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How Reliable Are Soft Tissue Cephalometric Measurements: A Reality Check

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Abstract
One of the most important components of orthodontic diagnosis and treatment planning is the evaluation of the patient's soft tissue profile. The methodology used in the previous studies on soft tissue profile analysis is highly variable and differ widely among studies. The present study was done on forty non orthodontic individuals (twenty males and twenty females) with normal occlusion and good facial esthetics. Lateral cephalograms of all the individuals were taken and the data obtained from the cephalometric tracings was compared and statistically analyzed to access the both intra-observer and inter-observer reproducibility of both the methods. The present study reveals that there were significant differences between the measurements with the anatomic point method and those with the tangent line method. In assessing the intra- observer reproducibility, no gross variability was seen in between both the groups except for two angles in the anatomic point group and other two angles in the tangent line group. In assessing the inter-observer reproducibility again one angle showed a high degree of variability in the anatomic point group. Where as in the tangent line group five variables out of the ten variables selected for the study showed a significantly variability. This study found that the anatomic point method has greater both intra-observer and inter-observer reproducibility than the tangent line method.

Key Words
Soft Tissue Cephalometry, Anatomic Point Method, Tangent Line Method, Intra-observer Reproducibility, Inter-observer Reproducibility

Introduction:

Evaluation of the orthodontic patient's soft tissue profile is critical for orthodontic diagnosis and treatment planning.[1]. The cephalometric analysis of the hard tissue structures of the face is relatively less complicated. [2] Landmarks are identified to represent various skeletal and dental structures; distances, angles and ratios are calculated to quantify the profile. However, curved surfaces of the soft tissue also must be reduced to distances, angles and ratios - a procedure that is much less precise than simply connecting hard tissue landmarks. [3] A review of the literature shows that there has been no consistency in the construction of lines for the analysis of soft tissue contours and quantification of a specific soft tissue contour may vary according to the method used in the analysis. [4],[5]

Taking this into consideration, the present study was done to compare the measurements obtained from two methods of soft tissue analysis; one based on the use of anatomic points and the other on the use of tangent lines in the construction of angles and the intra-observer and inter-observer reproducibility of both the methods was assessed.

Aims and Objectives:

- To evaluate and compare the measurements obtained from these two different drawing methods of soft tissue analysis
- To assess the intra-observer and inter-observer reproducibility for both these methods.

Methods and Materials:

Source of Data

Lateral cephalograms of Forty (Twenty males & Twenty females) individuals with normal occlusion who possessed good facial esthetics and had no history of orthodontic treatment, were the source of data.

Method of Collection of Data

Lateral cephalograms of all the individuals selected for the study were taken in natural head position and were traced on cellulose acetate paper using a pencil with 0.5mm diameter lead.

Each tracing was photocopied six times (three for anatomic point method & other three for tangent line method). First tracings (T_1) for both the methods were done by the primary investigator. To assess the intra-observer reproducibility the drawings were executed a second time (T_2) by the primary investigator, for both the methods and to assess inter-observer reproducibility, a second investigator independently constructed each tracing (T_3) for all the subjects and for both the methods. While tracing the cephalograms, the orientation plane used in this study was the Frankfort Horizontal, as determined by the location of anatomic Porion and Orbitale in the cephalometric radiograph. The Nasion Perpendicular was determined by constructing a line inferior to Nasion and perpendicular to the Frankfort horizontal and ten variables were selected to quantify the contour of the facial region according to the method described by McNamara et al .

For the Anatomic Point Group, ten corresponding angles were drawn as shown in **(Figure 1)** and to construct the corresponding ten angles using the tangent line method **(Figure2)** tangential lines were drawn to the soft tissue contour in each region according to the

method described by Mc Namara et al as follows:

- Forehead tangent
- Sub glabellar tangent
- Nose dorsum tangent
- Inferior contour tangent of nose
- Upper lip tangent
- Lower lip tangent
- Anterior contour tangent of chin
- Inferior contour tangent of chin

The intersection of these tangents were established as tangential landmarks.

