Correlation between lateral cephalometric analysis and photographic profile analysis in determining different skeletal malocclusions

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ABSTRACT

Introduction: Cephalometric analysis is considered gold standard for diagnosing skeletal morphology in orthodontics. However, the photographic assessment can be a great diagnostic tool for initial assessment as it is cost-effective and does not expose the patient to potentially radiation.

Objective: To find the correlation between lateral cephalometric analysis with photographic soft tissue profile analysis and determine if the photographic soft tissue profile analysis can determine common skeletal malocclusions like Class I, Class II and different growth patterns.

Materials and Method: Lateral cephalogram and profile photograph of 51 Class I patient and 51 Class II patients were obtained. L-ANB, L-Witts, L-Facial Axis Angle were measured inlateral Cephalometric analysis, and P-ANB, P-GlSnPog, P-NSnPog, P-NTraMn were measured for photographic soft tissue profile analysis. Descriptive analysis and Pearson correlation analysis were performed in different group of samples like Class I and Class II, Male and Female.

Result: Highly significant correlations ($p \leq .01$) were found between analogous cephalometric and photographic measurements for most of the variables in Class II malocclusion and in determining growth patterns. However, Pearson coefficients ranged from weak to moderate correlation.

Conclusion: Photographic soft tissue profile analysis may be considered a feasible and practical diagnostic substitute, particularly if there is a need for a noninvasive and low-cost method.

Keywords: growth patterns, Lateral Cephalogram, photographic soft tissue profile analysis, skeletal malocclusion

INTRODUCTION

Radiographic analyses in orthodontic diagnosis and treatment planning have been routinely performed using cephalometry since its introduction in 1931.[1] In cases where orthodontist requires information about growth and underlying osseous structures, lateral cephalometric analysis plays important role.[2,3] Although being gold reference standard for proper diagnosis of facial skeletal structures, it may not always be the most indicated tool due to its cost, specific training requirements for staff and risks related to radiation exposure.[1,4] Pretreatment soft-tissue analysis has also been used to determine facial esthetics, thus offering an important tool to clinicians in diagnosing and planning treatment.[5,6] Photographic soft-tissue profile analysis can also be beneficial for the detection of common relationships, such as Class I, Class II and hyperdivergent skeletal discrepancies, as well as for replacement of radiologic analysis when minimally invasive diagnosis is needed and to make decisions about treatment timing.

Several studies have reported considerable correlations between a selection of 2D soft tissue and skeletal measurements, concluding that photographic soft tissue analysis is a valuable tool.[7–9] Relationships between facial overlying tissues and skeletal structures have been found through lateral radiographs analysis. However, comparisons involving cephalometric and photographic measurements have seldom been performed. Moreover, in Nepal, study correlating the photographic soft tissue profile analysis to the lateral cephalometric study are very scarce. Hence, the aim of this study was to find the correlation between lateral cephalometric analysis and photographic soft tissue profile analysis determine if the photographic soft tissue profile analysis can determine common skeletal malocclusions like Class I, Class II and different growth patterns.

MATERIALS AND METHOD

A cross sectional study was conducted among the patients visiting Department of Orthodontics, Kantipur Dental College. Ethical clearance was taken from the Institutional Review Committee of Kantipur Dental College (KDC-IRC ref no. 09/23) before conducting the study. Class I and Class II malocclusion patient which are the most common group of malocclusions in Nepal[10] meeting the inclusion criteria were included in the study. Samples were divided into Class I and Class II malocclusion according to the ANB angle.[11] Inclusion criteria were patients of 13-27 years with all teeth present up to second molars and with good facial symmetry. Exclusion criteria were Cleft lip and Palate patients, patients with significant medical history, trauma, previous orthodontic or prosthodontic treatment and or maxillofacial/plastic surgery and patients with radiographs showing the mandible protruded or teeth not in occlusion. Sampling technique was non-probability convenient sampling. Sample size was calculated in reference to the study done by Acharya *et al.*[10] using the following formula: $N= Z^2pq / d^2+(Z^2pq/N) = 51$ [Where, z = 1.96, p = 27.33%, 19 q = 72.67%, e = 0.05, and N = number of patients visiting the department with Angle's Class II malocclusion in a period of 2 months = 60]. Sample size was calculated to be 51 in each class of malocclusion.

