

# Correlation between Hard and Soft Tissue Lower Anterior Facial Height of Different Skeletal Pattern on South Indian Population

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## Abstract

The soft tissue is in close contact to the underlying skeletal hard tissue and takes up whatever form is dictated by the hard tissue. Yet, there exists some variations in cases of which, the soft tissue thickness varies in certain places to camouflage the skeletal deficiency. Hence, the purpose of this study was to evaluate the correlation of hard and soft tissue lower anterior facial height (LAFH) of different skeletal patterns on the south indian population. The study consisted of 30 lateral cephalograms, which were divided into three groups based on the skeletal relationship: Group A - Class I skeletal pattern, Group B - Class II skeletal pattern and Group C - Class III skeletal pattern. All the groups contained 10 radiographs each of that particular skeletal pattern. FACAD software was used to do the digital tracing and analysis. The obtained results were tabulated and were subjected to statistical analysis using SPSS software version 23. The results of Pearson's correlation test revealed that Group A and Group B were positively correlated with statistical significance, whereas Group C was statistically insignificant. Hence, soft tissue LAFH can be used as a valuable indicator and an adjunct in diagnosis and treatment planning of orthodontic cases.

**Keywords:** Hard tissue; Lower anterior facial height, Lateral cephalogram, Soft tissue.

## Introduction

Lateral cephalometric readings of the hard tissue structures are often used as the diagnostic criteria in classifying the type of malocclusion, based on which treatment plans are formulated. The soft tissue however, is not given much consideration as it is not very apparent in lateral cephalograms. They also cannot predict the outcome and final soft tissue position, as the soft tissue doesn't accurately mimic the hard tissue changes to maximum extent.<sup>1</sup> This makes it essential for the establishment of a standard, for soft tissue structures pertaining to the different types of skeletal relationship.

Vertical discrepancies are one of the most commonly encountered types of skeletal malocclusion in everyday life.<sup>2</sup> Vertical discrepancies cause an increase or a decrease in the overall length of the face. They are usually termed as either a high angle case, a low angle case or a normal angle case. This can be due to a variety of reasons, like the rotation of mandible, rotation of occlusal plane, inclination of palatal plane, development of dentoalveolar segment etc.,<sup>3</sup>

The soft tissues are closely adherent to the hard tissue. They reflect the hard tissue configuration underneath. In certain cases, the soft tissues also effectively mask the skeletal defects, thereby effectively camouflaging the condition. The extent upto which the soft tissue thickness covers different regions of the face varies from person to person. Gender also plays a crucial role in variation of soft tissue thickness of the face due to a variety of factors such as difference in growth spurts, hormonal changes, etc,. This is commonly referred to as sexual dimorphism, that establishes the need for different standards of soft

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tissue structures in males and females.<sup>4,5</sup>

Lower anterior facial height is a direct reflection of the soft tissue morphology.<sup>6</sup> Increase or decrease in the lower anterior facial height can be a direct reflection of the type of growth pattern that influences the patient’s facial form.<sup>4</sup> Saxby and Freer in their study have evaluated the correlation between lower anterior facial height and soft tissue form in vertical and horizontal planes.<sup>7</sup> Soft tissues more often than not, tend to exaggerate the jaw discrepancies.

Ethnicity and race have also been found to be an important factor influencing the soft tissue configuration. The relationship between hard and soft tissue profiles are variable as they are closely related to the hard tissue as shown in studies done by Kasai.<sup>8</sup>

The purpose of this retrospective study was to evaluate the correlation between hard and soft tissue lower anterior facial height (LAFH) on different skeletal patterns of the south indian population.

