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Original Research Article

# Cephalometric and facial photographic assessment, their correlations: A study in a tertiary health centre

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ABSTRACT

**Background:** India as a country is still growing and luxurious cephalometric equipment is not available everywhere. There comes the importance of a low-cost photographic method. The photographic method can be beneficial where radiation is contraindicated or needs to be avoided. Further research needs to be conducted to test the diagnostic skill of the acquired photographs. This study was conducted to make orthodontic diagnosis and treatment accessible to the remote areas of the state of Odisha where there are no provisions for lateral cephalograms. Photography being a reproducible and non-invasive method has its access to every operator. The provision for photography can be done in every operatory setup without the risk of radiation hazards, even in remote areas, giving proper diagnosis aids in better treatment. Thus this study gives accessibility to diagnosis and further treatment for patients in the interior areas of the state.
**Aim:** This study was conducted to compare the correlation between craniofacial measurements obtained from lateral cephalograms with similar anthropometric measurements from facial photographs in the Odisha population and to assess the reliability of both techniques(lateral cephalograms and facial photographs) and evaluate the predictability of cephalometric values through facial photographs.
**Materials and Methods:** The study was an in-vitro cross-sectional study conducted on the patients presenting to the OPD of Hi-Tech Dental College and Hospital during 2 years tenure. The study was done on a sample of 100 individuals presenting to the hospital OPD in the age group of 10-35 years(mean age 22.38±3.342 years) age. The inclusion and exclusion criteria was decided. The photographic and radiographic analysis was done. The data was tabulated and statistical analysis was done with a statistical constant of p>0.05.
**Results:** The study concluded that SNA, SNB, SN-MP(CP-MP'), Nasolabial angle, S-line to upper lip, and S-line to lower lip showed a good correlation among the two different methods with no sexual dimorphism.
**Conclusion:** Photography being a reproducible and non-invasive method has its access to every operator. The provision for photography can be done in every operatory setup without the risk of radiation hazards, even in remote areas, giving proper diagnosis aids in better treatment. Thus this study gives accessibility to diagnosis and further treatment for patients in the interior areas of the state.



## 1. Introduction

Traditional cephalometric includes analysis of sagittal, vertical, and soft tissue profiles. Many the basic disadvantages of radiation exposure are:(1)

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Radiation exposure(2) Availability of cephalostat is not easy.[1] Traditionally facial photography has been a part of pretreatment and post-treatment orthodontic records. Graber in 1972 considered photographs as an essential diagnostic tool.[2] The rising concerns about radiation exposure have necessitated a non-radiographic, non-invasive, and cost-effective alternative. Though the radiation dose from a lateral cephalogram is 3 $\mu$Sv, which is much below the recommended dose by the International Commission of Radiologic Protection(ICRP) of 1 mSv annually, any reduction in the amount of possible radiation exposure would be beneficial to patients.[1] Photogrammetry is defined as the art, science, and technology of obtaining information about physical objects through the process of recording, measuring, and interpreting photographic images.[3] Photographic analyses are inexpensive and help in better assessment of harmonic relationships among external craniofacial structures.[4] In a developing country like India, where there are states that still do not have the provision for expensive cephalometric apparatus in every district photography plays an important role in diagnosis and treatment planning procedures as it is low cost and less technique sensitive.[1]

This study was conducted to compare the correlation between craniofacial measurements obtained from lateral cephalograms with similar anthropometric measurements from facial photographs in the Odisha population and to assess the reliability of both techniques(lateral cephalograms and facial photographs) and evaluate theof predictability of cephalometric values through facial photographs.

## 2. Materials and Methods

The study is an in-vitro cross-sectional study conducted on the patients presenting to the OPD of Hi-Tech Dental College and Hospital during 2 years of tenure. The study was done on the lateral cephalograms and standard profile photographs of 100 individuals presenting to the hospital OPD. The age group for the study was 10-35 years(mean age 22.38±3.342 years) age.

### *2.1. Inclusion criteria*

Presence of all 6 maxillary anterior teeth, Angle's Class I malocclusion, Angle's Class II malocclusion, Intra-arch malalignment, No previous history of Orthodontic or Surgical treatment, No history of Craniofacial trauma, No history of Congenital Anomalies

### *2.2. Exclusion criteria*

Presence of chronic diseases(such as muscular dystrophy, bone disorders, renal disorders), Maxillomandibular discrepancies requiring orthognathic surgery.

### *2.3. Radiographic procedure*

Each patient coming to the Department of Orthodontics and Dentofacial Orthopaedics, Hi-Tech Dental College and hospital was examined. Patients who had Angle's Class I and Class II malocclusion with all 6 maxillary anterior teeth were further enquired regarding any previous history of orthodontic or surgical treatment, craniofacial trauma, or congenital anomalies. A medical history was required to include or exclude the patients from the study. Digital lateral skull radiographs were then taken with a cephalostat. The exposure parameters and magnification applied for all the cephalograms were the same(Kvp-80, mA-10, DAP-0.200Gy/cm2, time-12.3sec, ratio-100%). The radiographs were recorded at maximum intercuspation with lips at rest position. The patient was asked to remove all metal objects and stand in natural head position with complete intercuspation, and the Frankfort horizontal plane was made parallel to the floor.

