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Correlation of skeletal and dental parameter in Sagittal plane

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Abstract---Background: The skeletal correlations in a sagittal plane do not correlate to the dental relationship each time. For orthodontic treatment planning, differential identification In the past, the terms overjet and overbite were used to examine sagittal jaw connections. The goal of the study was to see how closely a dental characteristic (overjet) correlated with skeletal angles (ANB, WITTS). Objectives: This research aims to see if occlusal characteristics are used in evaluating

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cranial and facial connections in the vertical and sagittal planes. The sagittal connection of upper with lower teeth is studied using the metrics overjet. Methodology: This study is done at the orthodontics department, Institute of Dentistry, LUMHS, Jamshoro. The total sample size was 110, random sampling technique was utilized to select the subject. For the patients coming to the orthodontic department data was collected from previous and new patients. The overjet and overbite value will be measured on dental casts using vernier caliper. The impression of patient will be taken by irreversible hydrocolloid and the cast will be poured with orthodontic hard plaster. This study also includes pre-treatment digital cephalometric xrays. The lateral cephalometric xrays are taken with patients Frankfort plane surface parallel with the floor, lower Jaw is placed in centric occlusal relationship and lips at resting position. The distance between the Xray source and the item is 150 centimeters, while the distance between the object and the film plane is 15centimetres. Every radiological film is to be transcribed on a standardized transparent acetate trace paper measuring 8 X 10 inches, with the help of a lead pencil, over a light illuminator view, geometric box with a transparent metric ruler. The data will be analyzed using computer software SPSS Version 24.0" (IBM Corp, Armonk NY USA). The qualitative variable will be showed in form of frequency and percentage like gender, age and Bar charts will be used to show the trends of relationship among ANB, Witts and Overjet. Results: The correlation of OJ with ANB is positive association (r= 0.293 with P-value > 0.05), the OJ with WITTS correlation is also positive association (r= 0.417, P-value > 0.05). The correlation of OJ with ANB is usually weak when compared with the correlation of OJ with WITTS. Conclusion: Overjet and overbite are good predictors for sagittal skeletal and vertical relationship, according to this study.

Keywords---overjet, ANB, WITTS, sagittal skeletal, vertical parameter.

Introduction

Man has been Attempting to alter man into his image since God created him in his image. Attempts to modify one's face look have been documented throughout history. The issue of what defines a normal face like the question of what constitutes beauty will almost definitely never be addressed in a free society.[1] While correcting the Oro-facial deviation, orthodontists have adopted cephalometric measurement as a standard for diagnosis and treatment planning.[2] Taking a correct history from the patient, as in general dentistry, is followed by thorough clinical analysis and diagnostic evaluation, such as dental cast models, radiographic analysis, and photographs, that provide the dentist with an idea of a patient's overall medical status and accurate diagnosis.[3,4,5]. The goal of clinical investigation is to assess the class and severity of misaligned teeth and to identify whether the problem is of Craniofacial or dental origin. This could help in diagnostic procedures. [5,6]

Overjet is a clinically assessed linear variable which helps in evaluation of sagittal correlation of the maxillary and mandibular arches. Skeletal, dental, or a combination of factors might lead to overjet.[7] Increased Overjet is thought to be caused by a growth deficiency of mandibula or Mandibular teeth or by an increased growth of maxilla or maxillary teeth rather than inadequate dental element alignment, although no major data on this has been published to far.[8] In addition to The facial profile, when making a decision about surgery or orthodontics at the end of growth. Analyses like the Steiner and Wits appraisal, a simple way to measure the severity or level a person has in their anteroposterior jaw dysplasia on their head film, can be used to get an accurate Measurement of the sagittal bone relationship between their jaws and their spines.[7] The ANB Measurement is utilized in Steiner's study to examine the sagittal skeletal connection. In a typical, well-proportioned face, it shows the size of the skeletal jaw discrepancy and varies from 1 to 5 degrees.[9] The ANB viewpoint, on the other hand, has significant drawbacks. If the nasion's

