COMPARISON BETWEEN CRANIAL BASE ANGLE AND SKELETAL DISCREPANCIES
"A RETROSPECTIVE CEPHALOMATRIC STUDY"

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Abstract
Introduction: The Aim Of This Study To Compare The Cranial Base Angle With The Skeletal Discrepancies To Know The Sizes And Positions Of The Cranial Base, Maxilla And Mandible And To Assess The Influence Of Cranial Base Angle On Maxilla, Mandible, Maxillomandibular Relationship.
Material And Methods: The Study Was Performed In The Department Of Orthodontics & Dentofacial Orthopaedics In Maharana Pratap College Of Dentistry & Research Centre Gwalior . 45 Lateral Cephalograms Were Taken With Age Ranging Between 15 -20 Years. The Sample Was Divided Into 3 Groups (Class I, Class II And Class III), On The Basis Of Skeletal Discrepancies By ANB Angle And Wits Analysis.
Results: One Way ANOVA Test Was Performed With Student T-Test To Demonstrate The Data For Each Variable Significant Variance In The Three Malocclusion Groups. It Was Found That Cranial Base Angle As Calculated By Measuring N-S-Ar Was Found To Be Statistically Significant Larger In Class I Than Class III Individuals (P Value- 0.3). While Comparing Class II & Class III The Cranial Base Angle Was Found To Be Larger In Class II (P Value- 0.2).
Conclusion: From The Above Study It Was Concluded That Cranial Base Angle Is Larger In Class I & Class II Individuals And Shorter In Class III Individuals. Hence, We Can State That Smaller The Cranial Base Angle More Forward The Mandibular Position, As Indicated By SNB. Statistically Significant Changes Were Found In Jaw Length Among The 3 Different Malocclusion. Maxillary Jaw Length Was Found To Be Greater In Class II Individuals While In Class III Individuals Mandibular Length Was Greater.
Key Words: Cranial Base Angle, ANB Angle, Wits Appraisal, Saddle Angle.

Introduction

Connection of cranial base relationship and malocclusion has been of deception especially to Anthropologists and Orthodontists, in connection to tribal variety and aesthetics.

Huxley [1] and Bjork [2] have completed investigations on dried skulls, cephalometrics individually to the discrepancy connecting cranial base, maxilla, and mandible can cause malocclusion.

Malocclusions with skeletal discrepancy can be brought about by unusual structures, sizes, and position of cranial base, mandible and maxilla. Facial patterns are communicated by the interrelation of variable factors, for example, heredity, function, and environment. Such factors affect the development and growth of maxillofacial bones [3]. Also, perceive that development at the cranial base can firmly impact facial growth[4], particularly mandibular positioning.[5]

The cranial base which frame the floor of the cranial vault and reaches out from the foramen caecum anteriorly to the basioccipital bone posteriorly. It is basically a midline structure containing parts of the nasal, orbital, ethmoid, sphenoid, and occipital bones. Sellaturcica lies close to the focal point of the cranial base and partitions it into front (sella to nasion) and back been utilized to depict the posterior limit of the cranial base.[6]

The saddle angle (Na-S-Ar) during birth is approx 142^{O} yet then decreases to 130^{0}next at the age of 5. In between 5 to 15 age group the saddle angle is stable.[6]The stability of the saddle angle depends on the procedure which involve bone remodeling at the endocranial and pharyngeal surface level of the spheno-occipital synchondrosis and it made this synchondrosis flexion and comparatively stable as observed by Melsen.[7] Flexion 130^{o} - 135^{o} framed at Nasion-Sella-Articulare prompts maxilla and mandible well articulates with dissimilar limbs of cranial base. The maxilla seems, by all accounts, to be connected to the anterior limb of the cranium and the mandible to the posterior limb. The saddle angle became progressively obtuse when the malocclusion became skeletal Class III to skeletal Class I as well as skeletal Class I to skeletal Class II, so various authors concluded that different malocclusion type are correlated with cranial base flexion.[6]

Thus in view of above facts, a cephalometric study was conducted with following purpose to find out the relationship between cranial base position and various type of malocclusion

Aims and Objectives of this study are

• To assess the influence of cranial base angle on maxilla to mandibular relationship.
• To assess the influence of cranial base angle on maxilla.
• To assess the influence of cranial base position on mandible.
• To compare and correlate the cranial base angle with size and position of maxilla and mandible.