The landmarks on the lateral cephalogram were (Figure 1): Nasion(N), Porion(Po), Sella(S), orbtale(Or), anterior nasal spine(ANS), subspinale/point-A(A), supramentale/point B(B), pogonion(Pog),gnathion(Gn), menton(Me), gonion(Go).

The planes taken on the radiograph were (Figure 1): SN plane, FH plane, Steiner's mandibular plane, Tweed's mandibular plane, S-line(Steiner's line).

1. The parameters taken on the lateral cephalogram were

   (a) Angular parameters (Figure 2): SNA, SNB, FMA, Go-Gn-SN, SN-FH, Nasolabial angle
   (b) Linear parameters (Figure 3): LAFH, TFH, Mandibular length,S-line to upper lip, S-line to lower lip.

### *2.4. Photographic procedure*

Each patient was made to sit 6 feet away from the wall. The patient was asked to remove all ornaments and glasses, hair tied up such that the forehead, neck and ear were visible. Anatomical landmarks(tragus, eye, gonion, and menton) were marked using adhesive stickers. Adhesive dots will be placed on anatomical landmarks such as soft tissue nasion, tragion, eye, and mandibular angular point. A 30cm scale was placed in front of the mirror to maintain parallelism. A mirror was placed at the wall 3 feet away from the subject to maintain the natural head position. The subject was made to sit 3 feet away from the camera. The asked to tie the hair properly such that the forehead, neck, and ears are visible The scale will be positioned in the mid-sagittal plane for standardization(1:1). The photographs were taken with a Nikon D-3400 camera mounted with an18-55mm kit lens mounted on a tripod placed 3 feet away from the subject.

*2.4.1. The landmarks marked on the photographs were* (Figure 4).[2]

1. Landmark Description

   (a) Soft tissue nasion(N'): The point where the nose meets the forehead
   (b) Eye(Ey): The lowest point on the right bony orbit was found by palpation
   (c) Tragion(T): The point where the inner crease meets the outer edge at the center of the ear.
   (d) Mandibular angular point(M) : Analogous to the Gonial angle of the mandible, located by palpation
   (e) Soft tissue point-A(A') : The maximum curvature above the

*2.4.2. The planes taken on the photographs were (Figure 5).*[2]

1. (a) Cranial plane: Line joining tragion(T) to soft tissue nasion(N').
   (b) FH plane: Line joining T' to Ey'.
   (c) Mandibular plane: Line joining M' to Me'.
   (d) S-line(Steiner's line): The line joining the "S" of the nose to soft tissue Pog.

*2.4.3. The parameters taken in the photograph were.*[2]

1. Angular parameters ( Figure 6)

   (a) TN'A'/SNA: Relative maxillary position.
   (b) FH'-MP'/FMA: Frankfort mandibular plane angle.
   (c) CP'-MP'/Go-Gn-SN: Facial plane to mandibular plane angle.
   (d) CP'-FH/SN-FH: The angle formed between the cranial plane and Frankfort's horizontal plane.

Nasolabial angle: The angle is formed by the tangent to the base of the nose and the tangent to the upper lip.

1. Linear parameters (Figure 7)

   (a) LAFH': The linear distance from Sn to Me'.
   (b) TFH' : The linear distance from nasion to Me'
   (c) Mandibular length(ML'): The linear distance between M to Me'.
   (d) S-line to the upper lip: Distance from S-line to vermillion border of the upper lip.
   (e) S-line to lower lip: Distance from S-line to vermillion border of the lower lip.

*2.4.4. Photographic superimposition (Figure 8)*

The photographic superimposition was done using Adobe Photoshop Elements2024.

*2.5. Statistical analysis*

MS Excel 2016 was used to fabricate the datasheet. IBM SPSS Corp. in Armonk, New York for Windows, Version 25.0, was used for the statistical analysis. Descriptive statistics were presented in the form of Mean and Standard Deviation(SD). One-way ANOVA statistics were applied to calculate the inferential statistics of the different variables between the different groups. The statistical constant was fixed at $p<0.05$. The reliability of the parameters was studied using the kappa statistics. The distribution of the study sample was normally distributed. Graphically the results were represented as bar graphs.