Lateral cephalogram and right sided profile photograph of each patient were obtained. Variables that were used in the lateral cephalometric analysis are: (Figure 1)

- L-ANB: angle formed by connecting Point A, Nasion and Point B
- L-Witts: distance between Aa and Bb on palatal plane
- L- Facial Angle: angle formed by line connecting Basion-Nasion and Pt-Gn

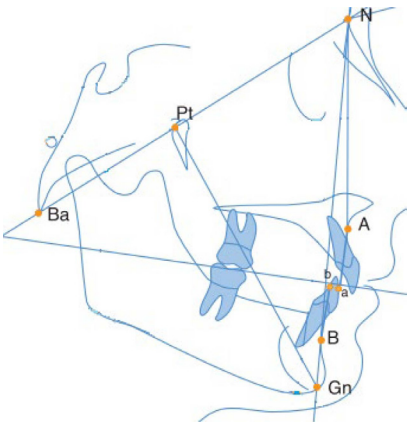

Figure 1: Cephalometric landmarks

Variables that were used in photographic soft tissue profile analysis are: (Figure 2)

- **P-ANB:**angle formed by photographic soft tissue Point A, soft tissue Nasion and soft tissue Point B
- **P-GlSnPog:** angle formed by photographic soft tissue Glabella,Subnasale and soft tissue Pogonion
- **P-NSnPog:**angle formed by photographic soft tissue Nasion, Subnasale and soft tissue Pogonion
- **P-NTraMe:**angle formed by photographic soft tissue Nasion, Tragus and soft tissue Menton

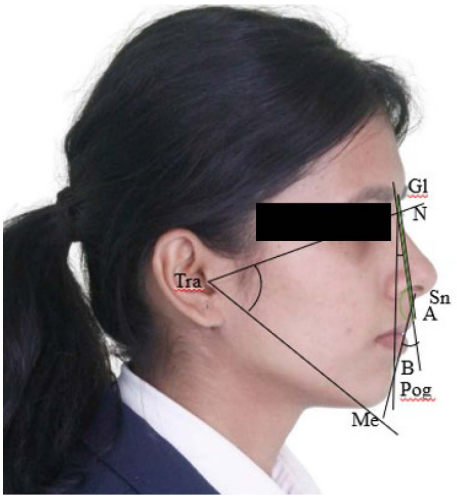

Figure 2: Photographic Soft Tissue Profile Landmarks

Lateral cephalogram was manually traced and analyzed by an orthodontist. Photographic soft tissue profile analysis was done using android base application. Data was entered using SPSS version 20. The Kolmogorov Smirnov test was done to evaluate the normality of data distribution. Descriptive statistics of the entire parameters were evaluated to determine the mean, standard deviationand range of the variables. Pearson correlation test was done to check the correlation between lateral cephalometric analysis and soft tissue profile analysis.

RESULT

Analysis was done on a total of 102 lateral cephalograms and photographic soft tissue profile analysis was done on profile photograph of the same patient.

Descriptive analysis and correlation of photographic soft tissue profile parameters with lateral cephalometric parameters of Class I sample is shown in Table 1. The type and strength of the correlation were classified according to Table 4. Mean value of P-ANB, P-GlSnPog and P-NSnPog was found to be 8.95° ± 2.33°, 161.5° ± 5.5° and 158.2° ± 5.3° respectively in Class I samples. Correlation analysis showed that P-GlSnPog among photographic soft tissue parameters was significantly correlated with L-ANB with weak negative correlation in Class I samples.

