

COMPARISON OF ANGULAR MEASUREMENTS IN CEPHALOMETRIC AND PHOTOGRAPHS

Atif Riaz,¹ Ayesha Ashraf,² Shazia Ramzan,³ Samina Kadir,⁴
Farhan Ashraf,⁵ Nedat Iqbal⁶

Abstract

Background and Objectives: The evaluation of the facial profile is an important factor in any current orthodontic diagnosis and accurate treatment planning is dependent on it. The aim and objective of the study is to find out differences in angular measurements between photographic and cephalometric measurements whether photographic measurements can be used in place of cephalometric measurements.

Methods: The study comprised 100 volunteers (50 males and 50 females) ranging in age from 12 to 16 years. The respondents were chosen at random throughout the sampling process. Cephalometric and photographic profile analysis was used, with angular measurements based on standard cephalometric and photographic records taken in natural head position in lateral view. Lateral cephalogram was used for cephalometric analysis and photograph taken in lateral view was used for evaluation. The study included four factors in total.

Results: There was no significant difference in facial angular measurements between the cephalometric and photographic analysis.

Conclusion: This study concluded that photographic measurements can be used in place of lateral cephalogram as there are negligible differences between them

Keywords: Photographic analysis, Cephalometric analysis, Naso-labial angle, Naso-mental angle, Naso-frontal angle, Naso-facial angle

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Correct identification of the structures on cephalograms is required for a correct cephalometric analysis.¹ Lateral cephalometric radiograph is one of the most important tool for evaluation and treatment planning in orthodontics. However, for this purpose knowledge is required for correct identification of structures on radiographs to be used for orthodontic measurements. This procedure can only be performed by a skilled orthodontist and requires allocation of a

large amount of time.² Cephalometric analysis can be used for evaluation, treatment planning, growth prediction, surgical tracing and the evaluation of results of orthodontic treatment.³ Tracing of these landmarks is done by correct identification of structures on cephalogram and measurements are taken using a protactor.⁴

Photographs in orthodontics are used for diagnosis, treatment planning and evaluation of ongoing treatment. Photographs in orthodontics are divided into extraoral and intraoral.¹⁵ The gold standard equipment for taking orthodontic clinical photographs is a DSLR (digital single-lens reflex) camera with a 100 mm macro lens and macro ring flash.^{5,6} When photographs are taken using a standardized method, comparisons can be drawn throughout treatment detailing the specific changes that have occurred during the intervening period. The changes seen are the direct results of our ministrations, combined with the normal growth and

1,2. Department of Orthodontics Children Hospital, Lahore

3. Department of Physiology, Sialkot Medical College, Sialkot

4. Department of Orthodontics

5. Department of Pathology, Services Institute of Medical Sciences/Services Hospital Lahore

6. Department of Oral Biology, Fatima Memorial Hospital-College of Dentistry, Lahore

Correspondence:

Dr. Shazia Ramzan ; M.B.B.S; M.Phil; PhD Scholar, Sialkot Medical College, Sialkot. Email: dr.shaziamanזור@yahoo.com

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development occurring during that time period.⁵

The assessment of facial structures is very important in orthodontics as a subtle change in them can cause worsening of patients facial aesthetics. The NLA is one of the most important factors in orthodontic diagnosis for the evaluation of attractiveness of the nose and facial profile. It is defined as the angle formed by the two lines passing through the columella and the edge of the upper lip (as shown in Figure 1). Its value varies from 90° and 95° for males and 95–115° for females.

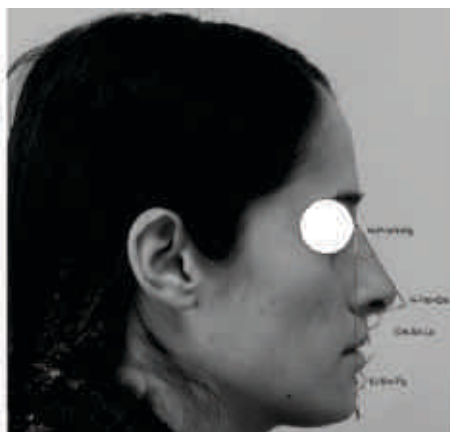
In general, increased values of NLA occurs in Asian populations, and appears to be decreased in Caucasian populations or with African populations⁸. NUSOMENTAL angle is formed by the line drawn through the nasal dorsum intersecting a line drawn from nasal



tip to soft tissue chin at pogonion

Other angular measurements which are considered for analysis of soft tissue are nasofacial angle and nasiofrontal angle.

Majority of investigators have proved that there are substantial differences among various racial and



ethnic groups and various cephalometric values have established for different racial groups including Caucasians, Korean, Japanese, Chinese, Persians, Yemeni and Turkish.⁹⁻¹⁵ An individual with certain ethnic background should be treated according to their ethnic norms and established values. Norms of one population might not be suitable for another population, therefore a dire need arises to establish the soft tissue norms for Pakistani population.¹⁶

The literature lacks in the establishment of soft tissue esthetic norms for Pakistani population. Very few studies have reported the soft tissue norms,¹⁷ lacking in the standardization of lateral cephalogram,¹⁸ and only hard tissue cephalometric norms have been evaluated.^{19,20} This demands a survey, to assess only the soft tissue parameters pertaining to lip, nose and chin using a standardized lateral cephalogram and photographs and assessment of these soft tissue parameters to find out whether any difference occurs between two methods.

With this aim in mind, this study was conducted to evaluate the soft tissue profile of growing children of Pakistani origin, to compare soft tissue angular measurements in both cephalograms and photographs and compare values in both methods.

