

Reliability of Profile Photography for Determining Growth Pattern and Sagittal Jaw Relationship in Different Classes of Malocclusions

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Abstract

Although the importance of facial photography has been stressed in literature, there are no studies on its diagnostic potential. This study was conducted to evaluate the diagnostic merit of photography in detecting growth patterns and jaw relationships. Standardized lateral cephalograms and profile photographs were taken for 40 patients. On cephalometry, growth patterns and sagittal classifications were determined. Diagnostic photography- based measurements for detecting departures from the norm were calculated according to the gold standard (lateral cephalometry). Independent sample t-test was used for comparing mandibular plane angles with profile photography and with lateral cephalometry. The mean value of the mandibular plane angle as determined by lateral cephalometry is 30.27+4.59. The mean value of the mandibular plane angle as determined by profile photography is 31.80+4.76. There was no significant difference seen. Profile photography is equally reliable as lateral cephalometry in detecting mandibular plane angle. Profile photography can be used as a perfectly accurate measurement tool for detecting horizontal and vertical growth patterns. It is also a rather accurate method for detecting normal growth patterns, as well as both Class I and non-Class I jaw relationships. These results highlight this non-invasive and economic method as an effective diagnostic tool. There is good association between lateral cephalometry and profile photography in detecting mandibular plane angle in different skeletal groups as well.

Keywords- Lateral cephalograms; Profile photography; Mandibular plane angle; Growth patterns

Introduction

One of the major components of orthodontic diagnosis and treatment planning is evaluation of patient profiles and detecting changes from the normal values¹. Knowledge of the dentofacial pattern and sagittal relationship allows the clinician to make correct decisions and enhance treatment success in getting optimal facial harmony²

The standard and widely used method for evaluating skeletal and dentofacial relationships is usage of lateral cephalograms³. Profile photography is used for establishing the treatment objectives and determines the soft tissue outline of the facial appearance^{4,5}. It is a non-invasive method that can be easy to obtain and gives us an early impression about the complaints of the patient and our chief objectives⁶. Although the importance of facial photography in orthodontics has been recognized, correlations between photography and cephalometric measurements have been established by Zhang et al^{7,8}. Furthermore there is no research on diagnostic values and accuracy of photography (compared with cephalometry) in detecting values departing from the standard values⁹.

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Therefore, our aim for this study was to evaluate the predictive value of photography as a diagnostic tool for detecting abnormalities in growth patterns, chin positions and sagittal jaw relationships.

Materials and Methodology

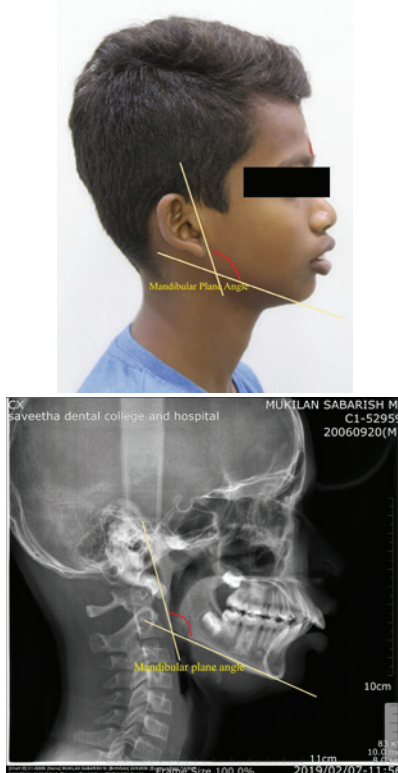


Fig 1: Anatomical landmarks utilized for tracing and determining mandibular plane angle in both lateral cephalogram as well as with profile photograph

This was a diagnostic study conducted in the Department of Orthodontics at Saveetha Dental College, Chennai. Our samples for this study comprised profile photographs and lateral cephalograms of 40 attendees each.

The inclusion criteria comprised patient's willingness to participate, necessity for lateral cephalometry and no history of any previous orthodontic treatment. A total of 40 patients were enrolled in their respective sequences

Lateral Cephalometry

Lateral cephalograms were taken from patients in the natural head position (NHP) by getting them to look at their pupils in a mirror located 1 meter away. Patients stood in a relaxed position, hands and shoulders were at rest and backs were upright without any support (Fig 1). Their Frankfurt plane was horizontal, teeth were in

centric occlusion and lips were in the resting position. The best radiograph for the patient was selected and the following landmarks were traced: soft tissue menton, supramentale, tragus, soft tissue Pogonion, orbitale, subnasale, soft tissue nasion, true horizontal and true vertical planes. Analysis was done using the OneCeph software. The growth pattern was determined as average, horizontal and vertical based on the gonial angle and Jarabak index. Sagittal classification (Class I, II, III) was determined based on ANB angle and Wits analysis.

