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Soft Tissue Angular and Linear Measurements in Kanpur Population

Running Title: Devang Dwivedi et al
Original Study / Research Paper

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Abstract:-

Introduction: Since the invention of the cephalostat and the standardization of the radiographic technique, facial photography has been used as an adjunct in anthropometric research and orthodontics clinical practice. However, radioprotection concerns have led researchers to rediscover photography. Having a low-tech, low-cost method to evaluate craniofacial morphology would therefore be advantageous.

The patient's standardized right lateral image was used to identify Burstone's cephalometric soft tissue landmarks, and several parameters were measured to confirm their validity in photometry.

Materials & Methods: There were 150 participants in this prospective study, and a thorough case history was obtained. The natural head position (NHP), with the lips at rest and the maximum intercuspation, was used to obtain standard right profile pictures. The tripod that a mirror was suspended from allowed for vertical adjustments in accordance with the subject's height, enabling the acquisition of an NHP. Patients were instructed to take one step behind a line drawn 120 cm from the mirror, with their feet slightly apart, their arms at their sides, and their posture relaxed. Patients were advised to walk forward while maintaining a straight-ahead gaze into their reflection in the mirror in order to assume the ortho stance. They were also instructed to tilt their heads up and down with decreasing amplitude until they felt comfortable doing so.

Results: The measured Parameters amongst various linear and angular measurements falls in the normal range of Burstone's analysis.

Conclusion: It was discovered that the results of the linear and angular values agreed with the Legan and Burstone values for cephalometric investigations. Standardized facial photography serves as a less invasive and better understood diagnostic tool for the patient. According to the findings of the current study, lateral facial photography may serve as an effective diagnostic tool that will aid in the patient's treatment planning.

Keywords:- *Cephalometric, Anthropometric, Photography.*

I. INTRODUCTION

The increase in the awareness of patients regarding the aesthetic consciousness has become the primary reason for most of the patients to seek orthodontic treatment. In order to properly treat patients and satisfy both their practical and aesthetic demands, there is a major need to comprehend and formalize the aesthetic norms in various groups.1

Roentgenographic cephalometrics, which combined craniometrics and radiography, was first introduced by Broadbent in 1931. Cephalometrics still offers crucial diagnostic data about the interrelationship between skeletal and dental structures nowadays. Traditional roentgenographic cephalometrics examines the soft-tissue profile as well as the sagittal, vertical, and transverse interactions between the skeletal and dental structures. Cephalometrics is the industry standard for describing dental and skeletal craniofacial morphology in clinical practice, although it may not be feasible for extensive epidemiologic investigations. First off, cephalogram patients are exposed to a lot less radiation. Second, a radiation source and a head holder are necessary for accurate cephalometrics.2

The majority of reports on dentofacial alterations have been based on cephalometric data, and many analyses have been created to interpret the diagnostic data offered by lateral cephalograms. Cephalograms, on the other hand, only record the anterior-most outline of the soft tissue structures and record them in profile. Patients are also not used to examining or deciphering cephalograms or their tracings. The soft tissues of the face can be more accurately conventionally documented by photos.4

The identification of an aesthetic ideal has frequently employed photographs. Researchers lately rediscover photography as a result of radio protection concerns5. Due to the fact that some aspects of facial appearance are correlated with the morphology of the underlying hard tissues, it would

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be advantageous to have a low-tech, low-cost method to assess craniofacial morphology. Standardized facial photography may be a useful tool for describing craniofacial anatomy.

This study involved 150 patients from Kanpur, with the aim of identifying Burstone's cephalometric soft tissue landmarks on patients' standardized right lateral photographs and measuring various metrics to verify their validity in photometry.

II. AIMS AND OBJECTIVES

- The aim of study was to trace and establish various soft tissue angular and linear measurements as described by Legan HL and Burstone CJ (1965) for cephalometric analyses, on standardized right lateral photographs of patients and compare the mean values given by Burstone analysis on the cephalograms to that found in the current study on photographs.
- A total of 150 subjects belonging to Kanpur were randomly selected for the study and their photographs were taken after taking their consent.
- The following parameters amongst the various linear and angular measurements of the Burstone's soft tissue analysis was selected for the study and located on the patients photograph:-

✓ Facial Convexity Angle (G-Sn-Pg) representing Facial Form.
✓ Lower Face Throat Angle (Sn-Gn-C).
✓ Nasolabial angle (Cm-Sn-Ls) representing Lip position and Form.
✓ Upper Lip Protrusion Ls to (Sn-Pg).
✓ Lower Lip Protrusion Li to (Sn-Pg).
✓ Labio-mental sulcus (Depth of the sulcus to Li-Pg Line).

