ORIGINAL ARTICLE

RELIABILITY OF VARIOUS SKELETAL INDICATORS IN ASSESSING VERTICAL FACIAL SOFT TISSUE PATTERN

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Background: Angle's paradigm has ruled the orthodontic diagnosis and treatment planning for past several decades, but the recent introduction of the soft tissue paradigm has significantly changed the dynamics of orthodontic practice. This study was designed to identify skeletal analyses that best correlates with the parameters use to assess facial soft tissue profile that may lead to an accurate diagnosis and efficient treatment plan. **Methods:** A total of 192 subjects (96 males and 96 females; mean age 22.95±4.75 years) were included in the study. The total sample was distributed into three equal groups (i.e., long, normal and short face) on the basis of soft tissue vertical pattern. Pre-treatment lateral cephalograms were used to assess various vertical linear and angular parameters. Various skeletal analyses and soft tissue parameters were correlated using the Pearson's correlation in different vertical groups, separately for males and females. **Results:** In males, a weak positive correlation (r=0.485) was found between skeletal anterior facial height ratio (Sk. LAFH/TAFH) and soft tissue anterior facial height ratio (LAFH/TAFH'), whereas in females maxillary-mandibular plane angle (MMA) showed a weak positive correlation (r=0.300). In the long face group, a positive but a weak correlation (r=0.349) was present between cranial base angle (SN-GoGn) and LAFH/TAFH'. **Conclusions:** Skeletal analyses (MMA, Sk. LAFH/TAFH) significantly correlated to soft tissue parameters. Males and long faced individuals showed a higher correlation between skeletal and soft tissue parameters as compared to that of the females.

Keywords: Soft tissue, Divergence, Cephalometry, Vertical dimension

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INTRODUCTION

Since the ancient times to our modern day society, a great emphasis has always been placed on facial beauty and aesthetics. There is a universal standard for facial aesthetics regardless of culture, gender, age and other variables. This universal standard is based on having a proportionate relationship among different facial structures. Thus, orthodontic treatment is not just aimed at achieving a proper functional occlusion, but also a well-balanced and aesthetic face. Therefore, many studies have been carried out exploring the ideal relationship of skeletal and soft tissues.[1–5]

Disharmony among different facial structures can occur in all three planes, i.e., vertical, sagittal and transverse. Angle's paradigm has ruled the orthodontic diagnosis and treatment planning for several decades that considered ideal occlusion as 'nature's intended ideal form'.[6] Thus, cephalometry during that era was primarily used to evaluate the dento-skeletal discrepancy and formulate a treatment plan accordingly.[7]

There are numerous skeletal analyses for assessing vertical growth pattern amongst which the most commonly used analyses include: the mandibular plane angle, Y-axis, facial axis and hard tissue facial height ratio.[8–11] Literature review shows that all of the aforementioned analyses have some drawbacks in terms of landmark identification and accuracy.[12,13] In addition to this, a treatment plan based solely on the analysis of dento-skeletal structures may result in un-aesthetic facial soft tissue appearance.[4,14]

With the introduction of the soft tissue paradigm, the dynamics of orthodontic practice has significantly changed. The soft tissue paradigm states that the goals of the current orthodontic treatment are determined by the facial soft tissues instead of the dental and skeletal structures.[15] Additionally, patients and their families evaluate the success of orthodontic treatment mainly by improvement in the physical appearance.[16]

Hence, soft tissue analysis is not only mandatory in achieving a satisfactory aesthetic outcome but it is also important in determining the extent of tooth and jaw movements. Moreover, considering facial soft tissues while planning a treatment for a patient ensures that the oral function is maintained and the results are stable.[9] This emerging soft tissue paradigm in orthodontic diagnosis and treatment planning gives priority to the clinical evaluation of soft tissue function and aesthetics instead of the jaw relationship and dental occlusion.