Profile Photography

All patients' foreheads, ears and necks were completely exposed. Patients stood in a marked space and made no facial expressions with lips and chin muscles at rest. Subjects' hands and shoulders were at rest and their backs were upright, without any external support. Their heads were in natural head position (NHP) with patients looking at their pupils in a mirror in a standard situation and adjusting their midface line¹⁰. Portrait photographs were taken of the patients right profiles with a DSLR camera with a focal length of 50mm and resolution of 10 megapixels (Fig 1). The vertical position of the camera was aligned with the subject's head, in such a way that the camera's central focus (focal spot) was set on the patient's tragus and the resulting image would include margins above the head and below the neck. Another photograph of the same patient was taken 30 seconds later in identical conditions. The best photograph of each patient was used for photographic analyses which were based on the following landmarks: soft tissue menton, supramentale, tragus, soft tissue Pogonion, orbitale, subnasale, soft tissue nasion, true horizontal and true vertical planes. Photographic soft tissue analysis were performed using FACAD software by using location of points tracing. The measurements used were the angles located, facial convexity and head position.

Statistical Analysis

Predictive values in the photogrammetric method are used for determining departures from normal values. An independent sample t-test was used to determine the mandibular plane angle and compare it between lateral cephalogram and profile photography. Presence of any significant differences was assessed between the two groups and the software used was SPSS Version 20.0 (SPSS Inc, Chicago). Pearson's correlation test was done between the two groups to determine the correlation. Chi-square test was done to determine the association

between the two groups in different skeletal patterns.

Results and Discussion

The cases were identified appropriately by the photographic and cephalometric method. The mean value of the mandibular plane angle as determined by lateral cephalometry is 30.27 ± 4.59 . The mean value of the mandibular plane angle as determined by profile photography is 31.80 ± 4.76 . There was no significant difference between the two methods for determining the growth pattern of an individual. Levene's test for equality of variances between the two groups showed changes while detecting sagittal relationships between the two groups mostly due to changes in chin position. Pearson's correlation test was done to determine the correlation between the two groups in detecting mandibular plane angle. The correlation coefficient was 0.901 indicating good reliability between the two groups. Chi-square test was done to determine association between the diagnostic aids in different skeletal patterns. They detected a good association between different skeletal types and the type of diagnostic aid used.

Our study introduced profile photography analysis as a method for detecting different growth patterns and sagittal relationships with appropriate accuracy¹¹. On analysis, we can detect that when the photography method detects a growth pattern change, it must be taken accurately in most instances¹². When photography suggests a face has an average growth pattern, then there is 78% probability that the cephalometry method will also identify the person as having average growth pattern¹³. The reverse applied is also true in most instances with the cephalometric method being applied accurately as well. The weak point of the photographic approach is its rather low sensitivity, meaning it might miss out on one out of two cases with actual growth pattern abnormality¹⁴.

The information given by the photographic method in detecting deviations from a non-Class I relationship is about 80 percent. Deviation in Class II and Class III

relationships are much harder to detect and present with variations¹⁵. Visualizing bony landmarks is important when the soft-tissue and hard-tissue landmarks are situated some distance apart¹⁶. Zhang et al observed the highest correlations between vertical facial heights calculated according to cephalometric and photographic analysis¹⁷.

Nasion and menton landmarks used for measuring facial height were not covered by thick soft tissues¹⁸. Nevertheless, they concluded that since the variations in soft tissue and bony landmark locations might have clinical implications, facial photography must be considered an adjunct to and not a substitute for cephalometry¹⁹.