**Figure 1:** Land marks and planes on lateral cephalogram.

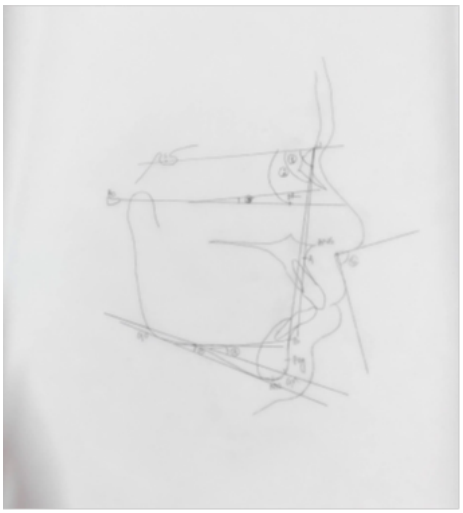


**Figure 2:** Angular measurements on lateral cephalogram.

**Table 1:** Reliability statistics of S-Upper Lip(Lateral Ceph vs Photograph).

| **S-UPPER LIP CEPH * SUPPERLIPCEPH4 Crosstabulation** | | | | | | |
|---|---|---|---|---|---|---|
| P<0.0001* | | | | **SUPPERLIPCEPH4** | | **Total** |
| | | | | .00 | 1.00 | |
| S-UPPER LIP CEPH | 0 | Count | | 13 | 4 | 17 |
| | | % within S-UPPER LIP CEPH | | 76.5% | 23.5% | 100.0% |
| | 1 | Count | | 0 | 83 | 83 |
| | | % within S-UPPER LIP CEPH | | 0.0% | 100.0% | 100.0% |
| Total | | Count | | 13 | 87 | 100 |
| | | % within S-UPPER LIP CEPH | | 13.0% | 87.0% | 100.0% |
| | | Value | Asymptotic Standard Error | Approximate $T^b$ | | P Value |
| Ordinal by Ordinal | Gamma | 1.000 | .000 | 4.519 | | .000 |
| Measure of Agreement | Kappa | .844 | .076 | 8.541 | | .000 |
| N of Valid Cases | | 100 | | | | |

**Figure 3:** Linear measurements on lateral cephalogram.

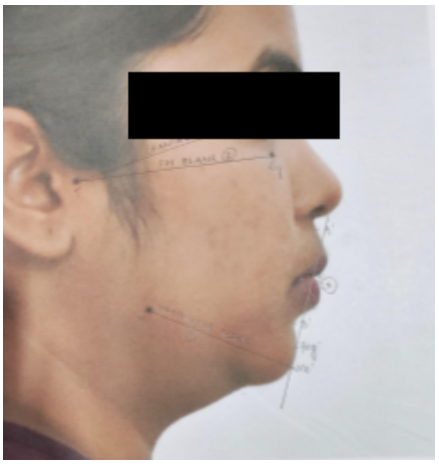


**Figure 5:** Planes on facial photographs.

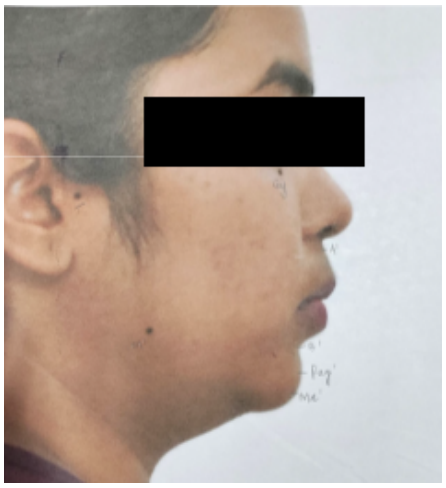


**Figure 4:** Landmarks on facial photographs.

**Figure 6:** Angular parameters on facial photographs.

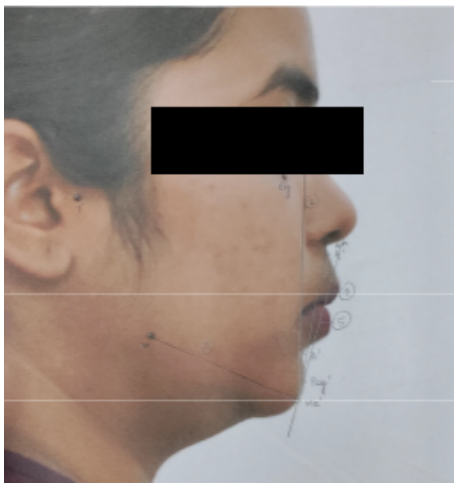


**Figure 7:** Linear parameters on facial photographs.

**Figure 8:** Super imposition of lateral cephalogram, facial photograph and cephalometric tracing.

## 3. Results

### *3.1. Reliability statistics of the different methods*

#### *3.1.1. S-Upper Lip(Lateral Ceph vs Photograph)*

For the S-Upper lip parameter; kappa statistics were found to be 0.844; noting it as highly reliable. There was a statistically significant reliability.

#### *3.1.2. S-Lower Lip(Lateral Ceph vs Photograph)*

For the S-Upper lip parameter; kappa statistics were found to be 0.716; noting it as highly reliable. There was a statistically significant reliability.

#### *3.1.3. SNA(Lateral Ceph vs Photograph)*

For the SNA parameter; kappa statistics was found to be 0.592; noting it as moderately reliable. There was a statistically significant reliability.

#### *3.1.4. SNB(Lateral Ceph vs Photograph)*

For the SNB parameter; kappa statistics was found to be 0.358; noting it as moderately reliable. There was a statistically significant reliability.