III. PATIENTS AND METHODS

In this prospective study a total of 150 participants (89-Males and 61-females) between the age group of 17-26 years were randomly selected visiting our Department of Oral and Maxillofacial Surgery, Rama Dental College, Hospital & Research Centre, Kanpur for general check-up and treatments.

A. Inclusion Criteria:
- Patients willing to participate in the study.
- Patients belonging from the Kanpur district.
- Patients not undergoing any orthodontic treatment.

B. Exclusion Criteria:
- Medically compromised patients.
- Patients unwilling to participate in the study.
- Patients with Prosthodontics replacements of natural teeth.
- Patients with pathological abnormalities of bone.
- Patients having any severe facial scars as a result of previous burn or trauma.

IV. METHOD OF STUDY

A thorough case history was obtained, and standardized right profile photos were taken with the intercuspation at its greatest in the natural head position (NHP). The patient's face, neck, and ears were made apparent by taking off her glasses and piling her hair high on her head. A tripod was used to hang a mirror in order to get an NHP since it allowed for vertical changes based on the subject's height. Patients were instructed to stand one step behind a line drawn 120 cm from the mirror while keeping their feet slightly apart, keeping their arms at their sides, and maintaining a relaxed posture. Patients were told to take a step forward and remain gazing straight ahead into the reflection of their eyes in the mirror while tilting their head up and down with decreasing amplitude until they felt calm to attain the "orthoposition.". All photographs were taken using the same digital camera (NIKON-D 5100) fitted with the same lens (18-55mm, 70-300 macro lens).

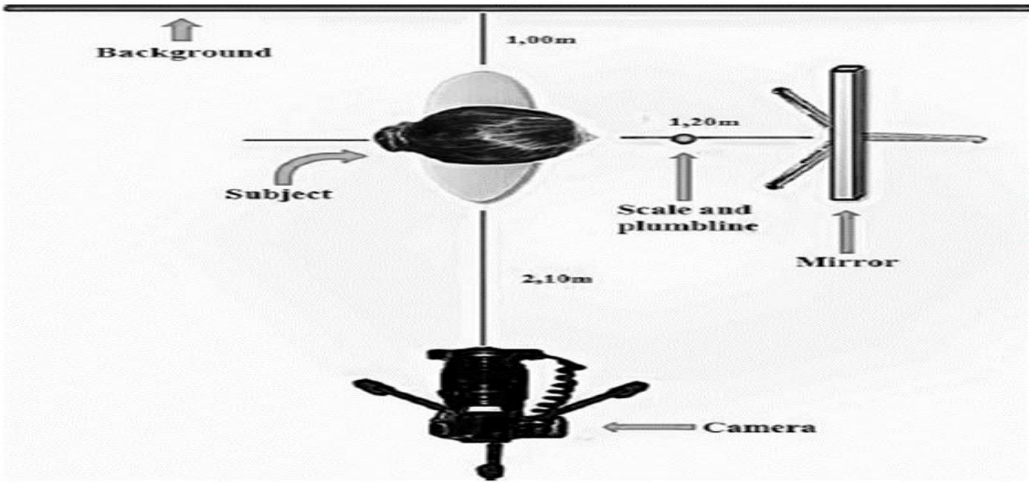

Fig. 1: Photographic Set-U[3]

ISSN No:-2456-2165

For stabilization and height-adjustment, the camera was fixed to a tripod. To prevent facial distortions and preserve natural proportions, a 100-mm macro lens was chosen. Given the local lighting conditions, the camera was operated manually to produce the best possible images.

Following selection, the patients' photos were traced using the Burstones soft tissue landmarks shown below.

