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## Correlation Between the Sagittal Skeletal Relationship and Lower Anterior Facial Height - A Retrospective Study

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**Abstract:** This investigation aimed to study and evaluate the correlation between the Sagittal Skeletal Relationship and the Lower Anterior Facial Height. A single-center data collection was done. 490 Lateral Cephalograms were collected and traced. Only adult patients with average were considered for the study. 31 cephalograms were included. Beta angle measurement was used to divide the cephalograms into 3 groups. The lower anterior facial height measurement was made for each cephalogram. The Data was tabulated into an MS Excel spreadsheet. One Way ANOVA analysis was performed to study the correlation between the groups. The average Lower anterior facial height for all the groups  $68.47 \pm 11.3$  mm. The significance derived from the ANOVA test is 0.762. No statistically significant correlation between the Sagittal Skeletal Relationship and Lower Anterior Facial Height in the south Indian population

**Keywords:** LAFH, Sagittal, Skeletal, innovative

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### INTRODUCTION

In orthodontics, facial forms are generally classified into long, average, and short according to the vertical facial dimensions ('A classification of skeletal facial types', 1969; Kim, 1974)(Sivamurthy and Sundari, 2016). It is long regarded that vertical dimension control is one of the most difficult tasks in orthodontics(Kim, 1974)(Samantha *et al.*, 2017). The understanding of this morphology is a key element in planning orthodontic treatment. There exists a close link between aesthetics and vertical facial dimension(Ta *et al.*, 2018)(Vikram *et al.*, 2017). Thus achieving the ideal vertical facial profile for patients becomes a key objective in orthodontic treatment(Johnston *et al.*, 2005)(Dinesh *et al.*, 2013). Previous studies made their findings based on the emphasis that individuals with malocclusion should not be treated through assessment by generic cephalometric analysis, but rather by individualized norms(Website, no date a)(Website, no date a, Website, no date b; Kim, 1974)(Website, no date a, Website, no date b; Kim, 1974; Solow, 1980)(Viswanath *et al.*, 2015). Literature evidence points to a large variation in skeletal relationships in normal occlusion samples(Website, no date a, Website, no date b)(Krishnan, Pandian and Rajagopal, 2017), thereby suggesting that significant anatomical variations exist in those with normal occlusion and to a greater degree in those with malocclusion(Krishnan, Pandian and Kumar S, 2015)(Kamisetty *et al.*, 2015). Our department is passionate about research we have published numerous high quality articles in this domain over the past years ( (Kavitha *et al.*, 2014) , (Praveen *et al.*, 2001),(Devi and Gnanavel, 2014), (Putchala *et al.*, 2013), (Vijayakumar *et al.*, 2010), (Lekha *et al.*, 2014a, 2014b) (Danda, 2010) (Danda, 2010) (Parthasarathy *et al.*, 2016) (Gopalakannan, Senthilvelan and Ranganathan, 2012), (Rajendran *et al.*, 2019), (Govindaraju, Neelakantan and Gutmann, 2017), (P. Neelakantan *et al.*, 2015), (PradeepKumar *et al.*, 2016), (Sajan *et al.*, 2011), (Lekha *et al.*, 2014a), (Neelakantan, Grotra and Sharma, 2013), (Patil *et al.*, 2017), (Jeevanandan and Govindaraju, 2018), (Abdul Wahab *et al.*, 2017), (Eapen, Baig and Avinash, 2017), (Menon *et al.*, 2018), (Wahab *et al.*, 2018), (Vishnu Prasad *et al.*, 2018), (Uthrakumar *et al.*, 2010), (Ashok, Ajith and Sivanesan, 2017), (Prasanna Neelakantan *et al.*, 2015). This investigation aimed to study and evaluate the correlation between the Sagittal Skeletal Relationship and the Lower Anterior Facial Height(LAFH).

### MATERIALS AND METHODS

The study was conducted with data acquired from a single center. The cases were those who sought treatment from