Due to the paradigm shift, soft tissue profile has been studied extensively in orthodontics both clinically and radiographically. Differences in thickness of the soft tissues may affect skeletal proportions thereby affecting facial aesthetics. Various studies have reported differences in facial soft tissue thickness; hence, many researchers have highlighted the importance of soft tissue analysis for orthodontic diagnosis and treatment planning rather than solely relying on dento-skeletal assessment.[3,17,18]

In the past, various studies[19,20] have compared different skeletal analyses with each other, but very few reported the correlation of different skeletal and soft tissue analysis in assessing the vertical facial pattern[19,20].

Moreover, no study identified the skeletal parameters that most closely relate to the soft tissue profile. This study was designed to identify skeletal analyses that best correlates with the parameters use to assess facial soft tissue profile. Identification of these parameters may facilitate replacing unnecessary skeletal analyses with those best representing facial soft tissue profile leading to an accurate diagnosis and an efficient treatment plan.

Thus a patient may be served better by choosing those analyses that best describe the facial soft tissue proportions of an individual. On the other hand, the practitioner may save important time by the elimination of unnecessary analyses.

MATERIAL AND METHODS

A cross sectional study was carried out with the data collected retrospectively from the orthodontic records of patients visiting our dental clinics. Keeping α=0.05, power of study (β) as 95% and using the correlation value (r) = 0.3 between soft tissue facial height and FMA as reported by Bahrou *et al*[20], the total sample size was calculated to be 174. This number was increased by 10% to obtain a final sample size of 192 (96 males and 96 females; mean age =22.95±4.75 years). The subjects were distributed into three equal groups (i.e., long, normal and short face) on the basis of soft tissue vertical pattern (LAFH'/TAFH' ratio) as follows:

- Short face: the ratio of LAFH'/TAFH' <51%
- Normal Face: the ratio of LAFH'/TAFH' 52–54%
- Long Face: the ratio of LAFH'/TAFH' >55%

Subjects aged between 18–35 years having good quality standardized lateral cephalograms were included in the study, whereas those with a previous history of orthodontic treatment, craniofacial syndrome or trauma were excluded.

Cephalograms were traced on acetate paper with 0.5 mm lead pencil manually over illuminator by principal investigator using conventional method. The specific skeletal and soft tissue landmarks and planes were identified (Figure 1 and 2). The linear and angular measurements were made with the help of a millimetre ruler and protractor, respectively.

The skeletal linear parameters were measured as follows (Figure-3):

Y-Axis:	The angle between S-Gn and SNa plane
Down's Y-Axis:	The angle between S-Gn and FH plane
Sella Nasion-Mandibular Plane: Angle (SNMP)	The angle between SNa and Steiner's mandibular plane
Maxillary Mandibular Plane: Angle (MMA)	The angle between maxillary and mandibular plane
Sella Nasion-Gonion Gnathion: Plane Angle (SN-GoGn)	The angle between SN and Steiner's mandibular plane.
Frankfort Mandibular Plane: Angle (FMA)	The angle between FH and Down's mandibular plane
Facial Axis:	The angle between Na-Ba and PTM-Gn plane
R-Angle:	The angle between Na, Co and Me

The skeletal angular parameters were measured as follows (Figure-4):

Posterior Facial Height (PFH):	Linear distance between S and Go
Total Anterior Facial Height: (TAFH)	Linear distance between N and Me
Lower Anterior Facial Height: (LAFH)	Linear distance between ANS and Me
Skeletal Facial Height Ratio: (Sk.LAFH/TAFH)	The ratio of LAFH/TAFH
Jarabak's Ratio:	The ratio of PFH/TAFH

The soft tissue measurements are as follows (Figure-5):

Soft Tissue Upper Anterior Facial: Height (UAFH')	Linear distance between Gb' and Sn
Soft Tissue Lower Anterior Facial: Height (LAFH')	Linear distance between Sn and Me'
Soft Tissue Total Anterior Facial: Height (TAFH')	Linear distance between Gb' and Me'
Soft Tissue Facial Height Ratio:	The ratio of LAFH'/TAFH'

To rule out the measurement error, 30 cephalograms were randomly selected, retraced and the measurements were repeated by the principal investigator to assess intra-examiner reliability. The intra class correlation coefficient denoted that the repeated measurements were highly correlated (Table-1).

