The Reliability of soft tissue profile analysis comparing photoshop and cephalometric measurements in maxillary protrusion patients

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The Reliability of Soft Tissue Profile Analysis Using Standardized Photographs Compared to Cephalometric Radiographs in Maxillary Protrusion Adult Patients

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ABSTRACT

Aim: Cephalometric x-ray is considered as a crucial step in orthodontic diagnosis and treatment planning. However, patients nowadays, especially those pursuing cosmetic goals, are concerned about radiation dosages as a result of increased understanding of its hazards. Therefore, the aim of this study is to provide a simple reliable, affordable and reproducible way to evaluate the soft tissue measures for creating an orthodontic treatment plan. Methods: Comparing standardized profile photographs and lateral cephalograms were obtained from twenty-eight patients with maxillary protrusion having an age range between 14 – 24 years. Evaluation and comparison were done for cephalometric radiographs by using webceph software as well as their corresponding standardized photographs using Adobe photoshop software, the compared outcomes were Nasolabial angle, Mentolabial angle, Upper lip protrusion/ E-line and Lower lip protrusion/ E-line. Results: Upon comparing soft tissue analysis using cephalometric radiographs and standardized photographs, it was proven that photographs are reliable for soft tissue analysis with insignificant difference between the two techniques. Conclusion: Although cephalograms provide precise measurements, unnecessary radiation exposure can be avoided by using photographic analysis. It is safer, quicker and affordable. It has been demonstrated that the photographic approach is reliable and reproducible. The photographic approach, with a uniform methodology, is a useful substitute for lateral cephalograms, particularly in situations when a non-invasive, affordable solution is required as soft tissue analysis not in skeletal analysis.

1. INTRODUCTION

One of the most crucial phases in orthodontic management is treatment planning. Prior to this, a precise diagnosis is essential which necessitates constructing patient database utilizing case history, clinical examination, and diagnostic tools including study models, radiographs and photographs. The five most important orthodontic treatment objectives are dental esthetics, stability, functional occlusion and periodontal health. However, the majority of individuals seek orthodontic care to improve their facial aesthetics.(1)

The Cephalometric radiograph is one of the fundamental elements of the diagnostic tools used for orthodontic treatment.(2) Radiographic examinations play an essential part of dental practice. However, patients will unavoidably receive some radiation during orthodontic treatment.

Orthodontists have long held the belief that adhering to cephalometric norms will produce more aesthetically pleasing results. However, the growing demand for aesthetic standards forced orthodontists to question whether ideal cephalometric measures are truly resembling facial aesthetics.(3)

The radiation dosage from a lateral cephalogram is only 3 Sv, which is considerably less than the 1 mSv annually recommended dose by the International Commission of Radiologic Protection (ICRP) however, any reduction in the amount of radiation exposed to patients would be advantageous.(3)

Recently experience has proven that the aim of aesthetic treatment should be perceived clinically or observed via photographs. Although cephalometrics has benefits, patients will only be satisfied if there is a comparable improvement in their face profile. A therapeutic strategy based on a patient’s profile has thus become the standard.

The purpose of this study is to compare the precision of soft tissue analysis using standardized photographs compared to cephalometric radiographs to provide a non-invasive, non-radiographic, and affordable alternative to reduce radiation exposure among orthodontic patients.

Sample Size Calculation:

Sample size calculation was performed by comparing nasolabial angle measured from cephalometric radiograph to that obtained from the photographs in patients with maxillary protrusion (pre and post retraction).
and the difference between them). Searching the literature failed to find any previous studies similar to the present study. Therefore, a pilot study was performed where the Mean±SD of the change of the nasolabial angle in cephalometric xray was approximately 5°±3 degrees, while that obtained from photographs was approximately 6°±3 degrees. Accordingly, it was calculated that the minimum proper sample size was 24 participants to be able to detect a real difference of 2 degree with 80% power at α= 0.05 level using Student’s t test for independent samples.

2. MATERIALS AND METHODS

The purpose of this study is to compare soft tissue analysis using lateral cephalometric radiographs to those measured from standardized profile photographs to ascertain the reliability of photographic analysis for orthodontic diagnosis.

