the null hypothesis. |                      |       |                                |                        |                   |
| c. Based on normal approximation.                                    |                      |       |                                |                        |                   |

female was  $99.51\text{mm} \pm 10.13\text{ mm}$ . Mandibular base length was larger in males as compared to females (Table III). Tables IV and V show correlation between mandibular dental crowding and mandibular base length (for males,  $r = 0.148$  and for females  $r = 0.199$ ). These values show weak correlation between mandibular dental crowding and mandibular base length.

## Discussion

One of the main goals of this study was to determine a correlation between mandibular base lengths with the severity of dental crowding among skeletal class II malocclusion. The findings of this study indicate statistically significant differences in the mean value of mandibular base lengths and mandibular dental crowding. However, the results of correlation analysis indicated a weak correlation as compare to Janson G et al<sup>1</sup>

who proved the relationship between maxillary and mandibular effective lengths and dental crowding in patients with Class II malocclusions to be significant. He concluded that patients with Class II malocclusion and moderate to severe crowding had significantly smaller maxillary and mandibular effective lengths A weak inverse correlation was also found between maxillary and mandibular effective lengths and the severity of dental crowding.

According to Turkkahraman and Sayin<sup>2</sup> mandibular anterior crowding is identified as the discrepancy between mesiodistal tooth widths of four permanent incisors and available space in the alveolar process. However, incisor crowding is not merely a tooth-arch size discrepancy. Many variables such as direction of mandibular growth, early loss of deciduous molars, the oral and perioral musculature and incisor and molar inclination can be associated with crowding. It was the aim of their study to search for dentofacial factors that might be associated with mandibular crowding in the early mixed dentition. Lateral cephalograms and dental casts of 60 children (33 girls, 27 boys) were evaluated. It was determined that patients with crowding had smaller lower incisor to NB angles, maxillary skeletal lengths, mandibular skeletal length, and mandibular dental measurements. They also had greater interincisal angles, overjet, overbite and Wits appraisal measurements. Significant inverse correlations were found between crowding and SNB, lower incisor to NB angle, anterior cranial length, mandibular length, maxillary length, mandibular dental measurement and direct correlations between crowding and interincisal angle, overjet, overbite, and FMIA. According to these results it was concluded that crowding of the mandibular incisors is not only a tooth-arch size discrepancy but dentofacial characteristics also contribute to this misalignment. Our results are in concordance with their study as well as other previous studies<sup>2,30,31</sup> which

provide compelling evidence that severity of dental crowding increases with retrognathic jaws or short bony bases and vice versa.

When maxillary and mandibular base lengths were compared between different skeletal malocclusions, Khoja et al<sup>13</sup> proved dental crowding to be one of the most frequently encountered problem for an orthodontist. He concluded that mandibular base length was greater in males than females and an increase in amount of dental crowding was weakly associated with smaller skeletal base lengths. This is in concurrence to the present study. Dhopatkar et al<sup>14</sup> found maxilla and mandible to be large in certain kinds of skeletal discrepancies. Baccetti et al<sup>15</sup> found a significant degree of gender dimorphism in subjects aged 13 years and above for maxillary and mandibular base lengths along with other craniofacial structures in Class III subjects. Male subjects with Class III malocclusion presented with a significantly larger linear dimensions of the maxilla (Co-PtA), mandible (Co-Gn) and anterior facial heights when compared to female subjects. Although, present study also showed greater linear dimensions for mandibular (Co-Gn) base lengths in males aged 14-25 years among Class II skeletal malocclusions, this increase was found to be significant only for mandibular base length. Another longitudinal study of Ursi et al<sup>16</sup> on sexual dimorphism on craniofacial growth observed greater linear measurements for mid-facial (Co-A) and mandibular length (Co-Gn) in males as compared to females at all ages but significant changes were observed after 14 years. Our results are in correspondence with the aforementioned studies however, unlike those studies, the cross-sectional sampling technique used in our study doesn't give supporting evidence for growth changes of the mandibular base lengths across genders at different chronological ages.

Numerous studies<sup>17-21</sup> in the past have investigated the gender differences for dental crowding. Dorris et al.<sup>18</sup> did not find any

significant difference for dental crowding between gender of subjects. Several studies<sup>19,22,23</sup> have been conducted to determine the tooth size discrepancies between different malocclusions. Sitrujic M et al<sup>20</sup> found mandibular tooth size excess in Angle Class III malocclusion and maxillary tooth size excess in Angle Class II malocclusion. In our study, the amounts of mandibular arch crowding was highest in skeletal Class II. On the basis of these finding, it can be interpreted that subjects with skeletal Class II had an increased mandibular arch crowding due to their smallest mandibular base length whereas, subjects with skeletal Class III had comparatively decreased amount of mandibular arch crowding due to their largest mandibular base length. The results showed that subjects with dental crowding had smaller mandibular base lengths compared with subjects without crowding or with slight dental crowding. In addition, there was a weak correlation between the amount of crowding and mandibular base lengths. Based on the results of the present study, it can be speculated that mandibular base lengths (Co-A and Co-Gn) would correlate to a given range of mandibular dental crowding. These results are similar to the results of previous studies conducted on samples with unspecified malocclusions.<sup>2,9,11</sup>

Therefore, effective lengths of the apical bases can be correlated to the amount of dental crowding independent of the type of malocclusion. The current results also suggest that besides tooth size and transverse arch dimensions, base length is also an important factor related to the amount of dental crowding, even in subjects with complete Class II malocclusion. Therefore, this has to be taken in consideration during treatment planning. If dental crowding is mostly due to the first two problems and ranges from slight to moderate, treatment protocols such as inter-proximal stripping and/or arch expansion are more appropriately indicated.

However, when dental crowding ranges from moderate to severe and is not attributable to tooth size and transverse arch dimension problems, it is most likely a result of deficient effective base length. Consequently, in these cases extractions would likely be the best treatment alternative.

In light of all the findings, it is suggested that in addition to the several other contributing factors of dental crowding as investigated in the literature, mandibular skeletal base lengths may also play a role in mandibular dental crowding. Therefore, during the selection of a suitable treatment strategy in patients presenting with varying severity of dental crowding, this factor should also be taken into consideration.

## Conclusions

Mandibular base length can be one of the contributing factors in mandibular dental crowding development and this must be taken into consideration during diagnosis and treatment planning. Methods for crowding relief have been suggested keeping in mind this variable.

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