### Materials and Methods

The retrospective study consisted of a total of 30 lateral cephalograms. The lateral cephalograms were divided into 3 groups, based on the skeletal pattern as :

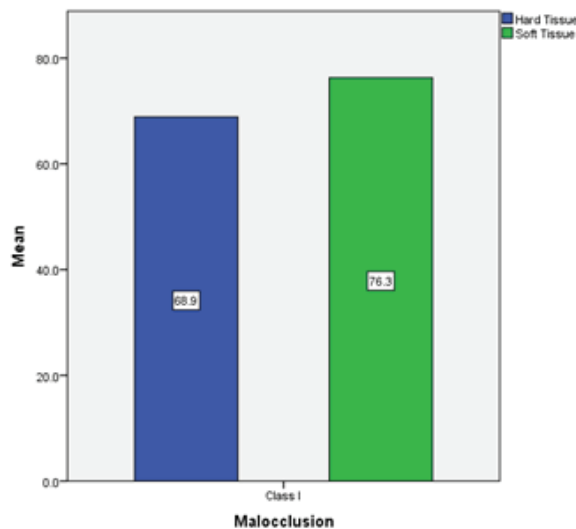
- Group A - Class I skeletal pattern

- Group B - Class II skeletal pattern
- Group C - Class III skeletal pattern

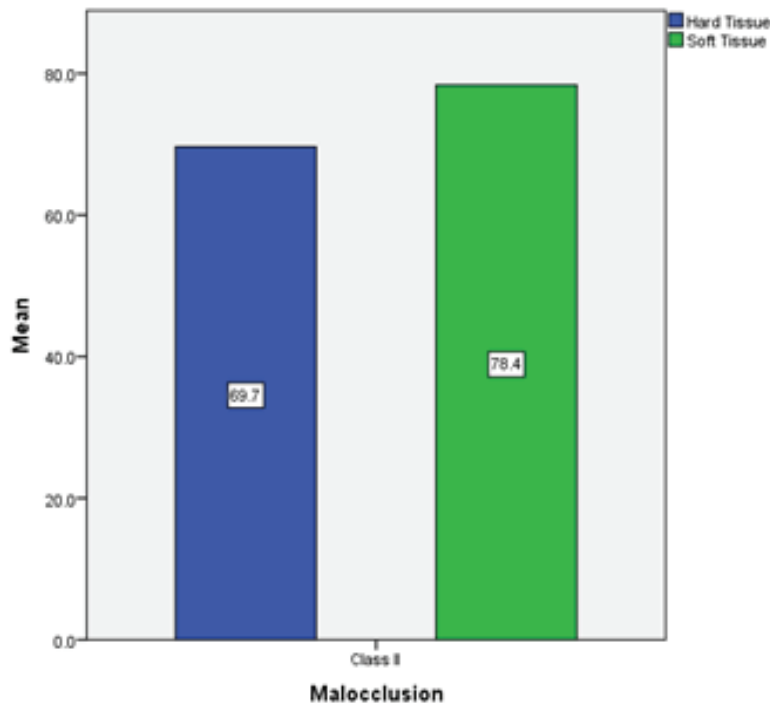
Each group contained 10 radiographs each, pertaining to the specific skeletal relationship. The data for the study was randomly collected from the Saveetha Institute of Medical and Technical Sciences (SIMATS) university database. Radiographs taken in proper natural head position with proper exposure were chosen for this study. Lateral cephalograms of syndromic patients and those with missing teeth were excluded from this study. Ethical approval was obtained from the institutional review board. FACAD software was used for digital cephalometric tracing and analysis. Points were plotted for hard tissue lower anterior facial height (LAFH) from anterior nasal spine to menton (ANS-Mn) and for soft tissue LAFH from Subnasale to Soft tissue menton (Sn-Mn’). The linear measurements were obtained and were subjected to statistical analysis using SPSS software version 23 for windows. Pearson’s correlation test was performed to determine the correlation between the hard and soft tissue LAFH in different skeletal patterns.