#### *3.1.5. Go-Go-SN(Lateral Ceph vs Photograph*

For the Go-Go-SN parameter; kappa statistics were found to be 0.139; noting it as highly reliable. There was no statistically significant reliability.

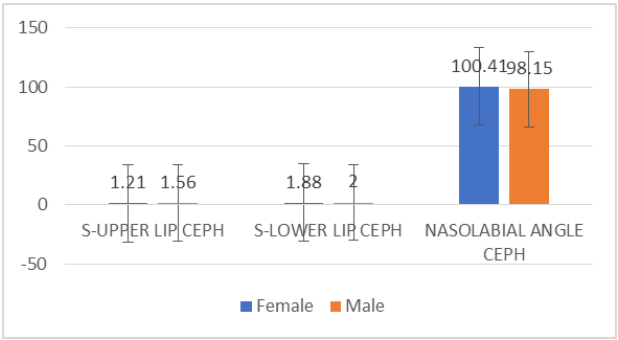
#### *3.1.6. Nasolabial Angle(Lateral Ceph vs Photograph*

For the Nasolabial angle parameter; kappa statistics was found to be 0.556; noting it as highly reliable. There was no statistically significant reliability.

### *3.2. Gender-wise comparison between the parameters*

#### *3.2.1. Soft tissue parameters*

The parameters were recorded based on the gender distribution. No statistically significant distribution was noted between the groups for any of the parameters.




Graph 1: Gender-wise comparison between soft tissue parameters.

#### *3.2.2. Hard tissue parameters*

The parameters were recorded based on the gender distribution. No statistically significant distribution was noted between the groups for any of the parameters for the Mandibular length, SNA, SNB, and SN-FH. A statistically significant difference was noted in LAFH, TFH, FMA, and. GoGo-SN.

## 4. Discussion

This was an in-vitro cross-sectional study that aimed to compare the correlation between craniofacial measurements obtained from lateral cephalograms with similar anthropometric measurements from lateral facial photographs in the Odisha population to(1) assess the reliability of both techniques(2) evaluate the relationship between facial tissues and underlying skeletal anatomy(3) evaluate predictability of cephalometric values through

**Table 2:** Reliability statistics of S-Lower Lip(Lateral Ceph vs Photograph).

**S-LOWER LIP CEPH * SLOWERLIPCEPH5 Crosstabulation**

| | | | SLOWERLIPCEPH5 | | Total |
|---|---|---|---|---|---|
| | | | .00 | 1.00 | |
| S-LOWER LIP CEPH | 0 | Count | 24 | 9 | 33 |
| | | % within S-LOWER LIP CEPH | 72.7% | 27.3% | 100.0% |
| | 1 | Count | 3 | 64 | 67 |
| | | % within S-LOWER LIP CEPH | 4.5% | 95.5% | 100.0% |
| Total | | Count | 27 | 73 | 100 |
| | | % within S-LOWER LIP CEPH | 27.0% | 73.0% | 100.0% |

**Symmetric Measures**

| | | Value | Asymptotic Standard Error | Approximate T$^b$ | Approximate Significance |
|---|---|---|---|---|---|
| Ordinal by Ordinal | Gamma | .965 | .024 | 7.161 | .000 |
| Measure of Agreement | **Kappa** | **.716** | .076 | 7.229 | .000 |
| N of Valid Cases | | 100 | | | |

**Table 3:** Reliability statistics of SNA(Lateral Ceph vs Photograph).

**SNA CEPH * SNACEPH6 Crosstabulation**

| P<0.0001* | | | SNACEPH6 | | Total |
|---|---|---|---|---|---|
| | | | .00 | 1.00 | |
| SNA CEPH | 0 | Count | 47 | 10 | 57 |
| | | % within SNA CEPH | 82.5% | 17.5% | 100.0% |
| | 1 | Count | 10 | 33 | 43 |
| | | % within SNA CEPH | 23.3% | 76.7% | 100.0% |
| Total | | Count | 57 | 43 | 100 |
| | | % within SNA CEPH | 57.0% | 43.0% | 100.0% |

| | | Value | Asymptotic Standard Error | Approximate T$^b$ | Approximate Significance |
|---|---|---|---|---|---|
| Ordinal by Ordinal | Gamma | .879 | .057 | 7.092 | .000 |
| Measure of Agreement | Kappa | .592 | .081 | 5.920 | .000 |
| N of Valid Cases | | 100 | | | |

**Table 4:** Reliability statistics of SNB(Lateral Ceph vs Photograph).

**SNB CEPH * SNBCEPH7 Crosstabulation**

| P<0.0001* | | | SNBCEPH7 | | **Total** |
|---|---|---|---|---|---|
| | | | .00 | 1.00 | |
| SNB CEPH | 0 | Count | 122 | 6 | 128 |
| | | % within SNB CEPH | 95.3% | 4.7% | 100.0% |
| | 1 | Count | 46 | 26 | 72 |
| | | % within SNB CEPH | 63.9% | 36.1% | 100.0% |
| Total | | Count | 168 | 32 | 200 |
| | | % within SNB CEPH | 84.0% | 16.0% | 100.0% |