Table 1: Correlation between lateral cephalometric and photographic soft tissue profile analysis in Class I skeletal malocclusion

Variables	Mean ± SD	Range	Significance (p value)	Pearson Correlation	Correlation
L-ANB°	2.46 ± 1.06	0 – 4	0.209	0.179	Weak +ve
P-ANB°	8.95 ± 2.33	4.7 – 13. 2			
L-ANB°	2.46 ± 1.06	0 – 4	0.042	-0.286*	Weak -ve
P-GlSnPog°	161.5 ± 5.5	151 - 176			
L-ANB°	2.46 ± 1.06	0 – 4	0.134	-0.213	Weak -ve
P-NSnPog°	158.2 ± 5.3	148.9 - 172			
L-Witts (mm)	2.03 ± 2.19	-4 – 9	0.340	0.136	Weak +ve
P-ANB°	8.95 ± 2.33	4.7 – 13. 2			
L-Witts (mm)	2.03 ± 2.19	-4 – 9	0.971	-0.005	None
P-GlSnPog °	161.5 ± 5.5	151 - 176			
L-Witts (mm)	2.03 ± 2.19	-4 – 9	0.715	0.052	None
P-NSnPog°	158.2 ± 5.3	148.9 – 172			

*Correlation is significant at the 0.05 level (2-tailed).

Descriptive analysis and correlation of photographic soft tissue profile parameters with lateral cephalometric parameters of Class II sample is shown in Table 2. The type and strength of the correlation were classified according to Table 4. Mean value of P-ANB, P-GlSnPog and P-NSnPog was found to be 10.98° ± 2.80°, 158° ± 5.7° and 154.6° ± 5.4° respectively in Class II samples. Correlation analysis showed all photographic soft tissue parameters to be significantly correlated with lateral cephalometric parameters in Class II samples except L-Witts with P-GlSnPog. L-ANB and P-ANB, L-Witts and P-ANB had Moderate positive correlation, all others parameters showed weak negative correlation.

Table 2 Correlation between lateral cephalometric and photographic soft tissue profile analysis in Class II skeletal maloccusion

Variables	Mean ± SD	Range	Significance (p value)	Pearson Correlation	Correlation
L-ANB°	6.22 ± 1.49	4.5 - 11	0.002	0.421**	Moderate +ve
P-ANB°	10.98 ± 2.80	4.1 – 18.3			
L-ANB°	6.22 ± 1.49	4.5 - 11	0.006	-0.378**	Weak -ve
P-GlSnPog°	158 ± 5.7	140 - 167			
L-ANB°	6.22 ± 1.49	4.5 - 11	0.001	-0.461**	Moderate -ve
P-NSnPog°	154.6 ± 5.4	138 - 164			
L-Witts(mm)	4.04 ± 2.58	0.5 – 12	0.001	0.467**	Moderate +ve
P-ANB°	10.98 ± 2.80	4.1 – 18.3			
L-Witts (mm)	4.04 ± 2.58	0.5 – 12	0.090	-0.240	Weak -ve
P-GlSnPog°	158 ± 5.7	140 – 167			
L-Witts (mm)	4.04 ± 2.58	0.5 – 12	0.032	-0.300*	Weak -ve
P-NSnPog°	154.6 ± 5.4	138 – 164			

*Correlation is significant at the 0.05 level (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Descriptive analysis and correlation of photographic soft tissue profile parameters with lateral cephalometric parameters according to growth pattern is shown in Table 3. The type and strength of the correlation were classified according to Table 4. Lateral Cephalomteric Facial Angle was found to be significantly correlated with photographic P-NTraPog in both Class I and Class II samples. In Class I samples, they were moderate negatively correlated while in Class II samples they were weak negatively correlated.

Table 3 Correlation between lateral cephalometric and photographic soft tissue profile analysis for determining growth pattern in skeletal maloccusions

Malocclusion	Variables	Mean± SD	Range	Significance (p value)	Pearson Correlation	Correlation
Class I	L-Facial Angle°	-1.5 ± 4.08	-13 - 5	0.000	-0.478**	Md -ve
	P-NTraPog°	62.2 ± 4.7	49. 1 – 72.7			
Class II	L-Facial Angle°	-1.01 ± 5.4	-21 - 11	0.005	-0.390**	Wk -ve
	P-NTraPog°	62.9 ± 5.2	48 - 74.7			

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

Table 4 Inference for Table 1,2 and 3

Score	Inference
-1	Perfect Negative
-0.70	Strong Negative
-0.50	Moderate Negative
-0.30	Weak Negative
0	None correlation
0.30	Weak Positive
0.50	Moderate Positive
0.70	Strong Positive
1	Perfect Positive

Descriptive statisticsof Class I and Class II samples according to the gender is shown in Table 5.