### Results and Discussion

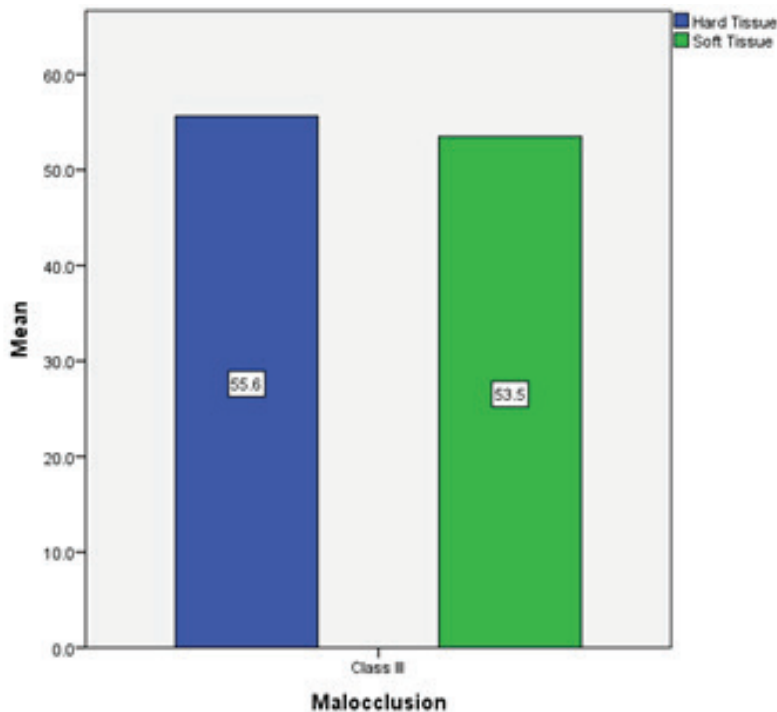
Descriptive statistics showing the mean and standard deviation of Class I, Class II and Class III skeletal patterns are shown in (Graph 1, 2, 3).



**Graph 1: Descriptive statistics showing mean of hard and soft tissue LAFH in Class I. Bar chart showing mean value of hard and soft tissue lower anterior facial height (LAFH) in Class I skeletal relationship. The mean hard tissue LAFH is 68.9 whereas the mean soft tissue LAFH is 76.3 (x axis - Skeletal relationship, y axis - soft tissue thickness; blue colour - hard tissue LAFH green colour - soft tissue LAFH)**



**Graph 2: Descriptive statistics showing mean of hard and soft tissue LAFH in Class II** Bar chart showing mean value of hard and soft tissue lower anterior facial height (LAFH) in Class II skeletal relationship. The mean hard tissue LAFH is 69.7 whereas the mean soft tissue LAFH is 78.4 (x axis - skeletal relationship, y axis - soft tissue thickness; blue colour - hard tissue LAFH, green colour - soft tissue LAFH)



**Graph 3: Descriptive statistics showing mean of hard and soft tissue LAFH in Class III** Bar chart showing mean value of hard and soft tissue lower anterior facial height (LAFH) in Class III skeletal relationship. The mean hard tissue LAFH is 55.6 whereas the mean soft tissue LAFH is 53.5 (x axis - Skeletal relationship, y axis - soft tissue thickness; blue colour - hard tissue LAFH, green colour - soft tissue LAFH)

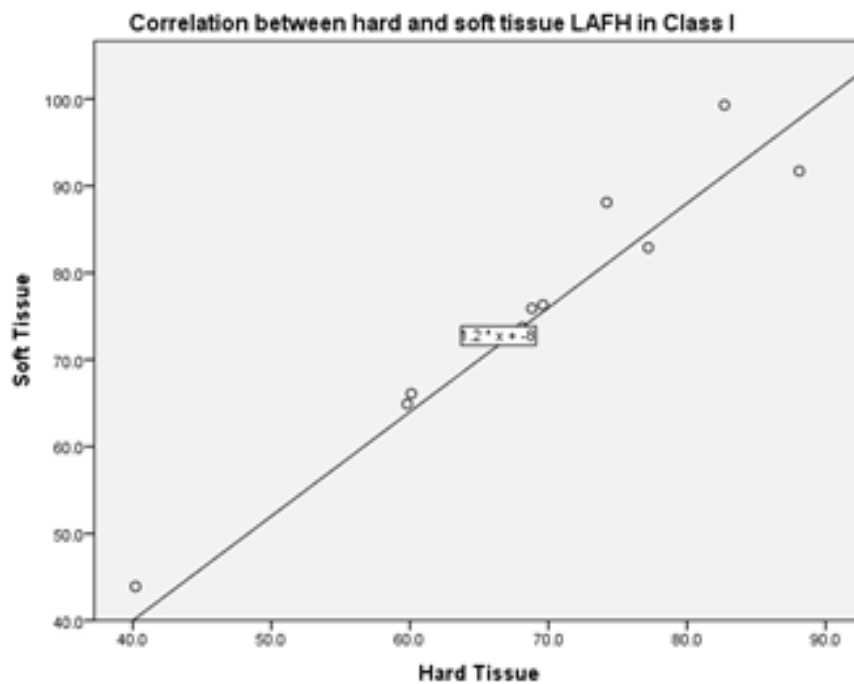
The results of the Pearson’s correlation test for Class I skeletal pattern is shown in (Table 1 and Graph 4). There is a positive correlation between the hard and soft tissue LAFH in Class I skeletal pattern which is statistically significant as the P value is <0.05.