**Chi-Square Tests**

| | | Value | Asymptotic Standard Error | Approximate T$^b$ | Approximate Significance |
|---|---|---|---|---|---|
| Ordinal by Ordinal | Gamma | .840 | .071 | 5.151 | .000 |
| Measure of Agreement | Kappa | .358 | .065 | 5.819 | .000 |
| N of Valid Cases | | 200 | | | |

**Table 5:** Reliability statistics of Go-Go-SN(Lateral Ceph vs Photograph).

| **GoGo-SN CEPH * GoGoSNCEPH9 Crosstabulation** | | | | | |
|---|---|---|---|---|---|
| P<0.0001* | | | **GoGoSNCEPH9** | | Total |
| | | | .00 | 1.00 | |
| GoGo-SN CEPH | 0 | Count | 65 | 21 | 86 |
| | | % within GoGo-SN CEPH | 75.6% | 24.4% | 100.0% |
| | 1 | Count | 13 | 1 | 14 |
| | | % within GoGo-SN CEPH | 92.9% | 7.1% | 100.0% |
| Total | | Count | 78 | 22 | 100 |
| | | % within GoGo-SN CEPH | 78.0% | 22.0% | 100.0% |

| | | Value | Asymptotic Standard Error | Approximate T$^b$ | Approximate Significance |
|---|---|---|---|---|---|
| Ordinal by Ordinal | Gamma | -.615 | .332 | -1.911 | .056 |
| Measure of Agreement | Kappa | -.139 | .067 | -1.447 | .148 |
| N of Valid Cases | | 100 | | | |

**Table 6:** Reliability statistics of nasolabial angle(LateralCeph vs Photograph).

| **NASOLABIAL ANGLE CEPH * NASOLABIALANGLECEPH1** | | | | | |
|---|---|---|---|---|---|
| P<0.0001* | | | **NASOLABIALANGLECEPH1** | | **Total** |
| | | | .00 | 1.00 | |
| NASOLABIAL ANGLE CEPH | 0 | **Count** | 34 | 11 | 45 |
| | | % within NASOLABIAL ANGLE CEPH | 75.6% | 24.4% | 100.0% |
| | 1 | Count | 11 | 44 | 55 |
| | | % within NASOLABIAL ANGLE CEPH | 20.0% | 80.0% | 100.0% |
| Total | | Count | 45 | 55 | 100 |
| | | % within NASOLABIAL ANGLE CEPH | 45.0% | 55.0% | 100.0% |

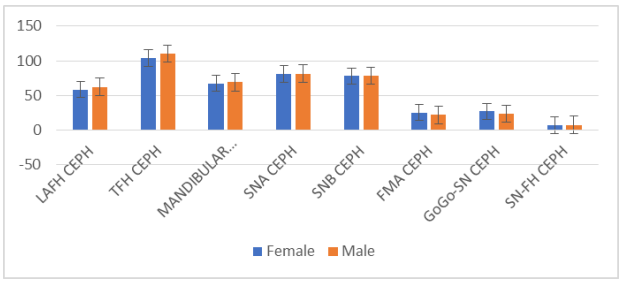
| | | Value | Asymptotic Standard Error | Approximate T$^b$ | Approximate Significance |
|---|---|---|---|---|---|
| Ordinal by Ordinal | Gamma | .850 | .067 | 6.576 | .000 |
| Measure of Agreement | Kappa | .556 | .084 | 5.556 | .000 |
| N of Valid Cases | | 100 | | | |

**Table 7:** Gender-wise comparison between soft tissue parameters.

| | | **N** | **Mean** | **Std. D** | **95% Confidence Interval for Mean** | | **F Score** | **P Value** |
|---|---|---|---|---|---|---|---|---|
| | | | | | **Lower Bound** | **Upper Bound** | | |
| S-Upper Lip CEPH | Female | 66 | 1.21 | 1.463 | .85 | 1.57 | 1.113 | .294 |
| | Male | 34 | 1.56 | 1.727 | .96 | 2.16 | | |
| | Total | 100 | 1.33 | 1.557 | 1.02 | 1.64 | | |
| S-Lower Lip CEPH | Female | 66 | 1.88 | 2.012 | 1.38 | 2.37 | .086 | .770 |
| | Male | 34 | 2.00 | 1.859 | 1.35 | 2.65 | | |
| | Total | 100 | 1.92 | 1.952 | 1.53 | 2.31 | | |
| NASOLABIAL ANGLE CEPH | Female | 66 | 100.41 | 9.508 | 98.07 | 102.75 | .965 | .328 |
| | Male | 34 | 98.15 | 13.246 | 93.53 | 102.77 | | |
| | Total | 100 | 99.64 | 10.909 | 97.48 | 101.80 | | |