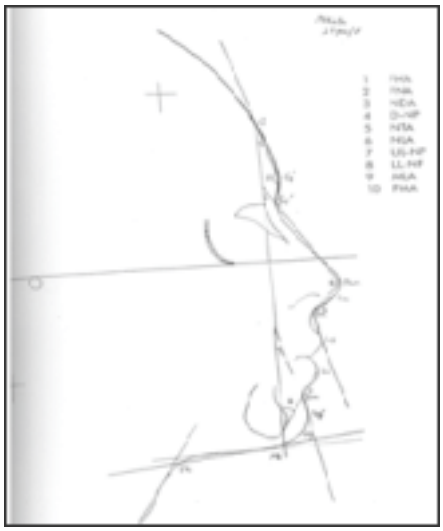

Figure 1: Construction Of Angles Using Anatomic Points

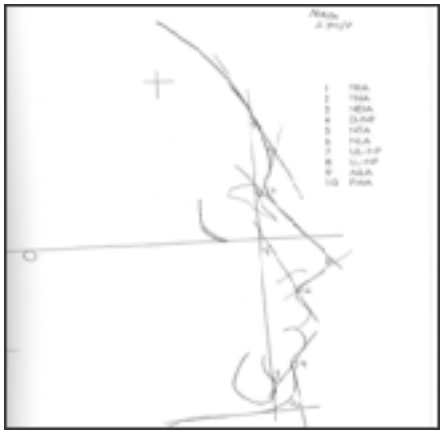

Figure 2: Construction Of Angles Using Tangent Lines

Table 1 Comparison Of The Measurements Between Tangent Line And Anatomic Point Methods

S. No	Variable	Tangent line group		Anatomic point group		t	P Value	Significance
		Mean	SD	Mean	SD	Value		
1	FHA	16.6750	6.1494	15.8750	4.8553	.646	.520	NS
2	FNA	137.4500	14.1674	150.4250	9.5726	-4.799	.000	VHS
3	NDA	116.3125	11.6733	136.1050	8.2127	-8.770	.000	VHS
4	D-NP	37.6500	4.0067	29.7125	3.3834	9.573	.000	VHS
5	NTA	74.1875	8.2070	99.9250	6.4326	-15.610	.000	VHS
6	NLA	77.3375	13.0371	105.3750	7.7151	-11.705	.000	VHS
7	UL-NP	36.1125	12.5169	8.6375	4.7677	12.973	.000	VHS
8	LL-NP	59.5250	11.1729	37.5500	8.0222	10.104	.000	VHS
9	MLA	107.6875	15.4142	128.4625	10.7581	-6.990	.000	VHS
10	PMA	89.9500	5.7029	85.2300	3.5316	4.4500	.000	VHS

Table 2 Pearson Correlation Coefficient Between Tangent Line And Anatomic Point Group

S. No	Variable	Correlation (r)	Probability (P)	Significance
1	FHA	0.828	0.000	VHS
2	FNA	0.826	0.000	VHS
3	NDA	0.673	0.000	VHS
4	D-NP	0.747	0.000	VHS
5	NTA	0.656	0.000	VHS
6	NLA	0.626	0.000	VHS
7	UL-NP	0.552	0.000	VHS
8	LL-NP	0.635	0.000	VHS
9	MLA	0.506	0.001	VHS
10	PMA	0.519	0.001	VHS

Angles between adjacent tangents were measured as an attempt to quantify the contours of facial region. Ten angles were measured, either as the intersection of two adjacent tangents or the intersection of a tangent with the Nasion Perpendicular.

Methods used for Statistical Analysis:

The data thus collected was statistically analyzed by using the following methods:

1. The mean and standard deviation of the cephalometric measurements were calculated and comparison of the measurements between tangent line group and anatomic point group were made for measurements obtained from T_1 drawings, T_2 drawings, average of T_1 and T_2 drawings (T_{12}) and T_3 drawings by using the students unpaired 't' test and the comparisons were made between First (T_1) and Second (T_2) drawings; between First (T_1) and the drawings executed by 2nd drawer (T_3); between 2nd drawings executed by the primary drawer (T_2) and (T_3) and between average of T_1 and T_2 (T_{12}) and T_3 in each group by using students paired 't' test. The 't values' thus obtained were compared with the standard table as described previously.

