Cephalometric Analysis Difference Between Skeletal and Soft Tissue Measurements

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ABSTRACT

Objective: To compare the skeletal and soft tissue measurements of the dento-facial region in a cephalometric study done in the Pakistani population.

Study Design: Comparative cross-sectional study.

Place and Duration of Study: Armed Forces Institute of Dentistry, Rawalpindi Pakistan, from Feb to Aug 2019.

Methodology: Total 160 subjects were enrolled in the study. Lateral cephalograms were recorded for all the study participants in natural head position. Patients were divided into Class I, II, and III according to the skeletal pattern. The distances of skeletal and soft tissue landmarks relative to the respective norm values and the angles between the Nasion Sella line and Frankfurt horizontal to the natural head position were measured and compared in the three classes using chi-square.

Results: Out of 160 patients, 96 (60%) patients were males, and 64 (40%) were females. In our study, 92 (57.5%) patients were classed in class I, 46 (28.75%) in class II and 22 (13.75%) in class III. The mean score of A point, Nasion, and B point angle was 7.5 ± 1.112, while the beta angle was 30.5 ± 2.214. The mean score of facial convexity angle was 14.1 ± 2.124, while the mean vertical height ratio was 1.05 ± 0.11. Both skeletal and soft tissue measurements significantly predict the skeletal pattern and discrepancy (p-value <0.001).

Conclusion: Lateral cephalograms and radiography measures emerged as reliable techniques to classify the patients in various skeletal patterns. Factors like age and gender do not influence skeletal discrepancies.

Keywords: Cephalometry, Skeletal measurements, Soft-tissue measurements.

How to Cite This Article: *Mehmood S, Jan A, Ijaz M, Ghaffar F, Bibi K, Tariq A. Cephalometric Analysis Difference between Skeletal and Soft Tissue Measurements. Pak Armed Forces Med J 2022; 72(3): 900-903. DOI: https://doi.org/10.51253/pafmj.v72i3.4539*

INTRODUCTION

Dentistry is an evolving field in our part of the world with recognized subspecialties, each dealing with a separate aspect of this diverse field. Orthodontics is a widely practised speciality in our country. The primary domain of orthodontics has been the occlusion problems faced by the patients.[1] Orthodontics achieved a different level of professionalism after using cephalograms in routine clinical practice for the collisional problems.[2] Various discrepancies have been noted among the skeletal architecture of patients and a normal population that can be picked up clinically and confirmed on the cephalograms with the use of different measurements and angles accepted universally.[3-5]

Common skeletal measurements include A point, nasion, B point (ANB) and beta angle. ANB angle has been used to assess the relationship of the posterior part of the maxilla with the mandible bone for a long. Riedle was the first to use this method in 1952.[6] Sagittal dysplasias can be picked up with accuracy. Beta angle is a relatively new method to assess the sagittal discrepancies.[7] Beta angles between 27 and 35 can be considered class-I. More acute indicates class-II and more obtuse is classed as class-III.[8] Methods of soft tissue measurements include facial form and facial convexity angle midface protrusion, lower face protrusion, soft tissue chin thickness and many others.[9]

The choice of method for evaluating sagittal discrepancies depends upon the cephalometric facilities available and the preference of the treating orthodontist. All the methods have their own merits and demerits. A recent study comparing the two methods concluded that both skeletal and soft tissue measurements have a strong relationship in predicting the sagittal discrepancy. It also proved that natural head position (NHP) is reproducible and accurate when recorded with the mandible in CR. Linear norms for skeletal class-I subjects about NTVL were established.[10]

Studies done in the west cannot be generalized to our population. Some work has been done in our country in cephalometric studies, but that revolves around the study of various skeletal measurements, not soft tissue measurements. Therefore, this study was planned at the Armed Forces Institute of Dentistry to compare the skeletal and soft tissue measurements

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Received: 16 Jun 2020; revision received: 18 Jun 2021; accepted: 21 Jun 2021

of the dentofacial region in a cephalometric study done on the Pakistani population.

METHODOLOGY

This comparative cross-sectional study was conducted at the Orthodontics Department of Armed forces Institute of Dentistry (AFID) Rawalpindi Pakistan from February to August 2019. The sample size was calculated by WHO sample size calculator using population proportion of sagittal maxillomandibular relation using natural head posture as 30%,[11] by keeping the margin of error as 10%. A consecutive sampling technique was used to gather the sample.

Inclusion Criteria: Subjects between the age of 12 and 30 years who presented in the Orthodontics Department, AFID and underwent cephalometry were included in the study.