Anteroposterior and vertical location, as well as the vertical height of the face, are modified, a false value can be reported.[10] Between the patient's centric occlusion and centric relation, the SN plane and ANB angle fluctuation.[11] There is a link between overjet and various cephalometric parameters In distinct forms of malocclusion. The link between overjet, ANB, and Wits evaluation was explored by Zupancic and colleagues. With a "r" value of 0.690, the study revealed a substantial positive association between overjet and ANB, as well as a "r" value of 0.750 between overjet and Wit's assessment. In class II division I malocclusions, over-jet can be a statistically significant analyst of sagittal skeletal connection. However, the outcomes for other forms of malocclusions Weren't really promising.[5] In contrast to the facial profile, overjet is an important criterion when deciding on surgical or orthodontic intervention in teenagers who have passed their growth spurt. If the over-jet is > 10-mm, surgery is usually the best therapeutic choice.[12] In persons with Class III malocclusions, Over-jet on the other hand, isn't always a reliable indicator of the jaw Relationship in the sagittal plane.[13] Cephalometric analysis is needed to get an accurate picture of jaw relationship because different malocclusions may look the same when only study casts are looked.

A detailed cephalometric investigation, on the other hand, might reveal the difference among different classes of mal occlusion. Therefore, in sagittal plane the skeletal and dental relationships the mal-occlusion does not show much variations as in Class I dental relationships which have been found to be the source of the most disagreements.[14] Whenever extractions are required, cephalometric data has been discovered to have a significant influence on how the therapy progresses.[15] Sagittal jaw correlations are assessed using a variety of cephalometric Measurements.[16] Whether the upper or lower jaw is in the right place is determined by the SNA (sella, nasion, A point), which shows if the maxilla is in the right place. The SNB (sella, nasion, B point) shows if the mandible is in the right place.[17] The angle between mandibular plane to sella nasion plane is usually 32 degrees (SD = 5 degrees; Riedel,1952), but it has some effect on the sagittal plane reliability of the ANB when it comes to the jaw relationships.[19] The Wits assessment can be used to get more information. This measurement is a linear one that helps with the analysis of ANB and the evaluation of jaw

interactions in the sagittal plane, which is why this measurement is important. In and of itself, it isn't a review of anything. In order to get a 20 Wits, score on anteroposterior connections, you need to be very specific about the occlusal plane and its angle.[21] There is another way to check for sagittal jaw connections: Ricketts analysis of the convexity at point A, which is the innermost point on the outer contour of the maxilla between the anterior nasal spine and each of its teeth. This is the point where the maxilla meets the incisor. Convexity of the middle face is measured from point A to point

Literature review

The use of technology in imaging and orthodontics has a long history of influencing biological sciences and biologists. The mechanics of orthodontics have been altered by advancements in arch wires, bracket, and band. Improvements in image analysis have shifted our perspectives. The radiographic imaging is a scientific method for examining craniofacial development over time and how orthodontic treatment impacts the biomechanics.[42] An accurate and extensive description of examination findings, intra and extra-oral clinical examinations, structural models, radiography, and cephalometric and pictorial studies is essential in order to establish a precise orthodontic diagnosis.[43]

During the 1930s, cephalometric radiographs was introduced in orthodontics. Roentgens in 1895 discovery of X-rays, 1895 is the start of the era of radiographic Cephalometry. It was described as the measurement of the skull based on the radiography image's bony and soft tissue land marks.[2] The Cephalometric radiograph is just a head radiograph obtained in a Cephalometer (Cephalostat), A head-holding equipment was designed by Holly Broadbent Sr. In the United States in 1931.[44] On radiographic films, the Cephalometer is taken to generate standardized craniofacial imaging. Craniometry, or the scientific measurement of bony skulls in connection to craniology, and anthropometry, or the scientific measurements and proportions of the human body, are combined in this technique. The drawback is that it creates a 2-dimensional representation of a 3 dimensional Structures.