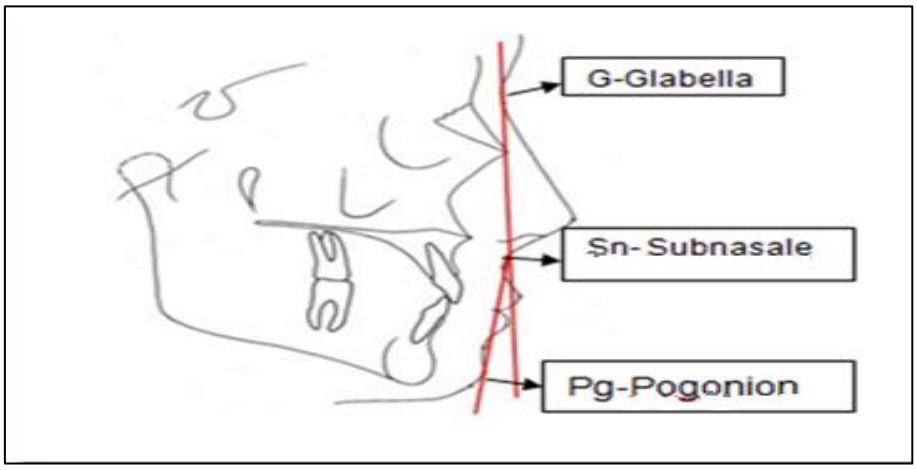

Fig. 2: Facial Convexity Angle (G-SN-Pg) representing Facial Form

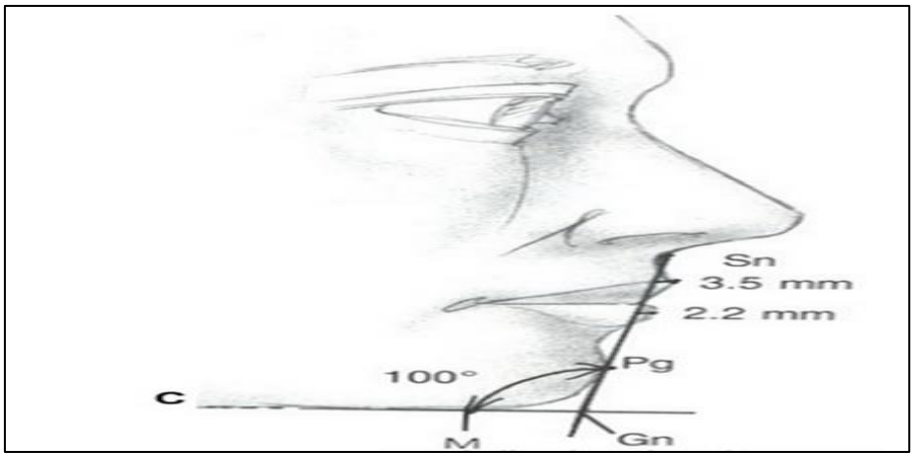

Fig. 3: Lower Face Throat Angle (Sn-Gn-C)