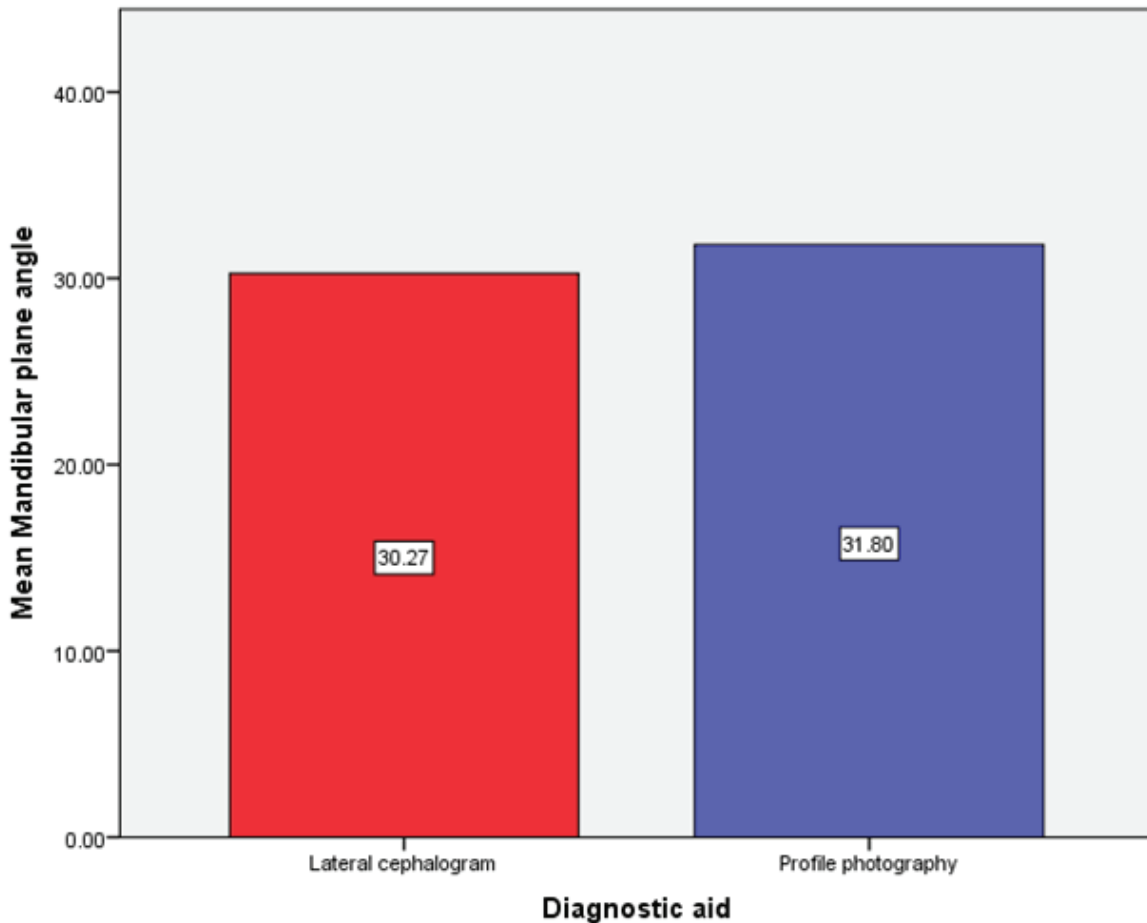
On the other hand, they approved the use of standardized photography as an epidemiologic tool as well as for evaluating hereditary facial forms in large hereditary studies regarding measurements such as facial heights which display a high correlation with the counterpart cephalometric measurements²⁰. As dental practice becomes more and more computerized, digital photo documentation is also becoming a standard procedure because of its numerous advantages²¹. Digital images can be easily seen and repeated in the same session, can be stored easily and retrieved rapidly¹. Moreover, digital images can be conveniently enhanced using digital features such as zooming and edge detection, while they take up no physical space²².

Considering all these advantages, plus the high reliability of photographic analyses as well as the high diagnostic value of this method in detecting deviations from the normal, this approach can be recommended as an appropriate method for clinical use^{23,24}.

Our study was limited by a number of factors. Future studies should improve the reliability of findings by calculating intra-evaluator concordance as well²⁵. Also, a sample size determination by appropriate power calculations could improve the reliability of the findings²⁶

Table 1: Independent sample t-test to determine test of significance between lateral cephalogram and profile photography while determining mandibular plane angle with p-value=0.959

S.NO	N	Mean	S.D.	Sig.
Lateral Cephalogram	40	30.27	4.59	0.959
Profile Photography	40	31.8	4.76	



Graph 1: This bar graph represents the depiction of mandibular plane angle when verified by two different diagnostic aids- Profile photography and Lateral cephalometry. The x-axis of the graph represents the two diagnostic aids used in the study (Lateral cephalogram and Profile Photography) and the y-axis of the graph represents the mean of mandibular plane angles. The red bar denotes the mandibular plane angle when determined by lateral cephalometry and the blue bar denotes the mandibular plane angle when determined by profile photography method. The mean value of mandibular plane angle is greater when determined by Profile photography (31.80+4.76 degrees) than with lateral cephalometry method (30.27+4.59 degrees). There is no significant difference between the mean values and the diagnostic aids used (lateral cephalometry and profile photography). Independent sample t-test was used to determine the descriptive statistics (mean and standard deviation) of the study (p=0.959). The significant difference between the two groups is 0.959 which is not statistically significant.