The antero-posterior connection in between maxilla and mandible is a very essential feature that must be assessed in order to establish a correct diagnostic and treatment strategy.[16,20] Sagittal Discrepancy must be corrected in order to provide a balanced profile after orthodontic treatment. The antero-posterior relationships of the upper jaw to the lower jaw is assessed using a variety of methods (Overbite, SNA, Overjet etc.).[20,46,47,48]. When the Overjet is more to 10mm, surgical option is usually The better.[7,50] He came to the conclusion that Overjet isn't a reliable indicator of malocclusion (Class I, Class II, and Class III) in the sagittal plane for skeletal connections, and that OJ and ANB have a weak correlation (r=0.257). This was most likely due to the reality that the inclination of The upper and lower incisors affect OJ more than ANB.[29] The anteroposterior position of the Nasion, the incline of SN plane, as well as the inclination of the jaws all influence ANB.[51] The slope of the Occlusal plane is another element that can change the width of ANB even if the connection among the jaws stays unchanged.

Importance of history and records in orthodontics

The recognition of what is known as malocclusion is the focus of orthodontic diagnostics. It entails the systematic collection of patient data to aid in the identification of the problem's origin and source.[57] The right diagnosis is the first step toward successful orthodontic therapy. An interview with the patient, an examination, and the gathering of relevant records are all part of the diagnosis process. The orthodontist must have a full database for each patient at the end of this process. An issue list is generated from this database, which is then turned into therapy goals. Following that, a therapy strategy based on the therapeutic goals might be devised.[58] Eliciting and documenting important data from the patients and parents to help with in overall diagnosis of cases is known as case history. Patients' personal information, chief complaint history, past health, dental, behavioural histories. The tmj disorders, and dental hygiene status are all included in this section. The oral history aids in determining the attitude of the patients and their parents toward dental health. It also indicates the nature of the patient's previous dental exposure and attitude.[59] The orthodontist and general dentist must work together to; maintain a high degree of oral hygiene in order for orthodontic treatment to be accepted.

Orthodontic therapy cannot be performed in the presence of current dental disease when treating any dental pathology. Teeth extraction as part of an orthodontic treatment protocol. Arranging any necessary restorative procedures, either before Or after orthodontic treatment. Evaluating the occlusal consequences of early tooth loss caused by caries or trauma.[60] Malocclusion can be caused by a variety of factors, including habits.[61] A habit could also put you at a higher risk of root recession after orthodontic treatment. The history questionnaire must include information on the presence of any habits. Extraoral and intraoral examinations are part of the clinical evaluation. Extra-oral examination is essential for determining appropriate facial dimensions and distinguishing among normal and abnormal facial patterns. [62]

Cephalometry

Case analysis in orthodontics is a method that involves examining the interactions between the face's component elements in order to assess their balance and harmony. The purpose of this is to discuss the case analysis, especially in light of the information that can be obtained via using the cephalometric xray. Whenever a person's teeth acquire a mal-occlusion, he presents an issue that is significantly more complicated than the interaction between dental components. The relationships of all the component elements of the head, the level of tissue metabolism, and the external factors of the forces and all factors that must be considered while preparing an assessment. In art, comparative anatomy, anthropology, and orthodontia, the profile of the face has long been a factor. (Camper (1786) was among the first to quantify the face-to-head relationship. His study is credited as being the start of contemporary anthropometry science.[63] The angular connection of a plane passing between the external auditory meatus and the frontal nasal spine to plane tangent to forehead and face was measured by Camper et al. "In the human species, the angle formed by the facial or distinctive line of the face ranges between 70-80°," he stated. All of

the top is resolved by artistic criteria, whereas everything below resembles that of monkeys." Dental mal-occlusions