Method of collection of data: This prospective clinical trial was carried out on twenty-eight female patients according to the pilot study that was made with minimum thirteen patients per group. The current study was conducted in the clinic of the Orthodontic Department, Faculty of Dentistry, Future University in Egypt.

Lateral radiographs and photographs are routinely acquired for diagnostic purposes that were obtained prior to treatment.

Cephalometric x-rays were obtained with the patient’s head in natural head position (NHP) and the horizontal Frankfort plane parallel to the floor. As required, digital lateral cephalograms were archived to be compared to photographic analysis. On the other hand, standardized lateral images of the patient’s profile in natural head position (NHP) were taken for the photographic method.

Before orthodontic treatment and after anterior segment retraction, lateral cephalograms were recorded with the lips relaxed and teeth occluded. The WEPCeph analysis (Figure: 2 and 3) software was used to trace and analyze each cephalometric radiograph. The utilized cephalometric machine: ORTHOPHOS XG PLUS Dentsply Sirona (parameters of the machine are 77 kV and 14 mA).

Before and after retraction, photographs of the subject’s profile were taken. Each participant’s photographs were captured by the same investigator under the same conditions, and Adobe Photoshop4(2012) software was used to analyze outcomes and treatment changes. This program was utilized globally for modifying and analyzing photographs. This study evaluated nasolabial, mentolabial, upper and lower lip protrusion to the E-line.

Extra-oral images were captured using a Digital camera (SLR Nikon D3200), Macro Ring Flash (VILITROX JY670N ITTL), and Macro-Lens (Sigma 105 mm). In addition, a Tripod was provided for stabilizing the camera. A chair was included in the arrangement, and a viewer (white light source) was placed behind the patient’s head to prevent shadows during the photographing process. For the finest image quality, a manual setting (f6, 1/200, ISO400) and flash (Macro Ring flash) were used. The patients were instructed to bite in maximum occlusion with their lips in the resting position. A tripod was adjusted based on the subject’s height to determine the midline of the patient’s face. A ruler was fixed on a white viewer behind the patients’ head to allow all the measurements to be calibrated at life size (1:1).

The recordings are calibrated for life size (1:1) using the same tools in both radiographic and photographic images. All measurements are computed automatically by the software once the appropriate landmarks have been accurately identified on radiographs while manually by identifying the points, lines and angles on photographs by Adobe photoshop software.

The following outcomes were evaluated for both cephalometric radiographs using Webceph software program and photographs analysis using Adobe photoshop software program.

1. Nasolabial angle: Measure of nasolabial angle (angle formed by a line tangent to the columella through the subnasale and by a line tangent to the upper lip passing through the labial superius) (Figure:6).

2. Mentolabial angle: It is the anterior angle formed by the intersection of a tangent to the lower lip (sublabiale to labrale inferius) and a tangent to the upper part of the soft tissue chin pad (sublabiale to soft tissue pogonion) (Figure:7).

3. Upper lip protrusion/ E-plane: evaluation of lip prominence to the esthetic line (the E-line) (nose-chin line) by joining the tip of the nose and the most prominent point on the soft- tissue chin in profile view. Protrusion of the upper lip in relation to E-line (esthetic line) defined as the horizontal distance between Labrale-Superius (Ls) and E-line which considered as tangent from the tip of the nose to the chin (Figure:4).

4. Lower lip protrusion/ E-plane defined as: Protrusion of the lower lip in relation to E-line (esthetic line) is defined as the horizontal distance between Labrale-Inferius (Ls) and E-line which considered as tangent from the tip of the nose to the chin (Figure:5).
Statistical methods:

Data were statistically described in terms of mean ± standard deviation (±SD), median and range when appropriate. Numerical data were tested for the normal assumption using Kolmogorov Smirnov test. Comparison between the study groups was done using paired t test. Two-sided p values less than 0.05 was considered statistically significant. IBM SPSS (Statistical Package for the Social Science; IBM Corp, Armonk, NY, USA) release 22 for Microsoft Windows was used for all statistical analyses.