**Table 8:** Gender-wise comparison between hard tissue parameters.

| | | N | Mean | Std. Deviation | 95% Confidence Interval for Mean | | F Score | P Value |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound | | |
| LAFH CEPH | Female | 66 | 58.74 | 4.507 | 57.63 | 59.85 | 14.974 | <0.0001* |
| | Male | 34 | 62.56 | 4.980 | 60.82 | 64.30 | | |
| | Total | 100 | 60.04 | 4.991 | 59.05 | 61.03 | | |
| TFH CEPH | Female | 66 | 103.98 | 6.022 | 102.50 | 105.47 | 27.536 | <0.0001* |
| | Male | 34 | 110.47 | 5.512 | 108.55 | 112.39 | | |
| | Total | 100 | 106.19 | 6.593 | 104.88 | 107.50 | | |
| MANDIBULAR LENGTH CEPH | Female | 66 | 67.38 | 5.197 | 66.10 | 68.66 | 2.253 | .137 |
| | Male | 34 | 69.15 | 6.267 | 66.96 | 71.33 | | |
| | Total | 100 | 67.98 | 5.616 | 66.87 | 69.09 | | |
| SNA CEPH | Female | 66 | 81.20 | 5.100 | 79.94 | 82.45 | .004 | .947 |
| | Male | 34 | 81.26 | 4.114 | 79.83 | 82.70 | | |
| | Total | 100 | 81.22 | 4.766 | 80.27 | 82.17 | | |
| SNB CEPH | Female | 66 | 78.06 | 4.346 | 76.99 | 79.13 | .156 | .694 |
| | Male | 34 | 78.41 | 3.940 | 77.04 | 79.79 | | |
| | Total | 100 | 78.18 | 4.196 | 77.35 | 79.01 | | |
| FMA CEPH | Female | 66 | 25.47 | 4.618 | 24.33 | 26.61 | 12.647 | .001* |
| | Male | 34 | 21.91 | 4.969 | 20.18 | 23.65 | | |
| | Total | 100 | 24.26 | 5.010 | 23.27 | 25.25 | | |
| GoGo-SN CEPH | Female | 66 | 26.95 | 4.799 | 25.77 | 28.13 | 9.550 | .003* |
| | Male | 34 | 23.85 | 4.665 | 22.23 | 25.48 | | |
| | Total | 100 | 25.90 | 4.955 | 24.92 | 26.88 | | |
| SN-FH CEPH | Female | 66 | 7.24 | 3.574 | 6.36 | 8.12 | .289 | .592 |
| | Male | 34 | 7.71 | 4.933 | 5.98 | 9.43 | | |
| | Total | 100 | 7.40 | 4.068 | 6.59 | 8.21 | | |




Graph 2: Gender-wise comparison between hard tissue parameters.

facial photographs. The study was conducted on a sample of 100 (66 females, 34 males) lateral cephalograms and their analogous lateral facial photographs in an age range of 10-35 years (mean age of 22.38±3.342 years). 6 angular and 5 linear parameters were taken.

On gender wise comparison of cephalometric and photographic parameters(Tables 7 and 8), a statistically significant difference was noted in LAFH(LAFH'), TFH (TFH'), FMA (FH'-ML'),and GoGn-SN (CP-ML') ($p \leq 0.001$), with males showing higher significant difference than females. Similar statistical results were seen by Gomes LDCR et al.,(2013).[4] Fernandez R et al.,(2003).[5] Ferrario et al.,(2002, 1993)[6] and Bishara(1995)[7] in their studies where they found out that males showed higher statistical significant difference than females concerning facial heights and vertical measurements. This study also showed no significant difference concerning ML(ML'), SNA(TN'A'), SNB(TN'B'),and SN-FH(CP-FH').

### *4.1. LAFH(Lower anterior facial height)*

It is a linear parameter measured from ANS-Me on lateral cephalograms and Sn-Me' on their analogous lateral facial photographs. LAFH showed no statistically significant difference($p>0.05$) on comparing both the values, but it showed a higher significant difference ($p \leq 0.001$) in males compared to females. A similar significant difference was seen in the study by Gomes LDCR et al.,(2013)[4], Fernandez R et al.,(2003).[5] Ferrario et al.,(2002,1993).[6] and Bishara et al.,(1995)[7] that showed higher male significant difference than females. The mean value for LAFH was 60.04±4.99 in cephalometrics and 58.88±5.95 in the analogous facial photographs. In this study, LAFH showed no correlation($p<0.05$) in both techniques. Similar results were seen in the studies by Khan W A et al.,(2018).[8] and Gomes et al.,(2013).[4] that showed a low coefficient of correlation.