Data was analysed using SPSS for Windows (version 20.0, SPSS Inc. Chicago). Baseline information on demographics was analysed using descriptive statistics.

Independent sample t-test was use to compare the means of each variable between males and females. One-way ANOVA was used to examine the differences amongst the three vertical groups. Correlation of various vertical skeletal parameters with soft tissue facial height was determined using the Pearson's correlation separately for males and females. A p-value of < 0.05 was taken as statistically significant.

Changes associated with growth can affect the size and width of skeletal and soft tissue structures.[17,21] To control this confounding factor, only adult subjects aged between 18-35 years were included in the study.

RESULTS

Pearson's correlation showed a significant positive correlation between Sk. LAFH/TAFH and soft tissue facial height ratio ($r=0.349$, $p<0.01$) (Table-2).

Independent sample t-test was use to compare the means of each variable between males and females, which showed a statistically significant difference in UAFH ($p<0.05$), LAFH ($p<0.001$), TAFH' ($p<0.001$) and LAFH' ($p<0.001$) (Table-3).

R-Angle ($r=0.358$, $p<0.01$) and Sk.LAFH/TAFH ($r=0.485$, $p<0.01$) showed a weak positive correlation and Sk.UAFH/TAFH ($r=-0.452$, $p<0.01$) showed a weak negative correlation with soft tissue facial height ratio in males, whereas MMA showed a significant positive correlation with soft tissue facial height ratio ($r=0.300$, $p<0.01$) in females (Table-4 and 5).

One-way ANOVA was used to compare the mean age and sagittal facial pattern among the three vertical groups which was statistically insignificant ($p<0.05$) (Table-6 and 7). Correlation between skeletal analyses and soft tissue height ratio was also separately evaluated for each vertical group (Table-8,9,10). Amongst the vertical groups, SN-GoGn showed the highest positive correlation as compared to other variables ($r=0.377$, $p<0.01$) in the long face group. In the normal face group, Jarabak's ratio showed a weak negative correlation ($r=-0.314$, $p<0.05$), whereas Down's Y-Axis ($r=0.256$, $p<0.05$) showed a weak positive correlation to soft tissue facial height ratio in the short face group.