2. Pearson Correlation Co-efficient between the two drawing methods; between the first (T_1) and second (T_2) drawings and between two drawers were calculated.

The following table summarizes the definitions and drawing methods for both the groups:

S. No.	Variable	Anatomic Point Group	Tangent Line Group
1	FHA(Fore-Head Angle)	NP - OG'	NP - Forehead tangent
2	FNA(Fronto-Nasal Angle)	O - G' - N'	Forehead tangent - Subglabellar tangent
3	NDA(Nasal Depth Angle)	G' - N' - Prn	Subglabellar tangent - nose dorsum tangent
4	D-NP(Dorsum-Nasion Perpendicular)	N'Prn - NP	Nose dorsum tangent - NP
5	NTA(Nasal Tip Angle)	N' - Prn - Sn	Nose dorsum tangent - inferior contour tangent of nose
6	NLA (Naso-Labial Angle)	Cm - Sn - Ls	Inferior contour tangent of nose - upper lip tangent
7	UL-NP (Upper Lip-Nasion Perpendicular)	SnLs - NP	Upper lip tangent - NP
8	LL-NP(Lower Lip-Nasion Perpendicular)	LiSm - NP	Lower lip tangent - NP
9	MLA (Mento-Labial Angle)	Li - Sm - Pog'	Inferior contour tangent of lower lip - Anterior contour tangent of chin
10	PMA(Pogonion-Menton Angle)	SmPog' - ThMe'	Anterior contour tangent of chin - Inferior contour tangent of chin

Results:

1. Comparison of the measurements between methods

It was found that all the variables except for the Fore Head Angle (FHA) showed a very highly significant difference (P value < 0.001) between the two drawing methods. There were major differences (more than twenty degrees) for Nasal Tip Angle (NTA); Naso Labial Angle (NLA); Upper Lip-Nasion Perpendicular (UL-NP); Lower Lip-Nasion Perpendicular (LL-NP) and Mento Labial Angle (MLA). **(Table - 1)**. All the variables had statistically significant Pearson correlation coefficients **(Table - 2)**.

2. Intra-observer reproducibility

The results showed that there was statistically significant difference between the first (T_1) and the second (T_2) measurements in two variables viz. Nasal

Tip Angle (NTA) and Pogonion Menton Angle (PMA), when the tangent line method was used. When the anatomic point method was used, two variables viz. (Dorsum-Nasion Perpendicular (D-NP) and Pogonion Menton Angle (PMA) showed statistically significant difference **(Table 3)**. Pearson correlation coefficients were calculated between 1st (T_1) and 2nd (T_2) drawings in each group and it was found that they showed a very highly significant ($P < .001$) correlation for both the methods **(Table 4)**.

3. Inter observer reproducibility

Comparisons were made between the (T_1) and (T_3) drawings; between the (T_2) and (T_3) drawings and between (T_{12}) and (T_3)drawings in each group. The results of the students 'paired t-test' between the measurements showed that there were statistically significant difference for one variable (Pogonion Menton Angle (PMA) when the anatomic point methods was used whereas five variables (Nasal Tip Angle NTA; Upper Lip-Nasion Perpendicular UL-NP; Lower Lip-Nasion Perpendicular, LL-NP; MentoLabial Angle, MLA; and Pogonion Menton Angle, PMA;) showed statistically significant difference when tangent line method was used for T_1, T_2, T_3 values .When T_2 measurement was compared with T_3 measurements it was found that 2 variables MentoLabial Angle, MLA; and Pogonion Menton Angle, PMA;) showed statistically significant difference in the anatomic point method where as five variables (Nasal Tip Angle, NTA; NasoLabial Angle, NLA; upper lip-nasion perpendicular (UL-NP), lower lip nasion perpendicular (LL-NP) and pogonion menton angle, PMA;) showed statistically significant different when the tangent line method was used .When the comparison was made between average of T_1 and T_2 drawings (T_{12}) and T_3 drawings it was found that only one variable (pogonion menton angle PMA) showed statistically significant difference when the anatomic point method was used where as 6 variables (nasal tip angle, NTA; nasolabial angle, NLA; upper lip-nasion per perpendicular UL-NP; lower lip-nasion perpendicular, LL-NP; mentolabial angle, MLA; and pogonion menton angle PMA) showed statistically significant difference when the tangent line method was used.These findings have also been summarized in **(Table 5)**. Karl Pearson correlation coefficients were calculated for the above measurements between the two drawers and were found to be statistically significant. These findings have also been summarized in **(Table - 6)**.