**Table 1: Pearson’s correlation test between hard and soft tissue LAFH of Class I**

**Correlations**

		Hard Tissue	Soft Tissue
Hard Tissue	Pearson Correlation	1	.968**
	Sig. (2-tailed)		.000
	N	10	10
Soft Tissue	Pearson Correlation	.968**	1
	Sig. (2-tailed)	.000	
	N	10	10

\*\*Correlation is significant at the 0.01 level (2-tailed).



**Graph 4: Scatter dot graph showing correlation between hard and soft tissue LAFH of Class I. Scatter dot chart showing correlation between hard and soft tissue lower anterior facial height (LAFH) in Class I skeletal relationship shows that there is a positive correlation between hard and soft tissue LAFH as it falls within the straight line and is also of statistical significance as p value is <0.05 (x axis - hard tissue LAFH, y axis - soft tissue thickness)**

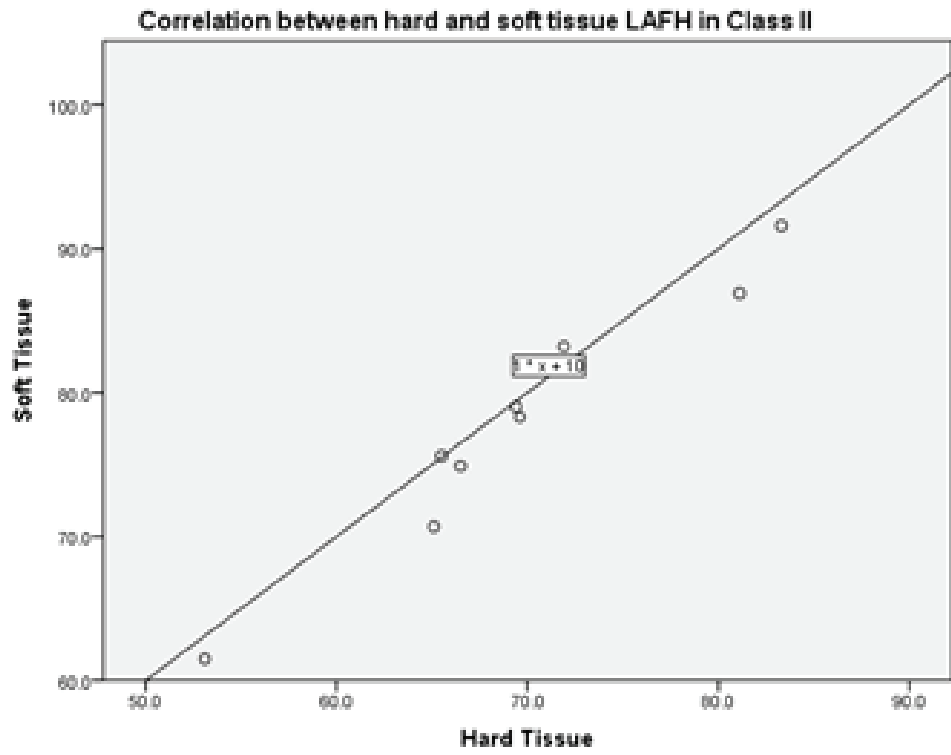
Results for Class II skeletal pattern are depicted in (Table 2 and Graph 5), which also shows a positive correlation between the hard and soft tissue LAFH. The results are also statistically significant with the P value of < 0.05.