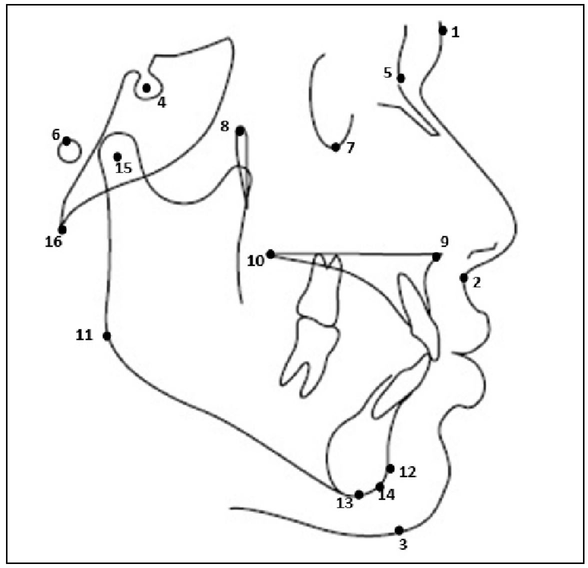

Figure-1: Skeletal and Soft Tissue Landmarks

1	Soft tissue Glabella (Gb')	The most anterior point in midsagittal plane of the forehead
2	Subnasale (Sn)	The point at which the columella merges with upper lip
3	Soft Tissue Me (Me')	The lower most point on the soft tissue chin
4	Sella (S)	The midpoint of sella turcica
5	Nasion (N)	The most anterior point on the frontonasal suture
6	Porion (Po)	The posteriosuperior margin of internal auditory meatus
7	Orbitale (Or)	The anterioinferior margin of orbital cavity
8	Pterygomaxillary fissure (PTM)	The posteriosuperior margin of pterygomaxillary fissure
9	Anterior Nasal Spine (ANS)	The tip of anterior nasal spine of the palate
10	Posterior Nasal Spine (PNS)	The tip of posterior nasal spine at the junction of hard and soft palate
11	Gonion (Go)	The angle of mandible
12	Hard tissue pogonion (Pog)	The most anterior point on bony chin
13	Hard Tissue Menton (Me)	The most inferior point on the bony chin
14	Gnathion (Gn)	The midpoint between pogonion and menton
15	Condylion (Co)	The center of the condyler head of the mandible
16	Basion (Ba)	The inferior most point on anterior margin of foramen magnum

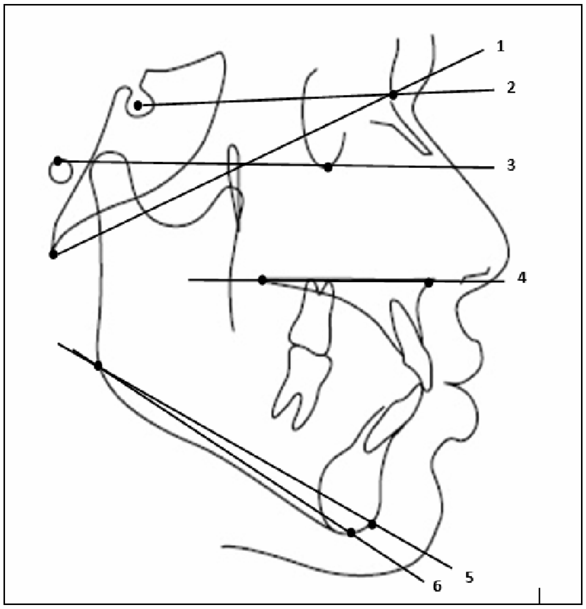

Figure-2: Cephalometric Planes

1	Na-Ba Plane	Plane between Na and Ba
2	SN Plane	Plane between S and N
3	FH Plane	Plane between Po and Or
4	Maxillary plane	Plane between ANS and PNS
5	Down's Mandibular Plane	Plane between Go and Me
6	Steiner's Mandibular Plane	Plane between Go and Gn

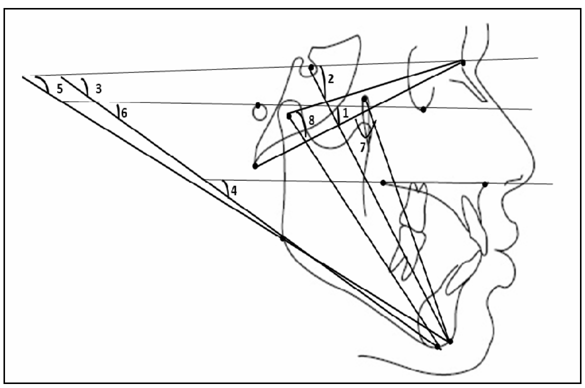

Figure-3: Skeletal Angular Parameters

1	Down's Y-Axis	The angle between S-Gn and FH plane
2	Y-Axis	The angle between S-Gn and SN plane
3	Sella Nasion-Mandibular Plane angle (SNMP)	The angle between SN and Down's mandibular plane
4	Maxillary Mandibular Plane angle (MMA)	The angle between maxillary and mandibular plane
5	Sella Nasion-Gonion/Gnathion plane angle (SN-GoGn)	The angle between SN plane Stiener's mandibular plane.
6	Frankfort Mandibular plane angle (FMA)	The angle between FH plane and Down's mandibular plane
7	Facial Axis	The angle between N-Ba and PTM-Gn plane
8	R-Angle	The angle between N, Co and Me