3. RESULTS

The change in the nasolabial angle after anterior teeth retraction was 12.7°±7.3° and 12.4°±7.6° using photographs and cephalometric radiographs respectively with a mean of difference of (0.3°±) which was statistically insignificant (p value 0.766). While, the change in the mentolabial angle using photographs was 10.5°±8.2° while it was 10.8°±8° using cephalometric radiographs with a mean of difference of (0.3°±) which was also statistically insignificant (p value 0.07). The change in the position of the upper lip was -2.69mm ±1.38mm and -2.4±1.35mm using photographs and cephalometric radiographs respectively with a mean difference of (0.29mm ±) which was statistically insignificant (p value =0.69). The change in the position of the lower lip using photographs was -4.1 mm ±2mm while using cephalometric analysis was -4.1mm ±2.07mm with a mean of difference of (0mm) which was statistically insignificant (p value 0.88).
Table 1. Comparison between cephalometric and photographic soft tissue measurements before and after anterior teeth retraction.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Photographic measures</th>
<th>Cephalometric measures</th>
<th>P-value</th>
<th>Mean</th>
<th>SD</th>
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<th>SD</th>
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<tr>
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<tr>
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<tr>
<td>Pre-retraction</td>
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<td>0.93°</td>
<td>125.4°</td>
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<td>0.1°</td>
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<td>0.98°</td>
<td>136.3°</td>
<td>13.6°</td>
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<td>0.08°</td>
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<td>8°</td>
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<td>Upper lip/ E-line</td>
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<tr>
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4. DISCUSSION

For orthodontists to develop the most effective treatment plan for each patient, accurate record-keeping is crucial. Cephalometry is a valid method for analyzing the skeletal and soft tissue craniofacial morphology. Nevertheless, it is costly and technique-sensitive. Moreover, it exposes patients, particularly children, to radiation. (14) Even though the amount of radiation caused by a lateral cephalogram is relatively low, it is always preferable to avoid exposure to radiation as much as possible because there is no threshold dose below which there is no risk of biological injury. Especially in developing countries, where there is no risk of radiation, cephalometric analysis can serve as a viable substitute for cephalometric analysis. By standardizing the photographic analysis protocol, multiple studies have demonstrated the technique’s reliability. (19)

A standard photography protocol necessitates a lateral facial photograph, i.e., a photograph taken at an angle of 90 degrees from the right side of the patient’s face with the head in its natural position. (19) Also the precise establishment considered very essential. In this investigation, the same operator identified the landmarks using Adobe Photoshop software for analysis, as it’s used in many previous studies. (15,20) where it was accurate and reliable, while Prasanna R T.R. et al. (2020), FACAD software was used to analyze photographs of soft tissue by drawing the locations of certain spots of interest.

Many studies (15,18,20) demonstrate the reproducibility of photographic analyses, conflicting results have been obtained regarding whether photographic analysis can serve as a viable substitute for cephalometric analysis. By measuring macro esthetic outcomes (linear and angular), this study compared conventional lateral photographs to their corresponding cephalograms in an effort to answer this question. Regarding the results, When the cephalometric method was compared to the photographic method for soft tissue analysis, it was found that the two methods yielded similar results, demonstrating that images are trustworthy for soft tissue analysis, while According to Patel D. and Trivedi R. (2013) discovered positive and statistically significant relationships between all of the cephalometric and photographic characteristics throughout the full sample. (21)
5. CONCLUSION

Although cephalograms provide precise measurements, unnecessary radiation exposure can be avoided by using photographic analysis. It is safer, quicker and affordable.

It has been demonstrated that the photographic approach is repeatable and reliable. The photographic approach, with a standardization, is a useful substitute for lateral cephalograms, especially in cases when skeletal analysis is not required a non-invasive, affordable solution will be needed.

This research’s findings were:

- Equivalent cephalometric and photographic measures were shown to have extremely significant correlations for practically all the outcomes that were evaluated. (Figure:8 and 9), (Table 1).
- This photographic approach was verified as trustworthy and reproducible.

6. REFERENCES

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