### 4.2. TFH(Total facial height)

A linear measurement from N to Me on lateral cephalogram & N' to ME' on analogous photographs. TFH showed a significant difference(P>0.05) on comparing both variables but showed a significant difference(P<0.001) on genderwise comparison, showing higher SD in males than in females. A similar significant difference was seen in the study by Gomes LDCR et al.,(2013).[4] Fernandez R et al.,(2003)[5],Ferrario et al.,(2002,1993)[6] and Bishara et al.,(1995).[7] showed a higher male significant difference than females. The mean for TFH onlateral cephalogram is 106.19±6.59 and 104.28±8.28 on their analogous photographs. The study showed no significant correlation in the measurements(P<0). The same was also concluded by Xhang X et al.,(2007).[2]

### 4.3. Mandibular length(ML)

A linear measurement from Go-Gn on lateral cephalogram and M'-Me'on analogous photographs. ML showed no statistically significant difference(P>0.05) in both lateral cephalogram and photographic measurements. 98±5.61 and 66.74 ±7.71 in photographic measurements. This study showed no significant correlation between the measurement of lateral cephalogram and the analogous photographs. Near similar results of low correlation were seen in a study by Gupta S et al.,(2018).[9]

### 4.4. SNB(Table 4)

An angular parameter was measured from S-N-point B on the lateral cephalogram and from T-N-B on analogous photographs. This analogous parameter showed a statistically significant difference between the groups(P<0.05) and no significant difference in the gender wise comparison(P>0.05). The mean value for SNB in lateral cephalogram measurement was 78.18 ±4.19 and in the analogous photographs was 75.78 ±5.35. The study showed a moderate correlation for both the measurements SNB and TNB. Similar results were seen by Xhang Z et al.,(2007).[2] Khan WA et al., in 2018[8], Tariq S et al., 2023 in their study had concluded of positive correlation.

### 4.5. SNA(Table 3)

It is a hard tissue angular parameter measured from S-N-A in lateral cephalograms and T-N'A' on the analogous lateral facial photographs. This angular parameter showed no statistically significant difference(p>0.05). The cephalometric mean for SNA was 81.22±4.76 and 79.96±4.64was the statistical mean for TN'A'. This study showed positive correlation for both techniques. Similar results were seen in the study by Xhang Z et al.,(2007).[2] on the white population. The study by Khan W A(2018).[8] showed a moderate correlation of SNA angle with its analogous TN'A'.

### 4.6. FMA

It is an angular parameter taken from the FH plane and tangent to the lower border of the mandible on the lateral cephalogram and is measured from the FH plane and MP plane on an analogous photograph. This parameter showed no significant difference(P>0.05) on comparison but showed a high SD(P=0.001) on gender-wise comparison. This study showed no correlation between lateral cephalogram measurement & the same from analogous facial photographs. Similar results were seen in the study by Xhang Z et al.,(2007).[2]

### 4.7. SN-MP(CP-MP')(Table 5)

It is an angular measurement from Steiner's mandibular plane (Go-Gn) with SN plane on the lateral cephalogram and MP' with CP' on analogous lateral facial photographs. This angular parameter showed a statistically significant difference(p<0.001) with a higher significant difference in males than in females. The mean value of SN-MP in the lateral cephalogram was 26.95±4.799 and that in the analogous lateral photograph was 23.85±4.665. in this study, SN-MP vs CP-MP' showed high statistical correlation(p<0.001). Similar results were seen in a study by Zhang X et al.,(2007).[2] Praveen M et al.,(2023).[10] and Banerjee S et al.,(2019).[11]

### 4.8. SN-FH(CP-FH')

This is an angular parameter measured between 2 planes SN plane and FH plane in the lateral cephalograms and the CP plane to FH' plane on the analogous facial photographs. SN-FH showed a statistically significant difference(p<0.001).The statistical mean for lateral cephalogram was 7.4±4.06 and for photographs was 18.29±4.32. This parameter showed no significant correlation between cephalometric and photogrammetric values. The difference in the position of "Sella" on the lateral cephalogram and "Tragus" on photographs determine different positions of the SN plane and CP plane respectively. Thus due to the difference in positions of both the planes, the SN-FH vs CP-FH' angles showed no correlation statistically in either technique.

### 4.9. Nasolabial Angle(NL angle)(Table 6)

A soft tissue profile parameter of Mc Namara analysis was used to determine facial harmony. This parameter indicates the position of the maxillary skeletal bone, maxillary dentoalveolar area in the anterior region, upper lip thickness, and alar base inclination. It is the angle formed from the tangent to the alar base of the nose to the tangent to the vermillion border of the upper lip. The nasolabial angle

showed no statistically significant difference(p>0.05). The mean value for nasolabial angle in lateral cephalogram was 99.64±10.909 and that for the analogous lateral photographs was 100.21±9.732. nasolabial angle being a soft tissue parameter showed high correlation in both the technique. Similar results were seen in the studies by Bharathy S V et al.,(2023).[12] Oliveria et al.,(2013).[13] Bergmann R T et al.,(2014).[14] Hasan M et al.,(2016).[15] and Fernandez P R et al.,(2003).[5]

### *4.10. S-line to Upper Lip(Table 1)*

This is a soft tissue linear measurement of Steiner's analysis. It is measured from the S-line to the vermillion border of the upper lip. It is used to measure the protrusion and retrusion of the upper lip to the S-line. The S-line is a line joining the "S" of the nose to the Pog'. The study showed no statistically significant difference in both techniques(p>0.05). The mean values are 1.33±1.557 for lateral cephalogram and 1.53±2.24 for their analogous photographs. In this study, there was a higher correlation seen between both variables. S-line being a soft tissue parameter showed no to very little difference in the positioning on the lateral cephalogram and the analogous facial photograph. S-line to upper lip being a linear measurement thus showed no difference in measurements on lateral cephalogram and their analogous lateral facial photographs.