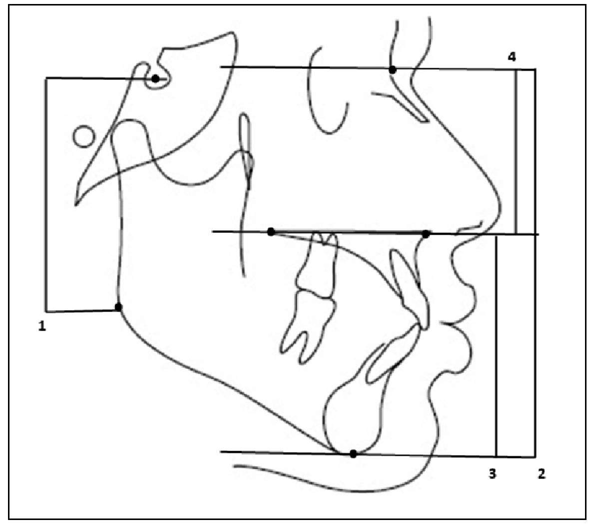

Figure-4: Skeletal Linear Parameters

1	Posterior Facial Height (PFH)	Linear distance between S and Go
2	Total Anterior Facial Height (TAFH)	Linear distance between N and Me
3	Lower Anterior Facial Height (LAFH)	Linear distance between ANS and Me
4	Upper Anterior Facial Height (UAFH)	Linear distance between N and ANS
	Skeletal Facial Height Ratio (Sk.LAFH/TAFH)	The ratio of LAFH/TAFH
	Jarabak's Ratio	The ratio of PFH/TAFH

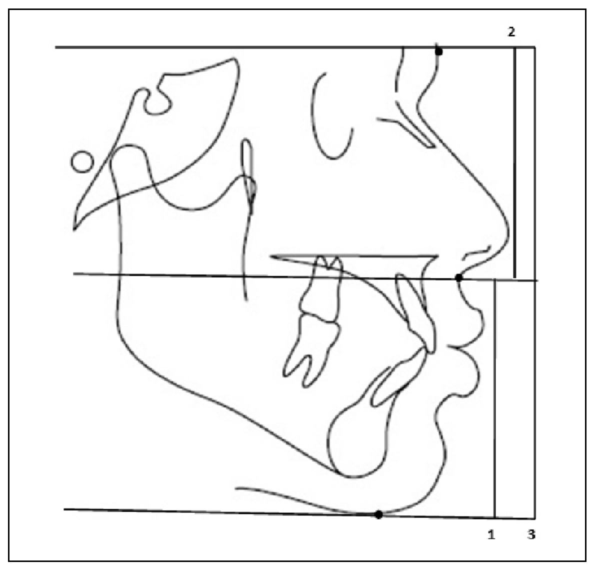

Figure-5: Soft Tissue Parameters:

1	Soft Tissue Lower Anterior Facial Height (LAFH')	Linear distance between Sn and Me'
2	Soft Tissue Upper Anterior Facial Height (UAFH')	Linear distance between Gb' and Sn
3	Soft Tissue Total Anterior Facial Height (TAFH')	Linear distance between Gb' and Me'
	Soft Tissue Facial Height Ratio	The ratio of LAFH'/TAFH'

Table-1: Intra-class correlation co-efficient

Measurements	1st Reading (n=30)	2nd Reading (n=30)	ICC
Down's Y Axis	61.17±3.13	61.3±3.5	0.983
FMA	25.17±6.61	25.33±6.33	0.994
SN-GoGn	28.90±8.49	29.10±8.29	0.997
ANS-Me	68.10±6.68	68.36±6.62	0.997
Na-ANS	52.51±3.71	52.48±3.90	0.990
R-Angle	72.53±4.06	72.36±4.11	0.994
SNMP	27.83±7.07	27.86±7.12	0.997
MMA	21.63±5.98	21.86±6.02	0.996
F. Axis	88.73±3.55	88.70±3.57	0.992
Y-Axis	66.60±4.56	66.66±4.59	0.995
Gb'-Me'	139.30±8.81	139.48±8.98	0.999
Sn-Me'	71.52±7.12	71.68±7.24	0.996