Table 2: Pearson’s correlation coefficient test done between the two diagnostic aids (lateral cephalometry and profile photography) used in the study. The correlation between the two is 0.901 which indicates high correlation value. Therefore, both lateral cephalometry and profile photography can be reliably used for determining mandibular plane angle.

Correlations			
		Lateral cephalometry	Profile photography
Lateral cephalometry	Pearson Correlation	1	.901**
	Sig. (2-tailed)		.000
	N	40	40
Profile photography	Pearson Correlation	.901**	1
	Sig. (2-tailed)	.000	
	N	40	40
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 3: Chi-square test to determine association between lateral cephalometry and profile photography in Class I skeletal groups. The likelihood ratio is 83.85 indicating good association between the two diagnostic aids in Class I skeletal groups.

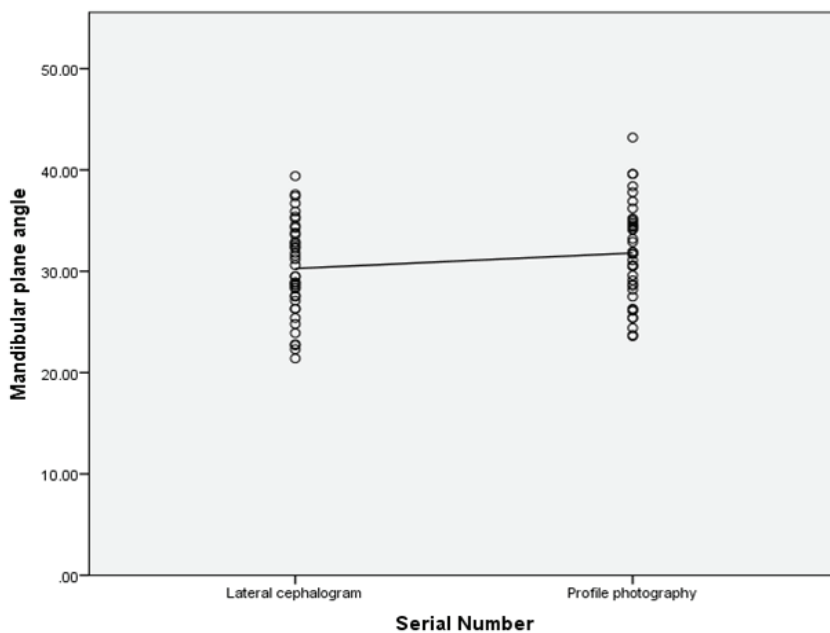
	Value	df	Asymp:Sig. (2-sided)
Pearson Chi-Square	60.667a	61	.488
Likelihood Ratio	83.857	61	.028
Linear-by-Linear Association	2.106	1	.147

Table 3: Chi-square test to determine association between lateral cephalometry and profile photography in Class I skeletal groups. The likelihood ratio is 83.85 indicating good association between the two diagnostic aids in Class I skeletal groups.

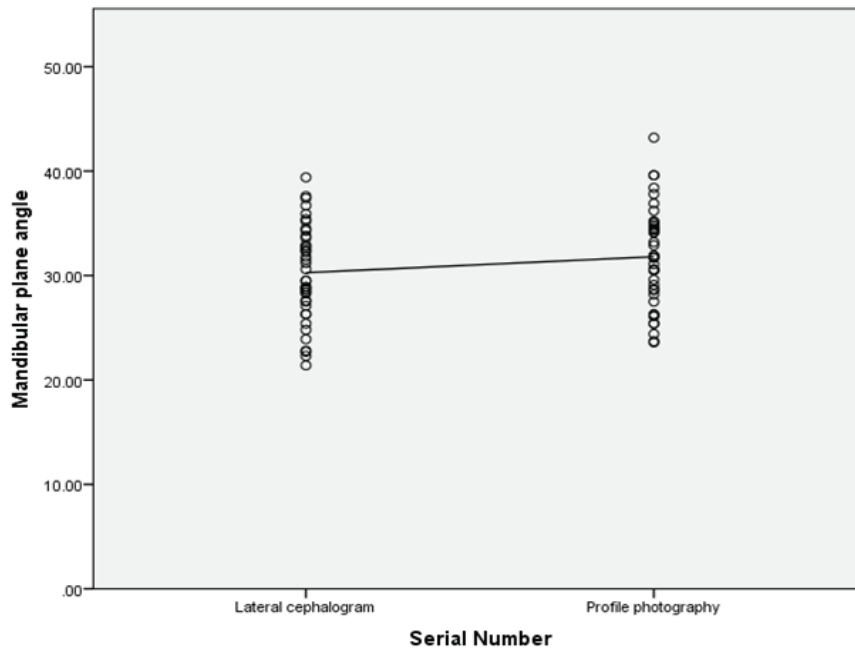
	Value	df	Asymp:Sig. (2-sided)
Pearson Chi-Square	58.646 ^a	61	.625
Likelihood Ratio	79.889	61	.129
Linear-by-Linear Association	2.897	1	.169