METHODS

It was a cross sectional study. Sampling was done through Non-probability consecutive sampling. A population size of 100 is calculated with a confidence level of 95% and a magnitude of error of 7 %. Both males and females were included in this sample and formula used was $n = N \times ((N-1)E^2 + x)$.

Photographs and lateral cephalometric radiographs of 50 males and 50 females were taken for this study. Nasiolabial, nasiomental, nasiofacial and nasiofrontal angles were evaluated separately on both radiograph and photographs. Standardized profile photographs were taken in natural head position (NHP) by positioning the patients into a custom-made mechanical device having markings on one side for assessing the photo in life size and a weight of 500 gms suspended on other side by a black thread to determine the true vertical line.

The patients were asked to look into the mirror straight at their eye level. Inclusion criteria included Normal angle cases, ANB should be (0-4), Age of patients should be between 12-16, No history of trauma, No craniofacial anomaly, No history of previous orthodontic treatment. And exclusion criteris included High and low angle cases, Skeletal class II, Skeletal class III

All the findings were recorded in a standardized proforma and data was analysed using SPSS Version 25. Arithmetic means and standard deviations were calculated for each quantitative variable. The analysis of variance (ANOVA) test was performed to compare the means or standard deviations of groups. Differences were considered statistically significant at $P < 0.05$.

NMA 2: Photographic nasomental angle

Table 1 gives the angular soft tissue characteristics of sample by both cephalometric and photographic methods

Table 1: Nasolabial and Nasomental Angles

Parameter	Mean	S.D	S.E. mean	t-value	Df	P-value
NFRA 1°	121.64	5.44	.544	-.377	198	.707
NFRA 2°	121.93	5.43	.543			
NFA 1°	36.15	2.76	.276	.699	198	.505
NFA 2°	35.89	2.83	.283			
NLA 1°	96.72	5.49	.549	-.228	198	.820
NLA 2°	96.60	5.37	.537			
NMA 1°	124.88	4.03	.403	-.275	198	.784
NMA 2°	125.04	4.19	.419			

The mean value of naso-frontal angle in cephalogram was $121.64^\circ \pm 5.44^\circ$ with minimum and maximum value were 110.00° and 132.00° respectively. In (NFRA2°) that is nasofrontal angle in photograph the mean was $121.93^\circ \pm 5.43^\circ$ while the minimum value was 111.00° and maximum value was 133.00° .

The cephalometric nasofacial angle (NFA1°) mean was found $36.15^\circ \pm 2.76^\circ$, minimum value was 29.00° and maximum value was 42.00° . The photographic nasofrontal angle (NFRA2°) was found to have a mean value of $35.89^\circ \pm 2.83^\circ$ with minimum value 30.00° and maximum value was 42.00° indicating relation of nose with rest of the face.

According to the table mean value of cephalometric nasolabial angle (NLA1°) was $96.72 \pm 5.49^\circ$ and minimum value was 89.00° and maximum value was 110.00° and $96.90^\circ \pm 5.37^\circ$ (NLA2) for photographic nasolabial angle, indicating that for aesthetically pleasing faces, there is no lip protrusion in our sample.

The mean value of nasomental angle in cephalogram (NMA1°) was found 124.88 ± 4.03 , minimum and maximum values were 118.00° and 135.00° respectively. The photographic nasomental angle (NMA2°) was $125.04^\circ \pm 4.19^\circ$ with the minmum value 118.00° and 135.00° as a maximum value according to the table.

DISCUSSION

Cephalometric analysis is the gold standard for orthodontic treatment planning. However, the photographic assessment is quite affective as it protects patient from harmful radiations from x-ray source and also is quite cost effective.²¹

The main purpose of our study was to determine whether we can use lateral photographic measurements in place of lateral cephalogram measurements for the treatment of patients, as it is not easy for every institute and research laboratory in Pakistan to provide an expensive apparatus for students and researchers.

During the past few years concerns have been raised over the increase in exposure to x-ray radiations. The average amount of radiation exposure from x-ray source for a lateral cephalogram is $3 \mu\text{Sv}$, which is very small as compared to the dose limit described by International Commission of Radiological Protection's (ICRP) which is 1 mSV. So risk caused by x-ray radiation during cephalogram is very minimal,^{22,23} but any reduction in the amount of possible exposure from lateral cephalograms would be beneficial for patients.²⁴

Photographic analysis provide a better visual understanding of craniofacial structures. Soft tissue structure changes especially those which are brought with ages, has made photographic analysis necessary thanks to Proffit.²⁵ By standardizing the photography protocol and its evaluation, multiple studies have shown the reliability of the photographic technique.²⁶⁻²⁹

A study by Almeida et al. (2012) found that the reading taken from both cephalometric analysis and photographic analysis were found to be similar for nasolabial and mentolabial structures.³⁰

The results in show that the difference in angular measurements recorded were not statistically significant ($P < .05$). In case of naso-frontal angle the difference between cephalogram and photograph was found to be 0.29 hence the difference was found to be minor. In case of naso-facial angle the difference between cephalogram and photograph was found to be 0.26 hence the difference was found to be minor. In case of naso-labial angle the difference between cephalogram and photograph was found to be 0.18 hence the difference was found to be minor. In case of naso-mental angle the difference between cephalogram and photograph was found to be 0.14 hence the difference was found to be minor. As the difference in both these values is found to be minor.

CONCLUSION

This study concluded that photographic measurements can be used in place of lateral cephalogram measurements for angular measurements of patients as they are reliable and can be implemented through low cost which would be a better alternative for developing countries as they cannot afford expensive apparatus of lateral cephalogram. Photographic technique is a better method than lateral cephalogram as patients will not be exposed to radiations which are hazardous for them.

Conflict of Interest

None

Source of Funding

None

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