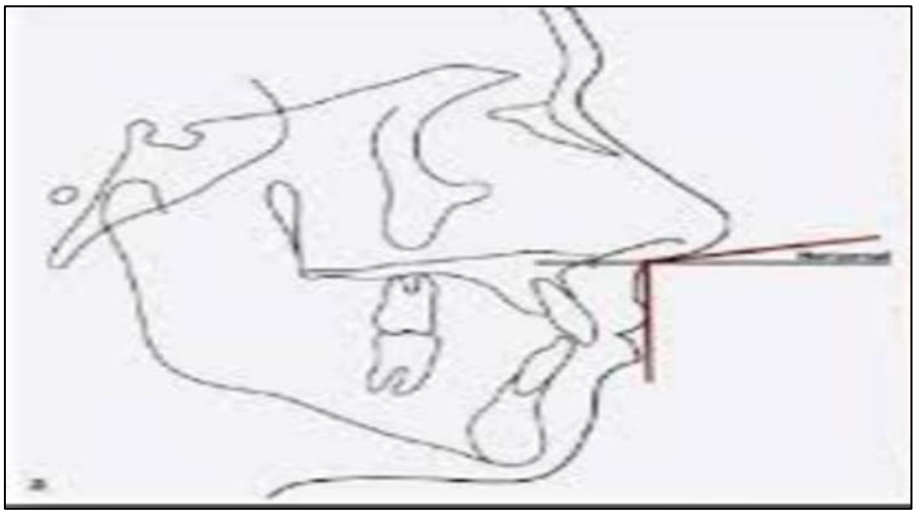

Fig. 4: Nasolabial Angle (Cm-Sn-Ls) representing Lip position and Form

ISSN No:-2456-2165

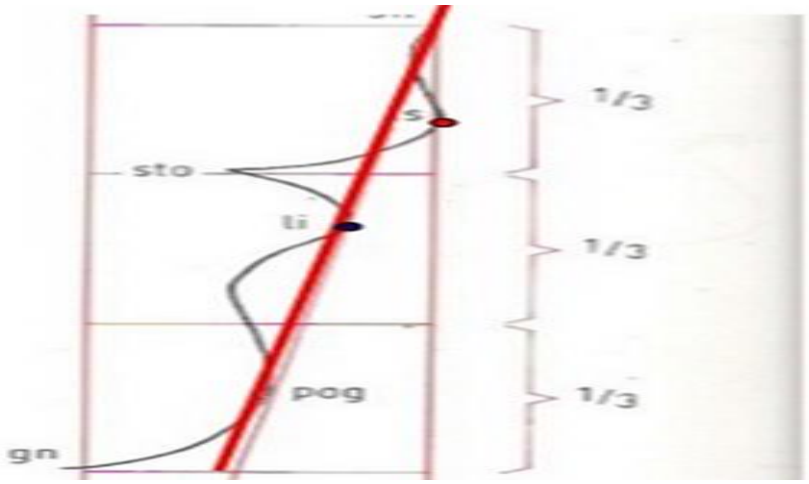

Fig. 5: Upper Lip Protrusion- Ls to (Sn-Pg)

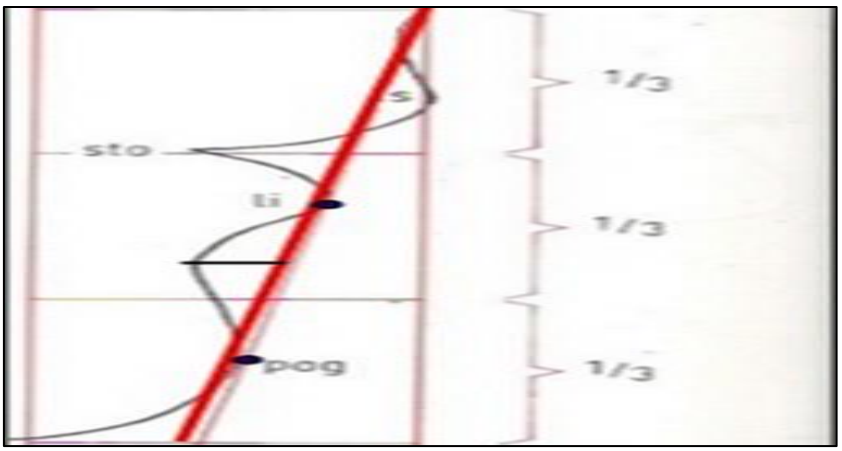

Fig. 6: Lower Lip Protrusion Li to (Sn-Pg) and Labio-mental sulcus (Depth of the sulcus to Li-Pg Line)

V. RESULTS

- The mean value of Burstone's soft tissue analysis for facial convexity angle (G-Sn-Pg) is 12 ± 4 °. In the current study when the facial convexity angle (G-Sn-Pg) was traced on right lateral photographs of all the 150 participants, its mean value was found to be 13° which falls in the normal range of Burstone's analysis (as depicted in Fig a).
- The mean value of Burstone's soft tissue analysis for lower face throat angle (Sn-Gn-C) is 100 ± 7 °. In the current study when the f lower face -throat angle (Sn-Gn-C) was traced on right lateral photographs of all the 150 participants, its mean value was found to be 102° which falls in the normal range of Burstone's analysis (as depicted in Fig b).