**Table 2: Pearson’s correlation test between hard and soft tissue LAFH of Class II**

**Correlations**

		Hard Tissue	Soft Tissue
Hard Tissue	Pearson Correlation	1	.975**
	Sig. (2-tailed)		.000
	N	10	10
Soft Tissue	Pearson Correlation	.975**	1
	Sig. (2-tailed)	.000	
	N	10	10

\*\* Correlation is significant at the 0.01 level (2-tailed).



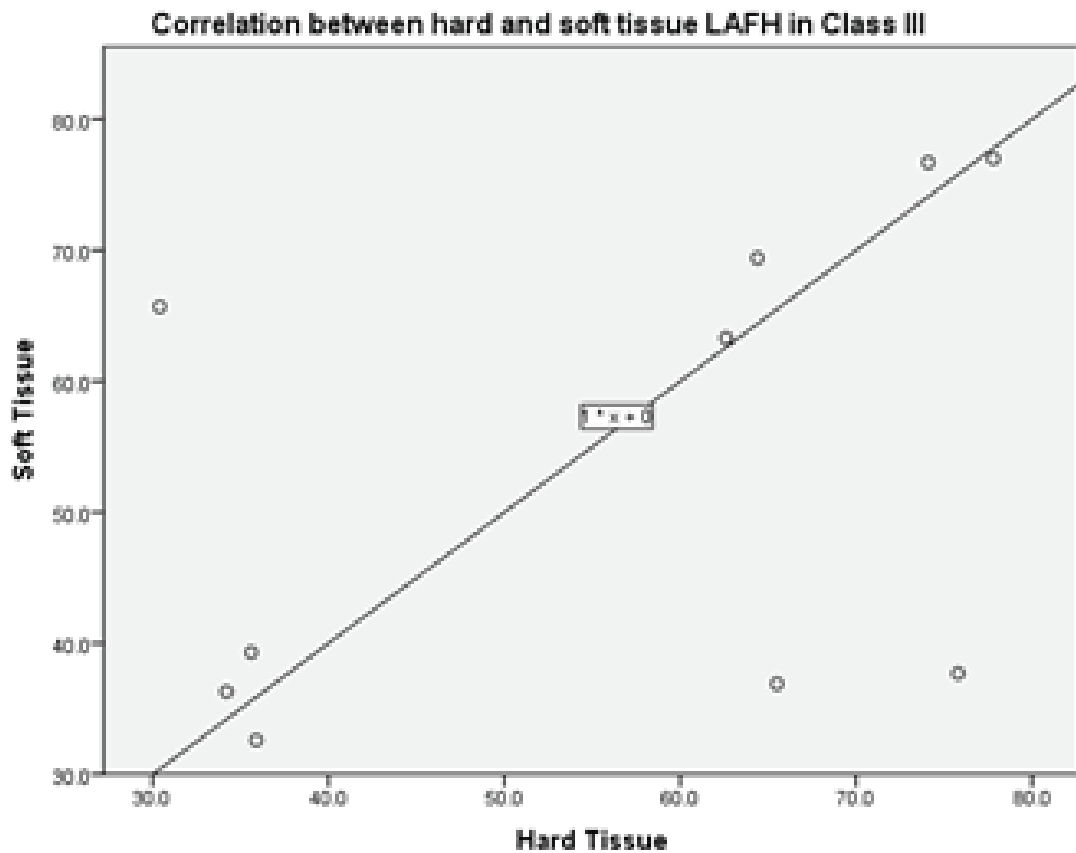
**Graph 5: Scatter dot graph showing correlation between hard and soft tissue LAFH of Class II. Scatter dot chart showing correlation between hard and soft tissue lower anterior facial height (LAFH) in Class II skeletal relationship shows that there is a positive correlation between hard and soft tissue LAFH as it falls within the straight line and is also of statistical significance as p value is <0.05. (x axis - hard tissue LAFH, y axis - soft tissue thickness)**

The results for Class III skeletal pattern however, is statistically no significance shown in (Table 3 and Graph 6).