Table-2: Correlation of skeletal analyses to soft tissue facial height ratio

Parameter	Soft Tissue Facial Height Ratio-r	p
Down's Y-Axis	0.100†	0.168
FMA	0.259†	<0.01**
SN-GoGn	0.255†	<0.01**
R-Angle	0.285†	<0.01**
SNMP	0.155†	<0.01**
MMA	0.272†	<0.01**
F-Axis	-0.088†	0.223
Y-Axis	0.115†	0.113
Jarabak Ratio	-0.022†	0.757
Sk.LAFH.TAFH	0.349†	<0.01**
Sk.UAFH.TAFH	0.291†	<0.01**

n=192; Pearson Correlations; † Weak Correlation (±0.01 < r <±0.5); ††Moderate Correlation (±0.5 < r <± 0.8); ††† Strong Correlation (±0.8 < r <±1), *p<0.05; **p<0.01

Table-3: Comparison of Means and Standard Deviations of Different Parameters between Males and Females

Parameter	Male (n=96) (Mean±SD) mm	Female (n=96) (Mean±SD) mm	p
Down's Y-Axis	61.74±4.30	61.68±4.74	0.924
FMA	23.82±6.47	25.42±5.81	0.074
S.Na-GoGn	29.59±6.67	30.67±6.89	0.275
ANS-Me	72.83±8.06	67.17±6.14	<0.01**
Na-ANS	57.15±5.80	54.49±5.89	<0.05*
MMA	20.34±5.47	21.92±5.64	0.051
F.Axis	87.73±4.51	87.82±4.68	0.888
Y-Axis	66.47±7.21	67.75±7.65	0.234
Gb'-Me'	146.67±8.71	138.59±7.78	<0.01**
Sn-Me'	75.15±6.87	70.79±5.86	<0.01**

n=192; *p<0.05; **p<0.01, Independent sample t-test

Table-4: Correlation of Skeletal Analyses to Soft Tissue Facial Height Ratio in Males

Parameter	Soft Tissue Facial Height Ratio-r	p
Down's Y-Axis	0.034†	0.739
FMA	0.287†	<0.01**
SN-GoGn	0.316†	<0.01**
R-Angle	0.358†	<0.01**
SNMP	0.218†	<0.05*
MMA	0.261†	<0.05*
F-Axis	-0.175†	0.089
Y-Axis	0.195†	0.057
Jarabak Ratio	0.057†	0.581
Sk.LAFH.TAFH	0.485†	<0.01**
Sk.UAFH.TAFH	-0.452†	<0.01**

n=96; Pearson Correlations; †Weak Correlation (±0.01 < r <±0.5); ††Moderate Correlation (±0.5 < r <±0.8); †††Strong Correlation (±0.8 < r <± 1), *p<0.05; **p<0.01

Table-5: Correlation of Skeletal Analyses to Soft Tissue Facial Height Ratio in Females

Parameter	Soft Tissue Facial Height Ratio-r	p
Down's Y-Axis	0.160†	0.120
FMA	0.245†	<0.05*
SN-GoGn	0.204†	<0.05*
R-Angle	0.207†	<0.05*
SNMP	0.108†	0.293
MMA	0.300†	<0.01**
F-Axis	-0.004	0.969
Y-Axis	0.47†	0.637
Jarabak Ratio	-0.181†	0.77
Sk.LAFH.TAFH	0.217†	<0.05*
Sk.UAFH.TAFH	-0.150†	0.145

n=96; Pearson Correlations; †Weak Correlation (±0.01 < r <±0.5); ††Moderate Correlation (±0.5 < r < ±0.8); †††Strong Correlation (±0.8 < r <±1) *p<0.05; **p<0.01