Table 3 - Comparison And Differences Between First (T1) And Second (T2) Drawing In Each Group (Intra Observer Reproducibility)

S. No	Variable	Tangent Line Group					Anatomic Point Group				
		Mean	SD	t Value	P Value	Significance	Mean	SD	t Value	P Value	Significance
1	FHA	.2500	1.0377	1.524	.136	NS	.0000	.6794	.000	1.000	NS
2	FNA	-1.0375	3.4444	-1.905	.064	NS	.2375	1.5892	.945	.350	NS
3	NDA	-.8625	3.0042	-1.816	.077	NS	-.070	1.4146	.313	.756	NS
4	D-NP	.0875	1.2904	.429	.670	NS	.2125	.6293	2.136	.039	SIG
5	NTA	-2.0875	4.6020	-2.869	.007	HS	-.013	1.3563	-.058	.954	NS
6	NLA	-1.1700	5.4521	-1.357	.183	NS	-.4125	2.3990	-1.088	.283	NS
7	UL-NP	.1625	2.4817	.414	.681	NS	-.3250	1.5045	-1.366	.180	NS
8	LL-NP	1.7875	7.9766	1.417	.164	NS	-.1625	1.4069	-.731	.469	NS
9	MLA	3.1375	18.2592	1.087	.284	NS	1.4375	5.1131	1.778	.083	NS
10	PMA	2.4750	2.9107	2.990	.001	VHS	2.3560	2.1590	1.853	.027	SIG

Table 4 - Pearson Correlation Coefficients Between First (T1) And Second (T2) Drawing In Each Group (Intra Observer Reproducibility)

S. No.	Variable	Tangent Line Group			Anatomic Point Group		
		Correlation (r)	P Value	Significance	Correlation (r)	P Value	Significance
1	FHA	0.986	.000	VHS	0.990	.000	VHS
2	FNA	0.970	.000	VHS	0.987	.000	VHS
3	NDA	0.967	.000	VHS	0.985	.000	VHS
4	D-NP	0.947	.000	VHS	0.987	.000	VHS
5	NTA	0.830	.000	VHS	0.978	.000	VHS
6	NLA	0.910	.000	VHS	0.951	.000	VHS
7	UL-NP	0.980	.000	VHS	0.952	.000	VHS
8	LL-NP	0.770	.000	VHS	0.985	.000	VHS
9	MLA	0.511	.000	VHS	0.880	.000	VHS
10	PMA	0.880	.000	VHS	0.982	.000	VHS

Table 5 - Comparison And Differences Between Two Drawers (In Summary) - (Inter Observer Reproducibility)

S. No.	Variable	Tangent Line Group			Anatomic Point Group		
		T_1 Vs T_3	T_2 Vs T_3	T_{12} Vs T_3	T_1 Vs T_3	T_2 Vs T_3	T_{12} Vs T_3
1	FHA	NS	NS	NS	NS	NS	NS
2	FNA	NS	NS	NS	NS	NS	NS
3	NDA	NS	NS	NS	NS	NS	NS
4	D-NP	NS	NS	NS	NS	NS	NS
5	NTA	HS	VHS	VHS	NS	NS	NS
6	NLA	NS	HS	SIG	NS	NS	NS
7	UL-NP	SIG	HS	HS	NS	NS	NS
8	LL-NP	VHS	VHS	VHS	NS	NS	NS
9	MLA	VHS	NS	SIG	NS	SIG	NS
10	PMA	VHS	HS	HS	VHS	SIG	VHS