With skeletal abnormalities require the use of cephalometric radiographs for treatment and diagnosis. Serial cephalometric x-rays are to be used to analyse and anticipate development and growth of craniofacial structures, the progress of orthodontic treatment, surgical result of dental and facial deformity treatment, and changes before and after treatment.[64,65,66] Tracing of landmarks on acetate paper and analyzing the angular and linear measurements is how cephalometric analysis is done. Although it is most commonly and time consuming procedure used in orthodontics and vulnerable to both random or systematic error. Technical measurements of radiogaphs, and locating the landmarks are the most common sources of inaccuracies. The majority of mistakes occur during landmark recognition, which is impacted by clinical expertise and the density and sharpness of images.[67,68,69] The difficulty increases when a 3-dimensioned image is reduced to 2- dimensioned picture.[70] the digital radiographs and the manual film to a digital format have several benefits: they are simple to use, allows the execution of multiple analyses at the same time, for formulating the treatment, it occupies less storage space, and allow image superimpositions.[71,72,73] this software allows users to alter the image's size and contrast, as well as archive and improve access to photos.[70,74,75] Furthermore, when a direct digital cephalography is utilized for image collection, patients benefit from lower radiation doses as well as the removal of toxins and consequent environmental problems. However, there are certain disadvantages, such as the difficulty in identifying landmarks due to the 2-Dimensional depiction of a3-Dimensional structures, the superimposition of bilateral features, and the requirement for a digital ozonometric radiography machine as well as a software application. Furthermore, the resolution, pixel size, shades of grey (bit), and compression format all influence the quality of digital photo .[70]

Cephalates machine

The components of cephalate device are two rods, a forehead clamp, a cassette holding part, and a picture cassette with intensifier. The sagittal plane of the patient must be held parallel in relation to roentgen film, teeth should be in centric occlusion, as well as the Frankfort horizontal plane should be oriented in horizontal plane. The lateral cephalometric radiograph is largely employed in diagnostic and planning the treatment, especially with orthognathic surgery. It's a good idea to keep track of your symptoms before starting therapy, and you can use it to track your progress as well. It is utilized to identify the cause of mal-occlusion, whether it is caused by a skeletal or dental relationships. The radiographs are also utilized for research reasons and clinical justification. The Cephalometric radiograph then be traced manually or virtually, and examined to aid in diagnostic and planning procedures. Before Tracing the radiograph, it is important to inspect it for any pathology.[76,77,78,79].

Dental cast assessment

Orthodontic diagnostic therapy relies on dental impression casts.[123] Because, in addition to disclosing the patient's occlusal circumstances within 3 dimension,

which allows variety of analyses that aid in orthodontics planning. Analyzing space discrepancies between mix and permanent dentitions, which includes arches integrity, Bolton's discrepancies, and orthodontics set-up procedures.[124-125] The treatment and diagnosis have typically been done by using dental casts. Tooth size, arch length disparities, overjet, or deepbite are all measured and documented on a regular basis. [126-127] Earlier studies of the reproducibility of dental casts assessment and measurements are done with vernier callipers and plaster casts revealed that measurements related to system programmes using virtual digital models have the same or less variability as measurements based on vernier callipers and plaster casts.[128–129] When virtual digital approaches are compared to traditional techniques employing callipers and plaster casts, the accuracy of measuring for overjet and overbite shows varied findings. Traditional procedures are recognised as having adequate repeatability and are suitable for clinical usage.[128,130,131s]

When the overjet is increased in the individuals?

This is a serious concern, but as long as the arches are properly aligned, it must be fine. The overjet < 6mm is acceptable. If treatment for other reasons is required there must be reduction of overjet 4mm. The skeletal pattern in increased overjet can directly correlate with patterns classified as Class-I, II, or III. In the case of Class-II, the mandible is placed posteriorly in relation to the cranial base, which is common. In increased overjet patients would likely to have incompetent lips. When lips are incompetent there is no lip seal which influences incisor position. If the lower lip is dragged up behind the upper incisors, greater overjet may result; however, if the incisor teeth are retracted With in the control of the lower lip at the conclusion of treatment, prospects for OJ reduction seems favourable. There may be increased lower facial height, there may be antero posterior discrepancy, retrognathic/short mandible or restrict growth of mandible. Dental crowding may lead to an increased overjet, however crowding clearance would help and improves stability. During the thumb or pacifier sucking causes upper anterior to be proclined and lower anteriors to be retroclined.[134] As from labial side of the mandibular central teeth toward the labial and incisor border of the maxillary central teeth, Overjet was assessed straight toward the occlusal line.[135]