Table 5: Descriptive statistics according to gender in different skeletal malocclusions

Variables	Class I				Class II			
	Male		Female		Male		Female	
	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range	Mean ± SD	Range
L-ANB °	2.4 ± 1.02	1 - 4	2.4 ± 1.1	0 - 4	6.5 ± 1.8	5 - 11	5.9 ± 1.1	4.5 - 8
L-Witts (mm)	2.04 ± 2.1	-2 – 5.5	2.03 ± 2.2	-4 – 9	3.5 ± 2.5		4.4 ± 2.6	.5 – 12
L-FacialAngle°	-0.8 ± 3.4	-7 – 5	-2 ± 4.5	-13 – 5	-1.6 ± 6.0	-21 – 7	-0.5 ± 4.9	-10 – 11
P-ANB°	9.6 ± 2.4	4.7 - 13. 2	8.3 ± 2. 08	5 – 12.6	10.7 ± 3.0	4.1 – 18.3	11.1 ± 2.6	7.1 – 17.1
P-GlSnPog°	161 ± 4.7	151 - 171	161 ± 6.2	152 - 176	159.5 ± 5.3	149 – 167.8	156.8 ± 5.8	140.7 – 164.9
P-NSnPog°	157.6 ± 5.1	148 - 168	158.8 ± 5.4	150 – 172.1	155.5 ± 5.3	143 – 164.4	153.8 ± 5.4	138.8 – 164. 5
P-NTraPog°	62.2 ± 5.2	49 – 72.7	62.3 ± 4.3	54.1 – 70.9	63.8 ± 5.7	48 – 74.9	62.1 ± 4.8	52.1 – 74.7

DISCUSSION

In the present study, photographic P-NSnPog value was found to be 158.2° ± 5.3° in Class I patients and 154.6° ± 5.4° in Class II patients. This result is in accordance with the study done by Hameed et al in Pakistani population (156.94° ±8.38° in Class I and 153.9°± 5.46° in Class II samples).[12] Photographic P-ANB value was found to be 8.95° ± 2.33° in Class I patients and 10.98° ± 2.80° in Class II patients. Thus, in absence of lateral cephalogram, photographic soft tissue profile angle, P-NSnPog can be helpful in diagnosing Class I and Class II malocclusion patients.

The correlation analysis showed that all photographic soft tissue profile parameters were correlated with lateral cephalometric parameters in Class II malocclusion patients and in determining growth pattern of a patient. This result is in accordance with the results of Bittner and Pancherz in which they concluded that sagittal maxillary and mandibular positions could only occasionally be determined on the basis of facial appearance, while a Class II jaw base relationship (large ANB angle) could easily be seen and the vertical jaw relationship could be determined with relatively high precision.[9] Hence, photographic soft tissue profile analysis can be suitable alternative to lateral cephalogram, particularly in rural areas of Nepal, where availability and cost of the radiographs may be of concern. Highly significant correlations ($p \leq .01$) were found between analogous cephalometric and photographic measurements for most variables. However, Pearson correlation coefficients ranged from weak to moderate. Similar results were found in the study done by de Carvalho et al.8 Descriptive analysis according to the gender showed gender dimorphism in photographic soft tissue profile analysis which was in accordance with the literature.[4,6,8]

CONCLUSION

Highly significant correlations between analogous photographic and cephalometric measurements were found for most sagittal and vertical variables. Photographic soft tissue profile analysis may be considered a feasible and practical diagnostic alternative, particularly if there is a need for a non-invasive and low-costmethod, particularly in rural areas where availability and cost of the radiographic intervention may be of concern.Further studies are needed to test the diagnostic accuracy of the photographic soft tissue profile analysis.

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