Table-6: Comparison of Mean age Between Different Vertical Groups

Vertical Facial Pattern	n	Mean age (years±SD)	p
Short Face	64	22.34±4.99	0.439
Average Face	64	23.35±4.90	
Long Face	64	23.16±4.34	
Total	**192**	**22.29±4.75**	

n=192; p<0.05 One-way ANOVA test

Table-7: Comparison of sagittal facial pattern amongst vertical group

Vertical Facial Pattern	n	ANB Angle (degrees±SD)	p
Short Face	64	4.45^0±2.93^0	0.439
Average Face	64	3.73^0±2.66^0	
Long Face	64	4.14^0±3.09^0	
Total	**192**	**4.11^0±2.90^0**	

n=192; p<0.05, One-way ANOVA test

Table-8: Correlation of Skeletal Analyses to Soft Tissue Facial Height Ratio in Short Face Groups

Parameter	Soft Tissue Facial Height Ratio-r	p
Down's Y-Axis	0.256†	<0.05*
FMA	0.138†	0.278
SN-GoGn	0.132†	0.299
R-Angle	0.222†	0.078
SNMP	0.101†	0.426
MMA	0.178†	0.161
F-Axis	-0.158†	0.214
Y-Axis	0.005†	0.971
Jarabak Ratio	-0.024†	0.852
Sk.LAFH.TAFH	0.049†	0.703
Sk.UAFH.TAFH	-0.133†	0.294

n=192; Pearson Correlations; †Weak Correlation (±0.01 < r <±0.5); ††Moderate Correlation (±0.5 < r <±0.8); †††Strong Correlation (±0.8< r <±1) *p<0.05; **p<0.01

Table-9: Correlation of Skeletal Analyses to Soft Tissue Facial Height Ratio in Normal Face Groups

Parameter	Soft Tissue Facial Height Ratio-r	p
Down's Y-Axis	0.022†	0.860
FMA	0.125†	0.325
SN-GoGn	0.114†	0.371
R-Angle	0.006	0.961
SNMP	0.206†	0.103
MMA	0.125†	0.326
F-Axis	-0.309†	<0.05*
Y-Axis	0.117†	0.357
Jarabak Ratio	-0.314†	<0.05*
Sk.LAFH.TAFH	0.020†	0.873
Sk.UAFH.TAFH	0.027†	0.830

n=192; Pearson Correlations; †Weak Correlation (±0.01 < r <±0.5); ††Moderate Correlation (±0.5 < r <±0.8); †††Strong Correlation (±0.8< r <±1) *p<0.05; **p<0.01

Table-10 Correlation of Skeletal Analyses to Soft Tissue Facial Height Ratio in Long Face Groups

Parameter	Soft Tissue Facial Height Ratio-r	*p*
Down's Y-Axis	0.188†	0.137
FMA	0.296†	< 0.05*
SN-GoGn	0.377†	< 0.01**
R-Angle	0.362†	< 0.01**
SNMP	0.280†	< 0.05*
MMA	0.375†	< 0.01**
F-Axis	-0.250†	< 0.05*
Y-Axis	0.249†	< 0.05*
Jarabak Ratio	-0.277†	< 0.05*
Sk.LAFH.TAFH	0.113†	0.375
Sk.UAFH.TAFH	-0.027†	0.832

n=192; Pearson Correlations; †Weak Correlation ($\pm0.01<r<\pm0.5$); †† Moderate Correlation ($\pm0.5<r<\pm0.8$); †††Strong Correlation ($\pm0.8<r<\pm1$) *$p<0.05$; **$p<0.01$

DISCUSSION

An accurate assessment of a patient's facial skeletal pattern in vertical, sagittal and transverse direction is essential in orthodontic diagnosis and treatment planning. The vertical pattern of face encompasses an important aspect by defining the variability in the orthodontic mechanics, as well as in the facial proportions.[22,23] Tweed, [24] for instance, in his famous diagnostic triangle has related the stability of lower incisors after treatment based on the vertical growth pattern. Since the vertical facial growth of face is the last to end, the diagnosis of vertical facial discrepancy is not only important for an adequate diagnosis and an efficient treatment plan, it is of utmost significance for retaining the corrected malocclusion, as continuation of vertical growth in later phases of life may result in relapse.