Aims and objectives

The goal of this research is to see whether occlusal characteristics may be utilised to identify the craniofacial connection in the sagittal and vertical planes. The sagittal and vertical connection of both upper and lower teeth is studied using the metrics over jet and overbite.

Null hypothesis (h_o)

In the sagittal and vertical planes, there is no link between occlusal traits and craniofacial skeletal elements.

Alternate hypothesis (h_1)

In both the sagittal and vertical planes, there is a link between occlusal characteristics and craniofacial structures.

Operational definitions

ANB: The ANB calculate the difference between the maxilla and the mandible. The angle formed by points A, nasion, and B.
Wits Analysis (WA): In the anterior and posterior planes, it is a measure of how closely the upper and lower jaws are linked to each other.
Overjet (OJ): It refers to the amount to which the upper anteriors overlap horizontally the lower anteriors in AP plane.

Material and Methods
Study design

It's cross-sectional study type.

Study duration

The research will begin 6 months after the summary has been approved.

Settings

This study will be conducted at Orthodontics department of LUMHS, jamshoro.

Sample size

The Sample size of current study is taken out by statistical RAO SOFTWARE and previous study's standard deviation of 12.91% with bound error and at a power of 80% and 95% confidence interval, the 130 population size which will be observed in study resulted in 98 total sample size. An additional 10% more case will be recruited to accommodate possible incomplete participation of participants. Therefore, the final sample size for this study is 110 participants.

Sample technique

Non-probability and convenient sampling technique.

Sample selection

Inclusion criteria

- Patient between ages 15-30 years.
- Both male and female subjects will be included.
- Subject with no history of orthodontic treatments.

Exclusion criteria

- People who have clefts or congenital deformities.
- Past craniofacial fractures history.
- Patients with bone diseases, dietary deficits, and endocrine disorders.

Results

This study includes 110 patients in total in which 76 (69.1%) are female and 34 (30.9%) are male as shown in table:1. with age range between 11 to 35, the mean age is 18.5 as shown in table:2. On basis of Overjet the overall sample size was divided into 3 groups; normal (0-2mm) OJ with 32 patients, increased (3-5mm) OJ with 38 patients and severe (6-10mm) OJ with 40 patients as shown in table:3. On basis of ANB the overall sample size was divided into 2 groups; Normal (0-4mm) ANB with 55 patients and Increased (more than 5mm) ANB with 55 patients as shown in table 4. On basis of Witts the overall sample size was divided 2 groups; Normal (0-1mm) witts with 21 patients and Increased (more than 2mm) witts with 89 patients as shown in table 5. The pearson correlation of Overjet with ANB is low (r=0.293) as shown in table 6. The pearson correlation of Overjet with Witts is high (r= 0.417) as shown in table 7.

Table 1
Gender of subjects

	Frequency	Percentage
Females	76	69.1
Males	34	30.9
Total	110	100.0

Table 2
Age of Subjects

N	Percentage
Mean	18.5364
Range	23.00

Table 3
Overjet of subjects

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Normal 0-2	32	29.1	29.1	29.1
Increased 3-5	38	34.5	34.5	63.6

Severe 6-10	40	36.4	36.4	100.0
Total	110	100.0	100.0	

Table 4
ANB of Subjects

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Normal 0-4	55	50.0	50.0	50.0
Increased 5-15	55	50.0	50.0	100.0
Total	110	100.0	100.0	