### *4.11. S-line to Lower Lip(Table 2)*

Linear measurement of Steiner's analysis, measured from the S-line to the vermillion border of the lower lip. This linear measurement is used to measure the retrusion and protrusion of the lower lip with the S-line. A line joining the "S" of the nose to the Pog' is referred to as the S-line. This variable showed no significant difference statistically(p>0.05). the mean cephalometric value was found to be 1.95±1.952 and the photographical mean was1.69±1.850. This study showed a high statistical correlation between the values of both techniques. A high correlation was due to similar positions in both lateral cephalograms and their analogous lateral facial photographs.

## 5. Conclusion

India as a country is still growing and luxurious cephalometric equipment is not available everywhere. The photographic method can be beneficial where radiation is contraindicated or needs to be avoided. Further research needs to be conducted to test the diagnostic skill of the acquired photographs. This study was conducted to make orthodontic diagnosis and treatment accessible to the remote areas of the state of Odisha where there are no provisions for lateral cephalograms. Photography being a reproducible and non-invasive method has its access to every operator. The provision for photography can be done in every operatory setup without the risk of radiation hazards, even in remote areas, giving proper diagnosis aids in better treatment.

## 6. Ethical Approval

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## 7. Source of Funding

None.

## 8. Conflict of Interest

None.

## References

1. Shraddha K, Shailesh S, Prakash M, Robin M, Sandeep S, Rohit K. Correlation between Cephalometric and Facial Photographic Measurements of Craniofacial Form-A Cross Sectional Study. *Med J Clin Trials Case Stud*. 2020;4(3):254–7.
2. Zhang X, MH, Graham G, Kirchner HL, Redline S. Redline S. Correlations Between Cephalometric And Facial Photographic Measurements Of Craniofacial Form. *Am J Orthod Dentofacial Orthop*. 2007;131(1):67–71.
3. Rudee DA. Proportional profile changes concurrent with orthodontic therapy. *Am J Orthod*. 1964;50(6):421–34.
4. Gomes L, Horta KOC, Gandini LG, Goncalves M, Goncalves JR. Photographic Assessment of Cephalometric Measurements. *Angle Orthod*. 2013;83(6):1049–58.
5. Riveiro PF, Chamosa ES, Quintanilla DS, Cunqueiro MS. Angular photogrammetric analysis of the soft tissue facial profile. *Eur J Orthod* . 2003;25(4):393–9.
6. Ferrario VF, Graziano S, Ciusa V, Morini M, Sforza C. Cephalometric and In Vivo Measurements of Maxillomandibular Anteroposterior Discrepancies: A Preliminary Regression Study. *Angle Orthod.* 2002;72(6):579–84.
7. Bishara SE, Jorgensen GJ, Jakobsen JR. Changes In Facial Dimensions Assessed From Lateral And Frontal Photographs. Part I-Methodology. *Am J Orthod Dentofac Orthop*. 1995;108(4):389–93.
8. Khan WA, Faisal SS, Hussain SS, Annals Abbasi Shaheed Hosp & Karachi Med & Dent Coll. Correlation of craniofacial measurements between cephalometric radiographs and facial photographs. *Ann* . 2018;23(1):37–45.
9. Gupta S, Ahuja S, Bhambri E, Sharma S, Goyal A, Kalia H. Lateral photographs versus lateral cephalograms: role in assessment of craniofacial morphology. *Int J Curr Res*. 2018;10(9):73343–7.
10. Parveen M, Muralidhar NV, Kiran J, Raghunath N. Photogrammetry Versus Cephalometric Analysis in Orthodontic Diagnosis and Treatment Planning. *Res Square*. 2022;p. 1–16. doi:10.21203/rs.3.rs-1571230/v1.
11. Banerjee S, Ray S, Narayan SV, Seth S, Jana D. A Comparative Study of Photographic and Cephalometric Measurements in Adult Female Bengalee Population. *J Dent Med Sci*. 2019;18(5):33–9.
12. Bharathy SV, Jain A, Sharma P, Sharma M. Evaluation of correlation between cephalometric analysis and photographic facial analysis . *Int J Sci Res*. 2023;12(6):19–21.
13. Oliveria MT, Candemil A. Assessment of correlation between cephalometric and facial analysis. *J Res Dent*. 2013;1(1):34.
14. Bergman RT, Waschak J, Farhani AB, Murphy NC. Longitudinal study of cephalometric soft tissue profile traits between the ages 6 and 18 years. Angle's orthodontics. *Angle Orthod* . 2014;84(1):48–55.
15. Hasan M, Durrani OK, Khan K, Ali RK, Tasneem SI, Bashir U. Can photographs replace lateral cephalograms? An evaluation

of orthodontic clinician's ability to assess selected cephalometric readings from extra-oral photographs. *Pak Orthod J*. 2016;8(1):2–6.

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