Table 4: Chi-square test to determine association between lateral cephalometry and profile photography in Class II skeletal groups. The likelihood ratio is 79.89 indicating good association between the two diagnostic aids in Class II skeletal groups.

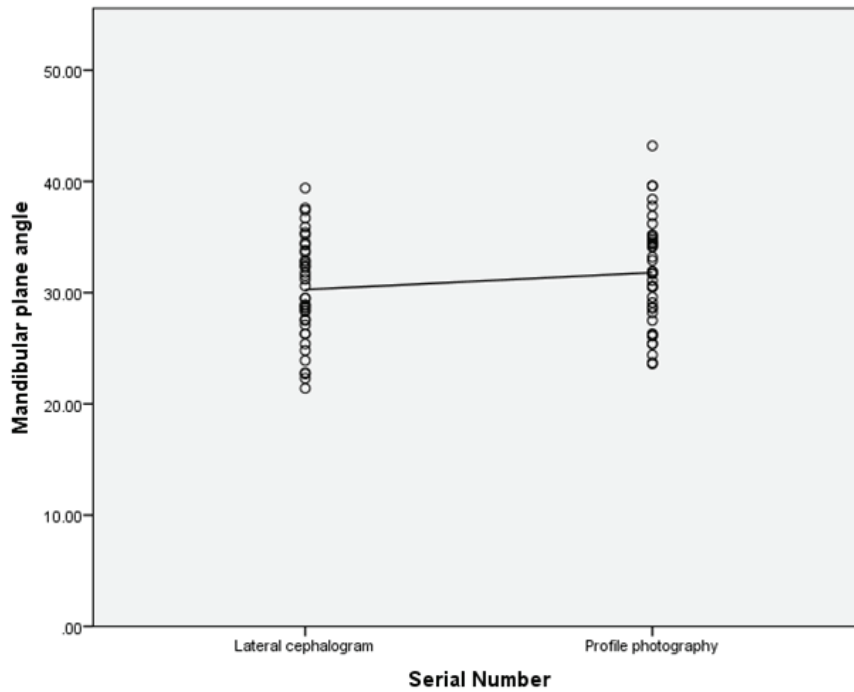
	Value	df	Asymp:Sig. (2-sided)
Pearson Chi-Square	67.822a	61	.399
Likelihood Ratio	81.369	61	.258
Linear-by-Linear Association	1.945	1	.227



Graph 2: Scatter plot to determine the association between lateral cephalometry and profile photography in Class I skeletal groups. The x axis denotes the two groups while the y axis denotes the Mandibular plane angle. The likelihood ratio is 83.85 indicating good association between the two diagnostic aids in Class I skeletal groups.



Graph 3: Scatter plot to determine the association between lateral cephalometry and profile photography in Class II skeletal groups. The x axis denotes the two groups while the y axis denotes the Mandibular plane angle. The likelihood ratio is 79.89 indicating good association between the two diagnostic aids in Class II skeletal groups.



Graph 4: Scatter plot to determine the association between lateral cephalometry and profile photography in Class III skeletal groups. The x axis denotes the two groups while the y axis denotes the Mandibular plane angle. The likelihood ratio is 81.37 indicating good association between the two diagnostic aids in Class III skeletal groups.

Conclusion

Profile photography can be used as a perfectly accurate method for detecting presence of horizontal, vertical, average growth patterns. It is fairly accurate for detecting normal growth patterns as well as both Class I and non-Class I jaw relationships. These results highlight this non-invasive and economic method as a useful clinical tool. There is good association between lateral cephalometry and profile photography in detecting mandibular plane angle in different skeletal groups as well.

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