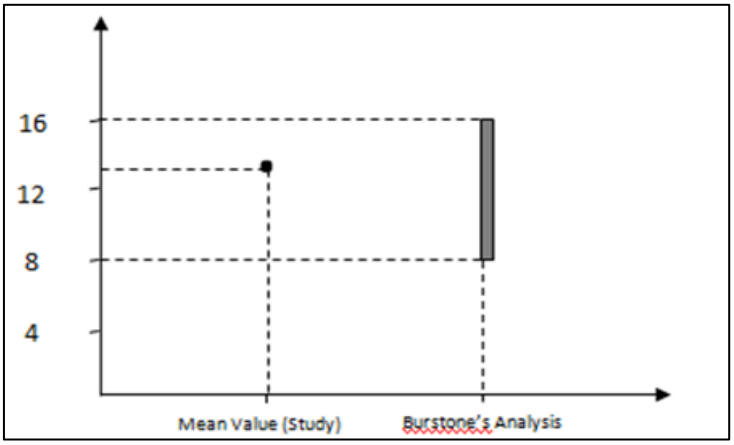

Fig. 7(a) Facial Convexity Angle (G-Sn-Pg)

ISSN No:-2456-2165

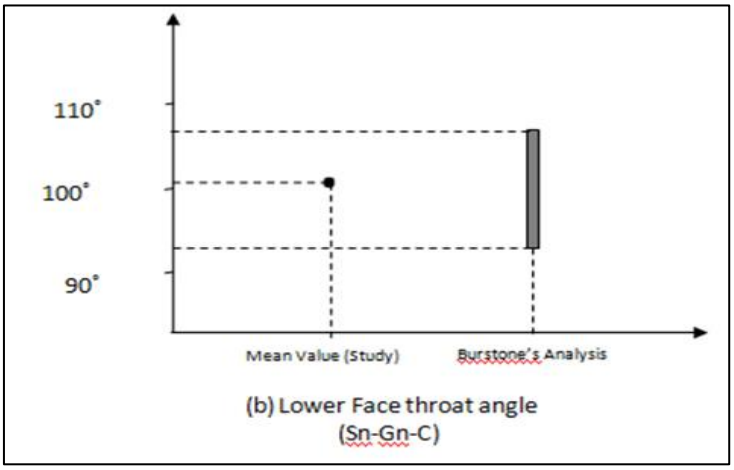

Fig. 7(b) Lower Face throat Angle (Sn-Gn-C)

- The mean value of Burstone's soft tissue analysis for Nasolabial angle (Cm-Sn-Ls) for Lip position and form is 102 ± 8 °. In the current study when the Nasolabial angle (Cm-Sn-Ls) was traced on right lateral photographs of all the 150 participants, its mean value was found to be 104° which falls in the normal range of Burstone's analysis (as depicted in Fig c).

- The mean value of Burstone's soft tissue analysis for Upper Lip Protrusion (Ls to Sn-Pg) is 3 ± 1mm. In the current study when Lip Protrusion (Ls to Sn-Pg) was traced on right lateral photographs of all the 150 participants, its mean value was found to be 3mm which falls in the normal range of Burstone's analysis (as depicted in Fig d).

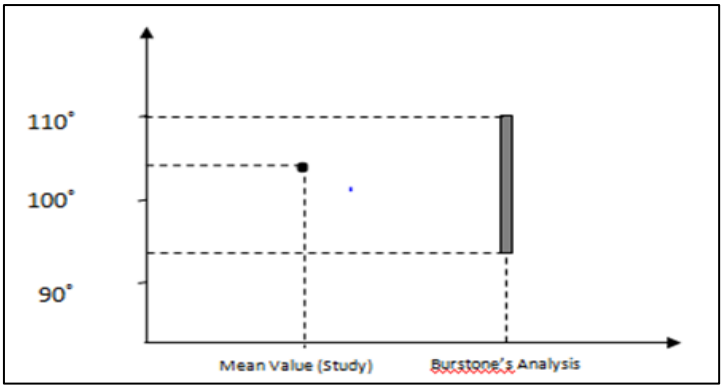

Fig. 7(c): Lip Position and form Nasolabial angle (Cm-Sn-Ls)

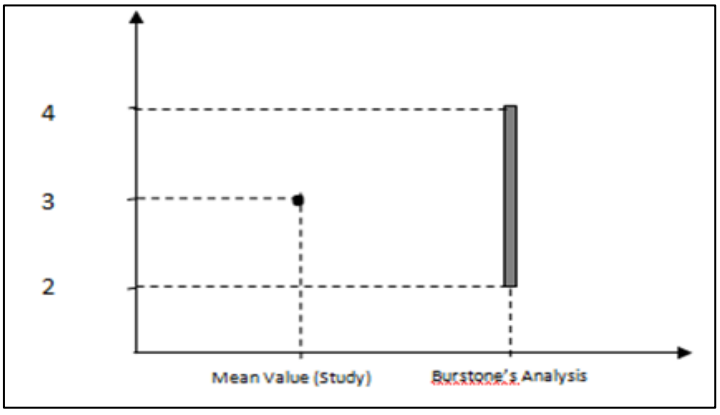

Fig. 7(d): Upper Lip Protrusion (Ls to Sn-Pg)