the Department of Orthodontics, Saveetha Dental College and Hospital in Chennai, India. The cases that were considered were those being treated by the Postgraduates in the 3-year orthodontic Postgraduate program in the Department of Orthodontics. 490 Lateral cephalograms were sought. These cephalograms were taken during August 2019 to March 2020. They were taken by a single operator using the same machine. The cephalograms were traced using FACAD version 3.11 (Ilexis AB, Sweden) by the first investigator(MTM). Landmarks were marked and required measurements were taken [Mandibular plane angle(MPA)(Steiner, 1953), Beta angle(BA)(Baik and Ververidou, 2004), and LAFH(Burstone *et al.*, 1978; Baik and Ververidou, 2004)]. These tasks were performed by a single operator to avoid bias. Intra-operator bias was validated by repeating a few tracings. The second investigator verified(MNK) the landmarks and tracings. Based on the MPA, the growth pattern(GP) was evaluated and the cephalograms were divided into three groups (vertical, horizontal, and average) based on GP. In this investigation, only cephalograms of adults (age 18 years and above) with average GP were considered for further evaluation. Those 27 cephalograms that remained were further divided into three groups ( skeletal pattern; Class I, class II, and class III) based on their ba values. Once grouping was complete, there were 12 cephalograms in the Class I group, 9 cephalograms in the Class II group, and 6 cephalograms in the Class III group. Of the 27, cephalograms 14 were female and 13 were male cephalograms. In the Class I group, 5 were male and 7 were female cephalograms. In the Class II group, 5 were male and 4 were female cephalograms. In the Class III group, 3 were male and 3 were female cephalograms. The lower anterior facial height measurements for cephalograms in each group were tabulated into a Microsoft Excel spreadsheet (Microsoft Office Home and Student 2013; Microsoft Corporation, Redmond, Washington, USA ). A One way ANOVA test and Chi-Square test was conducted using IBM SPSS software version 23 (IBM Corporation, USA).

## RESULTS AND DISCUSSION

The average LAFH for all 3 groups is  $67.8 \pm 8.69$  mm. The average for the class I group is  $66.75 \pm 5.42$ mm, the average LAFH in the class II group  $64.93 \pm 7.87$ mm, and the average LAFH for the class III group is  $74.2 \pm 12.74$ mm . The ANOVA test for the data had a p value of 0.108, therefore the results were insignificant implying that there is no correlation (Table 1). This differs from the conclusion put forth by other studies. The various plausible explanations for these results include variation in anterior cranial base(Kasai *et al.*, 1995)(Felicita, 2018), a more acute cranial base angle in skeletal class III group(Mouakeh, 2001; Choi *et al.*, 2010; Parajuli *et al.*, 2012; Celebi *et al.*, 2013)(Felicita, 2017b), cranial base bend, and forward rotation of the mandible in the class III group(Obaidi, 2006a, 2006b)(Felicita, 2017a). The study parameters eliminated cephalograms with vertical and horizontal GP to avoid skewing of the results due to the presence of outliers in these groups. Accurate assessment of a patient's skeletal pattern in all planes, vertical, sagittal, and transverse direction is essential during orthodontic diagnosis and treatment planning(Wang *et al.*, 2013; Fathalla, El Kadi and Nadim, 2017; Ta *et al.*, 2018)(Felicita, Chandrasekar and Shanthasundari, 2012, 2013). Variability in the vertical pattern determines the biomechanical approach for the treatment and facial proportions(Ta *et al.*, 2018)(Khan, 2016)(Rubika, Sumathi Felicita and Sivambiga, 2015). The diagnosis of the facial discrepancy in the vertical plane is of utmost importance not only for diagnosis but also for retention and stability('The diagnostic facial triangle in the control of treatment objectives', 1969, 'The long face syndrome: Vertical maxillary excess', 1976)(Pandian, Krishnan and Kumar, 2018). Cephalometric norms vary amongst ethnic and racial lines and it has been determined and compared. The need for individualized norms has been demonstrated(Opdebeeck and Bell, 1978)('The long face syndrome: Vertical maxillary excess', 1976), to better understand the cephalometric characteristics of various groups(Jain, Kumar and Manjula, 2014)(Ramesh Kumar *et al.*, 2011; Jain, Kumar and Manjula, 2014). The study failed to examine sex-based variations amongst the population. Further studies in this field are necessary.

## CONCLUSION

Within the limitations of this study, no significant difference for mean lower anterior facial height among class I, class II and class III malocclusions was noted. Also no difference for the mean LAFH in between the groups was noted.

## Conflict of Interest

The authors would like to inform you that there is no conflict of interest in this investigation.