### Correlations

**Table 3: Pearson’s correlation test between hard and soft tissue LAFH of Class III**

		Hard Tissue	Soft Tissue
Hard Tissue	Pearson Correlation	1	.448
	Sig. (2-tailed)		.194
	N	10	10
Soft Tissue	Pearson Correlation	.448	1
	Sig. (2-tailed)	.194	
	N	10	10



**Graph 6: Scatter dot graph showing correlation between hard and soft tissue LAFH of Class III. Scatter dot chart showing correlation between hard and soft tissue lower anterior facial height (LAFH) in Class III skeletal relationship shows that there is a positive correlation between hard and soft tissue LAFH as it falls within the straight line, but there is no statistical significance as p value is >0.05. (x axis - hard tissue LAFH, y axis - soft tissue thickness)**

Previously, our team had conducted numerous clinical trials<sup>9</sup>, in vitro studies<sup>4,10-14</sup>, Finite element studies<sup>15,16,17</sup>

and a couple of prospective studies<sup>18-22</sup> over the past 5 years. Now we are focusing on this retrospective study, done with the data obtained from our vast database. The idea for this study stemmed from the current interest in our community on the soft tissue paradigm shift.

This study was conducted to assess the correlation between hard and soft tissue LAFH of different malocclusions. The age of the subjects were maintained over 18 years to address the aspect of growth. Only the average growth pattern in all malocclusions with a mean FMA angle of 25-35° was chosen to maintain the uniformity of the chosen samples.

The positive correlation in Class I and Class II skeletal patterns show that the hard and soft tissue LAFH are within their appropriate proportions and are also statistically significant. However, the insignificant results of Class III skeletal pattern could be due to the variations in the soft tissue stretching due to the prognathic mandible. As a result of which, the soft tissue chin thickness is commonly reduced in Class III patients.<sup>23</sup>

Our team has conducted numerous clinical trials over the past 5 years on various topics pertaining to the hard and soft tissue characteristics of the face and its implications on treatment planning and its outcome. This current study aims at addressing the contribution of soft tissue in the increase of lower anterior facial height.

Increase in the lower anterior facial height is more commonly seen in patients with vertical growth pattern. They often exhibit a leptoprosopic facial form that is usually termed as long face syndrome. On radiographic evaluation, they have several diagnostic indicators such as the gonial angle, basal plane angle, mandibular plane angle, etc., that further confirm the diagnosis.<sup>4</sup>

Lateral cephalograms, ever since its discovery by Broadbent in the year 1931 has been a boon for orthodontists.<sup>24</sup> They are considered as supplemental diagnostic tools that aid during treatment planning and also planning of surgical cases. If taken with proper exposure, even the soft tissue structures can be visualised with ease and can be of much relevance in treatment planning. Soft tissue cephalometric analysis makes use of lateral cephalograms to analyse and interpret soft tissue changes in facial profile of a patient.<sup>25,26</sup> Besides,

they are much more feasible as they are less expensive and pose much lesser threat of exposure to radiation, when compared to CBCT and CTs. Hence, they were opted in this study for analysis of soft tissue and hard tissue LAFH.

Vertical dimension control has always been one of the most difficult malocclusions to treat.<sup>27</sup> They can be corrected by virtues of intrusion, extrusion of teeth or by redirection of the mandibular growth direction. Jain RK et al has conducted a study in which he has discussed and compared the usage of mini implants, j-hook headgear and intrusion arches for the purpose of intrusion. Similarly, Felicita AS et al has reported the effects of mini implants on retraction and intrusion of anterior teeth. Sivamurthy et al in his study has reported the use of mini implants and its stress distribution during intrusion as well as retraction in a finite element method study. Of all the parameters that contribute to LAFH, mandibular growth rotation is one of the most significant causes. Infact, AFH has been confirmed to have a strong influence on vertical disproportions.<sup>28</sup>

In today's time where the paradigm has shifted towards a soft tissue dictated treatment approach, it is of absolute importance to establish norms for soft tissue structures as well, similar to their hard tissue counterparts. This stands true in case of lower anterior facial heights as well, since ultimately we treat the patient for their face and not for their radiographs.

## Conclusion

Soft tissue LAFH are predictable diagnostic indicators in determining the skeletal hard tissue discrepancies.

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**Conflict of Interest:** None.

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**Ethical Clearance:** It is taken from "Saveetha Institute Human Ethical Committee" (Ethical Approval Number- SDC/SIHEC/2020/DIASDATA/0619-0320)

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