- The mean value of Burstone's soft tissue analysis for Lower Lip Protrusion (Li to Sn-Pg) is 2 ± 1mm. In the current study when the Lower Lip Protrusion (Li to Sn-Pg) was traced on right lateral photographs of all the 150 participants, its mean value was found to be 2mm which falls in the normal range of Burstone's analysis.

- The mean value of Burstone's soft tissue analysis for Mentolabial Sulcus [Sl to (Li-Pg)] is 4 ± 2mm. In the current study when the Mentolabial Sulcus [Sl to (Li-Pg)] was traced on right lateral photographs of all the 150 participants, its mean value was found to be 4mm which falls in the normal range of Burstone's analysis.

ISSN No:-2456-2165

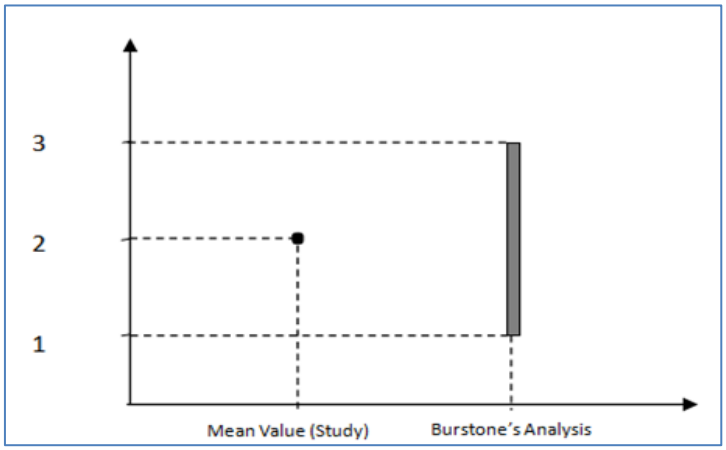

Fig. 7(e): Lower Lip Protrusion (Li to Sn-Pg)

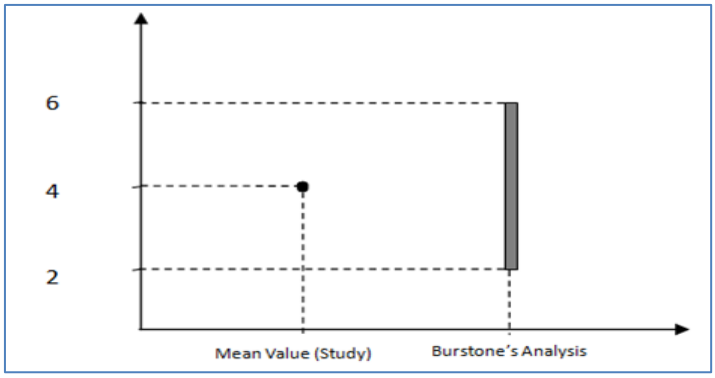

Fig. 7(f): Mentolabial Sulcus

VI. DISCUSSION

A definition of symmetry from Stedman's medical dictionary is "equality or correspondence in form of parts distributed around a center or an axis, at the two extremes or poles, or on the two opposite sides of the body." The degree of disparity or variation in a structure's qualitative and quantitative aspects, as well as both, is known as asymmetry.

Orthodontists evaluate facial attractiveness using lateral cephalograms in conjunction with facial pictures. X-ray scans help us grasp the link between the surface structures of the face and the skeletal and dental armature that supports them, which is seen in great detail in photographs of the face. Aside from being more accurate than lateral cephalograms, pictures are unquestionably far closer to the subject's natural state. In orthodontics, however, methods for standardized photographic orientation and quantitative evaluation of facial images are far less developed. Between the right and left halves of the face, there can be subtle to obvious asymmetry in the craniofacial complex (1).