## ACKNOWLEDGMENT

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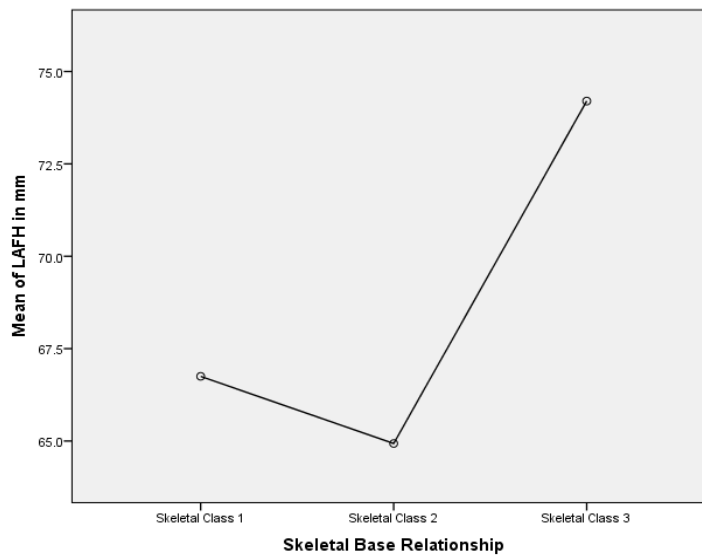
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**Table 1: One way ANOVA analysis was done to compare the Lower Anterior Facial Height of among the three groups. The result of the test had a significance of 0.108. Therefore the lower anterior facial height difference among the three groups is not significant.**

|                | Sum of Squares | df | Mean Square | F     | Sig.  |
|----------------|----------------|----|-------------|-------|-------|
| Between Groups | 332.950        | 2  | 166.475     | 2.447 | 0.108 |
| Within Groups  | 1632.530       | 24 | 68.022      |       |       |
| Total          | 1965.480       | 26 |             |       |       |

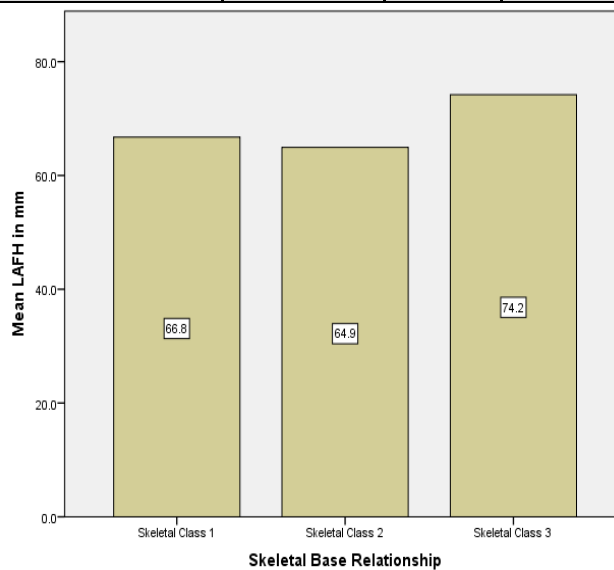


**Fig.1: Means plot of the One way ANOVA test. The mean LAFH of the skeletal class II group was the lowest at  $64.93 \pm 7.87$ mm, followed by the mean of the skeletal class I group at  $66.75 \pm 5.42$ mm, the skeletal class III had the highest mean value at  $74.2 \pm 12.74$ mm.**

**Table 2: Post-hoc Tukey analysis for the data. The Post-hoc analysis was done to compare the LAFH values amongst the groups. The p value was  $>0.05$  in all comparisons. Hence, there was no statistically significant differences amongst the three groups.'**

| (I) Skeletal Base Relationship | (J) Skeletal Base Relationship | Mean Difference (I - J) | Std Error | Sig   | 95% Confidence Interval |             |
|--------------------------------|--------------------------------|-------------------------|-----------|-------|-------------------------|-------------|
|                                |                                |                         |           |       | Lower Bound             | Upper Bound |
| Skeletal Class I               | Skeletal Class II              | 1.8167                  | 3.6368    | 0.872 | -7.266                  | 10.899      |
|                                | Skeletal Class III             | -7.4500                 | 4.1238    | 0.189 | -17.748                 | 2.848       |
| Skeletal Class II              | Skeletal Class I               | -1.8167                 | 3.6368    | 0.872 | -10.899                 | 7.266       |
|                                | Skeletal Class III             | -9.2667                 | 4.3468    | 0.104 | -20.122                 | 1.589       |

|                    |                   |        |        |       |        |        |
|--------------------|-------------------|--------|--------|-------|--------|--------|
| Skeletal Class III | Skeletal Class I  | 7.4500 | 4.1238 | 0.189 | -2.848 | 17.748 |
|                    | Skeletal Class II | 9.2667 | 4.3468 | 0.104 | -1.589 | 20.122 |



**Fig.2: Bar graph representing the mean among the sagittal skeletal malocclusions. X-axis represents the sagittal skeletal base relationship and Y-axis represents the mean LAFH in mm. One way ANOVA test was performed to evaluate the mean difference of LAFH among the three malocclusions. The p value is 0.108(>0.05) therefore no significant difference in LAFH among the three malocclusions was noted.**