Table 5
Witts of Subjects

	Frequency	Percentage	Valid Percentage	Cumulative Percentage
Normal 0-1	21	19.1	19.1	19.1
Increased 2	89	80.9	80.9	100.0
Total	110	100.0	100.0	

Table 6
Symmetric Measures OJ with ANB

		Values	Asymp. Std. Errors[a]	Approxs.[b]	Approx. Sig.
Interval Interval	byPearson correlation	.293	.089	3.189	.002[c]
Ordinal Ordinal	bySpearman-correlation	.291	.089	3.165	.002[c]
Total		110			

Table 7
Symmetric Measures OJ with Witts

		Values	Asymp. Std. Errors[a]	Approxs.[b]	Approx. Sig.
Interval Interval	byPearson correlation	.417	.082	4.768	.000[c]
Ordinal Ordinal	bySpearman Correlation	.411	.082	4.684	.000[c]
Total		110			

Discussion

The tables show correlations between maxillary and mandibular skeletal and dental characteristics. Correlation values range from -1 (complete negative correlation) to 1 (perfect correlation). (perfect positive correlation). As a consequence, the current study's goal is to see if there is any link between dental and skeletal factors. The anterior and posterior connection of both the upper and lower jaws are very essential feature that must be assessed in order to establish a correct diagnostic and treatment strategy.[16,45] Sagittal discrepancy must be corrected while doing orthodontic treatment to get a good harmonic facial profile. The anterior and posterior relationships of the maxillary and the mandibular teeth is measured using a variety of methods (ANB, Witts, OJ, etc.).[20,46,47,48]

There are 34 men and 76 women in current study, the sample size is 110 patients undergoing orthodontic treatment. Because the study is not gender-based, there were more females than males. A positive association was predicted for overjet and ANB as they represents jaw connections in the midline both direct and indirect ways Because overjet is influenced by location of nasion including the Sella Nasion line whether it be the anteriorly or posteriorly placed or either by the vertical position, maxillary line, and ANB is influenced by location of nasion whether it be anteriorly or posteriorly placed, changes might occur. The differences within the normal values should be taken into account while interpreting ANB. In actuality, the size of ANB is influenced by the Nasion point, as well as positioning of point A and point B in the anterior and posterior plane, rather the true sagittal connection among upper and lower jaws. Overjet and Wits evaluations investigate the jaw connections in the sagittal plane in the same manner as overjet with ANB. The occlusal line is a dental variable, acts as reference line for Witts assessment. When compared to the overjet and ANB readings, it's not surprising that the coefficient of correlation was greater.[5] According to the present research, there is a weak link between OJ with ANB as compared to Witts. But there is positive association of overjet with ANB and Witts, i.e (r= 0.293, P-value > 0.05) of ANB, (r= 0.417, P-value > 0.05) of Witts.

This outcome was equivalent to Zupancic et al findings[7] When evaluating the entire sample, they revealed a statistical significant and robust correlationship (P=0.01) Over jet and ANB (r = 0.690), over jet and Witts evaluation (r = 0.750), over jet and angle of convexity in point A (r = 0.608) are all examples of correlations. According to Thayer,[138] over-jet and Witts assessment have a lesser association i.e; (r = 0.574 as in functioning occlusal line and r = 0.647 as in bisected occlusal line). Either occlusal plane may be used to compute wits evaluation. Although a 5 degree error may modify the Witts assessment over 3 to 6 mm relying upon face's vertical height, the bisected occlusal surface demonstrated more accuracy than that of functioning occlusal surface. Overjet is one of the elements investigated with in sagittal interaction of upper and lower jaws and teeth. Positive or negative overjet may be influenced by either dental or skeletal, or either including both.[46] Over-jet more than 10millimeter, according to Profit et al, orthognathic surgery is the preferred therapeutic option.[8]

Conclusion

With the limitation, we concluded the summary a;

- A significant connection between overjet and ANB angle is found (r = 0.293).
- There is a moderate link between overjet and Witts (r = 0.417).
- Vertical pattern is not predicted by overjet in a statistically meaningful way.

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