The majority of orthodontists perform soft tissue evaluations on a daily basis primarily subconsciously and haphazardly. Nevertheless, in the current study, soft tissue face measurements were established by photogrammetric analysis to assist orthodontists in conducting more quantitative evaluation and making deliberate decisions.

The benefit of using oriented facial photographs in orthodontic studies is that, aside from initial diagnostic studies, one can compare the same person at different times of treatment or of his or her growth, as well as to compare different people and find similarities between them, defining these people as a distinct group.

When it comes to analyzing human profiles, photogrammetric analysis has several benefits. First off, unlike cephalometric analysis, photogrammetric analysis does not suffer from the effects of photographic enlargement on angular measurements (Malkoç et al., 2005a). Thus, the method can be applied in a clinical setting for both planning the course of therapy and assessing the outcomes of an operation on a patient.

In order to choose the best profile points, each profile point can be freely changed on a computer screen using the cephalometric software application. Last but not least, angular photogrammetric profile analysis delivers digitized findings that are simple to examine and does not necessitate costly equipment or laborious methods. The gathered information can also be arranged in unified charts.3

The current gold standard for skeletal craniofacial morphology diagnosis in orthodontics clinical practice is cephalometric analysis. However, because it is affordable and doesn't subject the patient to potentially dangerous radiation, the photographic assessment is a great diagnostic tool for epidemiologic research. The repeatability test revealed that the linear and angular metrics relevant for describing facial morphology can be accurately obtained from facial pictures, supporting earlier findings. This conclusion implies that photography may be a possible and useful substitute when radiography is deemed to be overly invasive or logistically

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unfeasible. For diagnosing craniofacial morphology, direct anthropometry is a useful alternative, but the standardized photographic method has a number of advantages. The duration of interaction with the subject may be shortened because there are no skin pressure-related inaccuracies and the patients are immobile, making it simpler to take measurements. Additionally, measurements are repeatable and data is permanently recorded, making longitudinal follow-up research possible. The photographic method, on the other hand, has significant drawbacks, such as the distortion brought on by the distance between the lens and the subject, which makes items close to the camera appear larger than those farther away. But only when comparing structures that are situated in various planes of space is this factor important. Most landmarks obtained from lateral photographs in the current study are at the midline, so this issue should minimally affect the measurements. In addition, angular variables were most commonly used, which partially overcomes the problem of magnification.[6]

Another potential error-causing factor is head position, which needs to be consistent throughout the radiography and photographic recording protocol. The placements of landmarks and measurement outcomes can be significantly impacted by even a small NHP variance. Additionally, opening the mouth or tensing the lip due to mentalis muscle constriction may make matters worse.3

Cephalometric and photographic measures of the face were compared by Zhang X et al. The relationships between cephalometric and photographic measures, while statistically significant, suggested that these modalities measure various aspects of facial morphology and should not be compared to one another.

There is no objective justification for the selection based on a "good" soft tissue profile because the primary goal was to obtain the linkages between the lips and the chin, which was indicated earlier. There is a large level of subjectivity in how the facial profile is perceived, as various authors have noted in their writings (Arnett and Bergman, 1993). The subject's photograph was reviewed and arranged by three authors before the measurements were interpreted, and a decision was made as to which subject should be included in the study based on their consensus. Quality elements weren't taken into consideration, and the criteria were determined based on the aesthetic harmony of the facial features.

In this study, it was determined that the photographic assessment of soft tissue cephalometric values as described by Legan HL and Burstone CJ (1965) for cephalometric analyses, when located on standardized photographs, were within the acceptable range.

Therefore, standardized photographic techniques for the assessment of soft tissue abnormalities can be employed more frequently because they limit the radiation exposure to patients and also provide a more clear and comprehensible method of interpretation for patients than cephalograms do.

VII. CONCLUSION

This study was performed with an aim to check for the validity of linear and angular measurements as given by Legan HL and Burstone CJ, which traced and measured right lateral photographs of the patients. The results of the linear and angular values were found to be in accordance with the Legan and Burstone values for cephalometric analyses.

Therefore the diagnostic importance of photography cannot be laid up.

As standardized facial photography is a non-invasive[5] and forms a more understandable diagnostic aid for the patient, and on the basis of outcome of study, it can be assumed that lateral facial photography could form an appropriate diagnostic aid which would be helpful in treatment planning of the patient.

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