Table 6 - Pearson Correlation Coefficiants Between Two Drawers (In Summary) - (Inter Observer Reproducibility)

S. No.	Variable	Tangent Line Group			Anatomic Point Group		
		T_1 Vs T_3	T_2 Vs T_3	T_{12} Vs T_3	T_1 Vs T_3	T_2 Vs T_3	T_{12} Vs T_3
1	FHA	VHS	VHS	VHS	VHS	VHS	VHS
2	FNA	VHS	VHS	VHS	VHS	VHS	VHS
3	NDA	VHS	VHS	VHS	VHS	VHS	VHS
4	D-NP	VHS	VHS	VHS	VHS	VHS	VHS
5	NTA	VHS	VHS	VHS	VHS	VHS	VHS
6	NLA	VHS	VHS	VHS	VHS	VHS	VHS
7	UL-NP	VHS	VHS	VHS	VHS	VHS	VHS
8	LL-NP	VHS	VHS	VHS	VHS	VHS	VHS
9	MLA	VHS	VHS	VHS	VHS	VHS	VHS
10	PMA	VHS	VHS	VHS	VHS	VHS	VHS

Discussion:

Soft tissue profile evaluation of the patient is comparatively more different and unreliable compared to the hard tissue assessment because of either variable soft tissue drape thickness,[6] inconsistency, unreliability of reproducibility[7] or growth changes or because of poorly defined landmarks to evaluate the soft tissue profile.[8] The methods and variables used in the present study were selected as these are the most commonly used[9] ones in the clinical practice. The analysis of the results obtained from this study showed that while comparing the accuracy of measurements obtained by using the two methods 3, it was found that nine of the ten variable selected for this study in each

method differed significantly from one another which in itself is a strong indication that it is imperative to use a more precise methodology while evaluating a soft tissue variable.

While evaluating intra observer reproducibility it was found that two variables in the anatomic point method and two variables in the tangent line method presented significant differences between the first and second measurements. Thus, the use of the anatomic point method or tangent line method did not show much difference as for as intra observer reproducibility is concerned. From the analysis of these results it is evident that the inter observer reproducibility was more reliable in anatomic point method than in the tangent line method. The present study found that the anatomic point method has superior reproducibility than the tangent line method. It would not be prudent to say that the soft tissue measurements should be obtained by the anatomic point method and this study strongly indicates that there is a need for further evaluation with a larger sample size from different ethnic groups.

References:

1. MC.Namara J.A Jr. , Brust E.W., Riolo M.L.: Soft tissue evaluation of individuals with an ideal occlusion and a well balance face. In: Mc Namara J A, ed. Esthetics and the treatment of facial form. Craniofacial Growth Series. Ann Arbor, Mich: Center for Human Growth and Development, The University of Michigan; 1992: 115-146 .
2. MC Namara J.A. Jr , & E. Ellis: Cephalometric analysis of untreated adults with ideal facial and occlusal relationships. Int. J. Adult Orthod, Orthognathic Surg. 1988; 3: 221-231.
3. Hyeon -Shik Hwang, Wang -Sik Kim and Mc Namara J.A. Jr.: A Comparative study of two methods of quantifying the soft tissue profile. Angle Orthod 2000; 70: 200-207.
4. Christie, T.E.: Cephalometric patterns of adults with normal occlusion. Angle Orthod 1977; 47: 128-135.
5. Steiner, C.C.: Cephalometrics for you and me. Am. J. Orthod., 1953; 39:729-755.
6 E. Hillesund, D. Fjeld and B.U. Zachrisson: Reliability of soft tissue profile in cephalometrics Am. J. Orthod.1978; 74:537-550
7. Meng H., Goorhuis, Nanda R.S, and Kapila : Growth changes on the soft tissue facial profile. Angle Orthod. 1990; 60:177-190.
8. Baumrind S, and Frantz R.: The reliability of head film measurements. Am. J. Orthod, 1971; 60: 111-127; 505- 517.
9. Substelny. J.D., Rochester, N.Y.: A longitudinal study of soft tissue facial structures and their profile characteristics defined in relation to underlying skeletal structures. Am. J. Orthod., 1959; 45:481-507.

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