Exclusion Criteria: Patients with any congenital facial malformations, including cleft lip, cleft palate, or any facial region abnormality, patients with facial asymmetry were part of the exclusion criteria. Those who had undergone any recent maxillofacial surgery were also not included in the study. Pregnant women or those diagnosed with any endocrine or medical problems affecting the bones or skeleton were not included in the analysis. Subjects who refused to give written informed consent for the study or undergoing the procedure of cephalometry were also excluded at the start of this study.

After ethical approval from the Ethical Review Board committee (905/Trg-ABP1k2) and written informed consent from potential participants, subjects were evaluated in detail by the consultant orthodontist and enrolled in the study after applying inclusion and exclusion criteria. A lateral cephalometric radiograph for each participant was taken in centric occlusion with lips in rest position. A single person (SM) did the cephalometric tracing onto acetate tracing paper using a 0.3mm pencil. ANB angle was the angle between the deepest midline point in the curved bony outline from the base to the alveolar process of the maxilla, the most anterior point of the front nasal suture in the median plane and the most posterior point in the outer contour of the mandibular alveolar process, in the median plane. Beta angle was the angle between the perpendicular line from the deepest midline point in the curved bony outline from the base to the alveolar process of the maxilla to the head of the condyle and the line between the most posterior points in the outer contour of the mandibular alveolar process, in the median plane.[12-14] Facial convexity angle and vertical height ratio were the soft tissue measurements used in our study. They were measured by the routine standard method.[15]

Subjects were classed in different skeletal patterns and categories in the following manner; class-I: incisor relationship, straight or slight convex but esthetically pleasing profile, ANB angle between 2° and 4°, Wits appraisal −3 to +3 mm, Beta angle 27° to 35°, Yen angle 117° to 123°, W angle 51° to 56°. Class-II: incisor relationship, convex profile, ANB >4°, Wits appraisal > +3 mm, Beta angle <27°, Yen angle <117°, Wangle <51°. class-III: incisor relationship, concave profile, ANB <2°, Wits appraisal <−3 mm, Beta angle >35°, Yen angle >123°, W angle >56°. Patients who matched at least five criteria out of 7 were classified accordingly.[16]

All statistical analysis was performed using the Statistics Package for Social Sciences version24.0 (SPSS-24.0). Frequency and percentages for gender and classes of skeletal discrepancy were calculated. Mean and standard deviation for age and ANB, Facial convexity angle, vertical height ratio and beta angle scores were calculated for all the subjects. The chi-square test was used to look at the relationship of ANB angle scores, beta angle scores, Facial convexity angle, vertical height ratio, age and gender with different classes of skeletal discrepancies. The *p*-value <0.05 was considered significant to ascertain the significance of the relationship between parameters.

RESULTS

A total of 165 patients were initially approached to get them included in the analysis. Unfortunately, five patients could not fulfil the inclusion/exclusion criteria, so they were not included in the analysis from the start of the study. Out of 160, 96 (60%) patients were males, and 64 (40%) were females. The mean age of the patients was 26.3 ± 3.326 years (Table-I). In our study, 92 (57.5%) patients were classed in class-I, 46 (28.75%) in class-II and 22 (13.75%) in class-III. The mean score of ANB angles among the patients was 7.3 ± 1.131. The mean score for beta angles in the study participants was 31.1 ± 1.144. The mean score for facial convexity angle in the study participants was 14.1 ± 2.124. The mean score for vertical height ratio in the study participants was 1.05 ± 0.11. When chi-square was applied, soft tissue and skeletal measurements emerged as equally effective methods to evaluate the sagittal skeletal discrepancies. At the same time, age and gender had no significant relationship with the

class of skeletal discrepancy among the subjects studied in our analysis (Table-II).

Table-I: Characteristics of study participants with skeletal discrepancies.

Characteristics	Values
Age (Years)	
Mean ± SD	26.3 ± 3.326 years
Range (min-max)	12 years – 29years
Gender	
Male	96 (60%)
Female	64 (40%)
Class of Skeletal Discrepancy	
Class I	92 (57.5%)
Class II	46 (28.75%)
Class III	22 (13.75%)
Mean A Point, Nasion, B Point Angle Score	7.5 ± 1.112
Mean Beta Angle Score	30.5 ± 2.214
Mean Facial Convexity Angle	14.1 ± 2.124
Mean Vertical Height Ratio	1.05 ± 0.11

Table-II: Factors linked with different classes of skeletal discrepancies.