There are many skeletal and soft tissue analyses for determining vertical facial growth of an individual. The most commonly used soft tissue analyses in vertical plane include UAFH/TAFH, LAFH/TAFH, UAFH/LAFH.[25] To achieve adequate facial aesthetics and balance, facial soft tissue examination is mandatory. As the skeletal structure forms the backbone, therefore their significance cannot be denied. Hence, the present study focused on finding the skeletal parameters that correlates well with the existing soft tissue analyses so that the process of orthodontic diagnosis can be concised to least number of analyses.

In the present study, subjects were divided into short, normal and long face on basis of soft tissue vertical pattern. The groups were statistically well matched on the basis of gender, chronological ages and sagittal relationships. In our study, a statistically significant difference was present between LAFH, UAFH, TAFH' and UAFH' in males and females. This is in concordance with the other studies.[20,26]

Correlation between various skeletal analyses has already been described in the literature.[19,20] In contrast, only one study has reported the correlation between the vertical skeletal parameter and soft tissue facial height ratio. [20] In our study, a weak positive correlation was present between Sk.LAFH/TAFH (r=0.485, $p<0.01$), R-angle (r=0.358, $p<0.01$), SN-GoGn (r=0.316, $p<0.01$), whereas a weak negative correlation was present between Sk. UAFH. LAFH (r=-0.452, $p<0.01$) and soft tissue facial height ratio in males. In females, MMA showed a weak positive correlation (r=0.300, $p<0.01$). In contrast, Bahrou *et al*[20] reported a positive correlation between MMA (r=0.551, $p<0.01$) and soft tissue facial height ratio in males. In the same study, a positive correlation was found between SNMP (r=0.355, $p<0.05$) and soft tissue facial height ratio in females. The heterogeneity in results might be due to a difference in sample size.

Correlation between skeletal vertical analyses and soft tissue height ratio was also assessed for each vertical group separately. Amongst the vertical groups, long face groups showed greater number of skeletal analyses to be correlated to soft tissue facial pattern as compared to short and normal face groups. In the long face group, SN-GoGn showed a positive, but weak correlation (r=0.377) whereas Jarabak's ratio showed a negative correlation (r=-0.341) in the normal face group. In the short face group, Down's Y-axis showed a positive correlation (r=0.256). A survey of the pertinent literature showed that none of the studies have reported a correlation between skeletal and soft tissue facial height ratio in vertical groups separately.

Since sagittal facial parameter may affect the vertical dimension, hence inclusion of subjects of all skeletal classes of malocclusion was a possible limitation in this study. To minimize this and maintain the homogeneity amongst the vertical groups, One-way ANOVA was used to measure the mean ANB which confirmed the homogenous distribution.

Although the present study aimed at determining the skeletal analyses that better describe facial soft tissue profile, it can be summarized that correlation of skeletal parameter to soft tissue vertical pattern may vary depending on gender and vertical soft tissue pattern. Thus, although the number of skeletal analyses can be minimized during orthodontic diagnosis and treatment planning to evaluate a soft tissue facial pattern, these parameters can be used only as a relative guide to the orthodontic diagnosis. The final treatment plan should be based on a combination of these analyses and will depend on specific characteristics of an individual.

CONCLUSIONS

1. Skeletal analyses (MMA, Skeletal LAFH/TAFH) showed a significant correlation to soft tissue parameters.
2. In males, a greater number of skeletal analyses were correlated to soft tissue parameter as compared to the females.
3. More number of skeletal parameters showed a higher correlation to soft tissue parameter in long face as compared to the short and average face groups.

AUTHOR'S CONTRIBUTION

MA conducted the entire study under the supervision of AS and MF.

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