Factors Total, n=160	Class I n (%) 92 (57.5)	Class II n (%) 46 (28.7)	Class III n (%) 22 (13.8)	*p*-value
Age				
<18 years	44 (47.8%)	19 (41.3%)	09 (40.9%)	0.704
18-30 years	48(52.2%)	27 (58.7%)	13 (59.1%)	
Gender				
Male	50 (54.3%)	30 (65.2%)	16 (72.7%)	0.192
Female	42 (45.7%)	16 (34.8%)	06 (27.3%)	
A Point, Nasion, B Point Angle Scores				
1-4	81 (88.1%)	25 (54.3%)	09 (40.9%)	<0.001
<1 or >4	11 (11.9%)	21 (45.7%)	13 (59.1%)	
Beta Angle Scores				
27-35	76 (82.6%)	25 (54.3%)	07 (31.8%)	<0.001
<27 or >35	16 (17.4%)	21 (45.7%)	15 (68.2%)	
Facial Convexity Angle Scores				
12.5-14.5	71 (77.2%)	29 (63.1%)	10 (45.4%)	0.011
<12.4 or >14.5	21 (22.8%)	17 (36.9%)	12 (54.6%)	
Vertical Height Ratio				
50-55%	68 (73.9%)	19 (41.3%)	06 (27.3%)	<0.001
<50% or >55%	24 (26.1%)	27 (58.6%)	16 (72.7%)	

DISCUSSION

Orthodontics is a speciality linked with skeletal problems of the jaw and related apparatus. Cephalometry has revolutionized the orthodontics speciality. Various landmarks can be studied with this non-invasive technique, and much information can be generated regarding the functional anatomy of the facial region. The clinicians and researchers apply various measurements of different planes and angles to find the best way to predict the malocclusions among the patients and the average population.[17] Race, nutri-tional factors, genetic factors, early trauma and presence of comorbid illness may affect the skeletal architecture of the facial region and result in the problems relating to its proper functioning.[18] Usually many abnormalities remain unnoticed until there is a gross problem in appearance or functioning related to the jaw or related apparatus. Sometimes patients come with other dental or medical conditions and get diagnosed with the skeletal discrepancy. Various methods have been used to classify the patients with this discrepancy. This study was the plan to compare the role of skeletal and soft tissue measurements in evaluating the sagittal skeletal discrepancy in a cephalometric study done in the Pakistani population at the Armed forces institute of dentistry.

Multiple methods have been used to identify and classify skeletal discrepancies. Skeletal measurements were the commonly used modality in most of the studies as well as clinical settings. In our study, both the methods used to evaluate the sagittal skeletal discrepancy merged as accurate methods and significantly found differences in various classes of skeletal discrepancies. Similar results have been produced in the studies done in the past by Latif *et al,* in 2015 and Singh *et al,* in 2013 in various world populations.[10,11] This highlights the fact that accurate screening and timely diagnosis of the sagittal skeletal discrepancy are important. However, the method used has little significance, and soft tissue and skeletal measurements can be used.

Most of the patients in our analysis belonged to class-I followed by classes II and III. These findings differ slightly from the studies done in the past by Singh *et al,* in 2013 and Ahangar Atashi *et al,* in 2008.[11,12] Many factors could account for this finding. Most important are the study design and the inclusion criteria. Most of our study participants were normal people not diagnosed with any dental or medical problem, so they fell in class-I of skeletal discrepancies. A pure population-based study or a case-control study can throw more light on this phenomenon.

Most of our study participants were males. It may be due to sampling from a military dental setup instead of a routine public sector hospital. Gender was not associated with the class of skeletal discrepancy in our study. Previously a study done in Iran by Ahangar Atashi *et al,*[12] in 2008 showed a significant difference in soft tissue measurements of both genders. Studies with large sample sizes and in a public sector hospital,

giving an equal chance to the whole population to get enrolled may generate different results in this regard.

LIMITATIONS OF STUDY

Our study had some limitations. Though inclusion/ exclusion criteria were strict, the effect of nutritional status and family history was not considered before classifying the subjects in different skeletal patterns. There are various other methods of classifying sagittal skeletal discrepancies which were not studied in this analysis. The sampling technique was neither reflective of patients nor the normal population. The sample size was also not very large. Further studies with a better design and sample from the public and private sectors may generate more generalizable results.

CONCLUSION

Sagittal skeletal discrepancies can be evaluated with accuracy using soft tissue and skeletal measurements. Lateral cephalograms and radiography measures emerged as reliable techniques to classify the patients in various skeletal patterns. Factors like age and gender do not influence skeletal discrepancies.

Conflict of Interest: None.

Author's Contribution

SM:, FG: Data collection, AJ:, AT: Proof Reading, MI: Statical analysis, KB: Manuscript writing.

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