Material and Methods

The present study was conducted at the Department of Orthodontics Maharana Pratap College of Dentistry and Research centre Gwalior. For the present study, 45 cephalogram were obtained from the Department of Orthodontics. Their age ranged between 15 -20 years. The sample was divided into of 3 groups, each group contains 15 patients.
Group 1: Patients among Class I skeletal jaw relationship
Group 2: Patients among Class II skeletal jaw relationship
Group 3: Patients among Class III skeletal jaw relationship

Sample criteria

Based on ANB angle and Wits analysis
1 Any cases with systemic diseases that affect the growth and development or craniofacial Syndromes, patient with trauma, previous orthodontic treatment and orthognathic surgery were excluded.
2 The age range of the subject was between 15-20 years.
3- All teeth were present and free of crown restorations.
4 Group 1 (Class I or normal occlusion)

- Well aligned upper and lower arches with no crowding or spacing.
- Bilateral Class I molar and canine relationship,
- The overjet ranged between 2-4 mm and over bite between 1-3 mm,
- ANB angle was 2°- 4°
- Wits appraisal between 0 to 1 mm

5 For group 2 (Class II malocclusion)

- Bilateral half unit Class II or greater molar and canine relationship
- Retroclination of the maxillary anterior teeth, as a minimum of the two central incisors and deep bite, complete vertical overlap through a maxillary central incisor to the crown of following mandibular incisor.
- The normal or proclined upper incisors with an increased overjet.
- Overjet was >5mm,
- ANB angle was $>4^0$.
- Wits appraisal greater than 1 mm

6 For group 3 (Class III malocclusion)

- Bilateral half Class III or greater molar and canine relationship,
- Edge to edge or reversed overjet
- ANB angle was < 2°.
- Wits appraisal less than -1 mm

Lateral cephalometric radiographs were under strict standardized conditions. They were printed and the point identification and measurements were done directly on the radiographs using a lead 6H pencil, protractor and metric ruler and they were traced twice to minimize the error. In case of discrepancy the mean shadow of bilateral structure were traced. All the linear measurements were made closest to 0.5 mm and angular measurements nearest to 0.5 degree. Further following cephalomatric points were plotted, lines and angles were drawn and necessary angular and linear parameters were recorded for carrying statistical analysis.

I. **Points**

Nasion (N), SellaTurcica (S), Basion (Ba), Articulare (Ar),Orbitale (Or),Porion (Po), Anterior nasal spine,Posterior nasal spine (PNS),Point A (Subspinale), Gonion (Go), Menton (Me), Point B (Supramentale).

II. **Angles and Measurements.**

The above measurements were selected S-N, S-Ar, S-Ba, Maxillary base length, Mandibular base length, N-S-Ar, N-S-Ba, SNA, SNB, ANB. primarily to investigate the role played by the cranial base flexure is influencing by the saggital and vertical position of the jaws. After identification and tracing of cephalogram, the results were tabulated and subjected to statistical analysis.

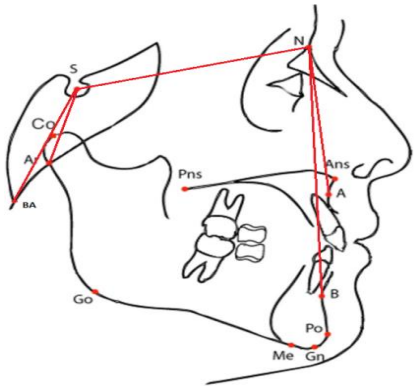

Figure1- Diagram Showing Landmarks In Lateral Cephalometircs

Results

- The result showed that the differences in cranial base size and shape in the angle classes by means of t-tests. When assessed the results following relationship found between the cranial base size, shape and jaw relationship.

- The results are displayed in Tables 1– 4. To begin with, it was important to exhibit that the information for every factor demonstrated critical variation in

group	degree of freedom	sum of squares	mean	variance ratio F	p- value
witts	2	626	1.3778	91	0.0001
SNA	2	300591	3.2544	12.39172	0.005
SNB	2	279015	3.9667	16	0.0001
ANB	2	1002	2.9333	237.90642	0.0001
N-S-BA	2	764224	130.267	10.98986	0.001
N-S-AR	2	692245	123.933	2.50077	0.94163
N-S	2	178249	62.8667	2.87923	0.6732
S-BA	2	85669	42.1111	1.70568	0.193991
cd-ANS	2	301647	81.7556	7.69471	0.001
cd-Pog	2	442943	99.0889	7.58956	0.001
Ar-ANS	2	282858	79.1556	6.99313	0.002
Ar-Pog	2	393121	93.3111	24.35433	0.0001
ANS-PNS	2	106739	48.5556	6.58008	0.003
Me-Go	2	175632	62.3111	3.79006	0.03

these three malocclusion groups so as not to nullify correlations between all these malocclusion groups.

- This was done using a one-way ANOVA of relevant groups (Table 1). Table 1 also shows that N-S-AR ,

TABLE 1. Results of One-way ANOVA of Relevant Groups

- N-S and S-BA did not showed significant changes as the p value >0.05.

- Tables 2,3 and 4 show following factors and furthermore between group comparisons(Class I, Class II and Class III) of factors as per independent t-tests.

Cranial base parameters

Tables 2,3 and 4 show the saddle angle considered according to N-S-Ar was found to be insignificant value into class I and class II same as in class II and class III. Table 2 and 4 showed insignificant results in cranial base length N-S and S-Ba.

Maxillary skeletal parameters

Angle SNA in table 2, 3 and 4 indicated no remarkable variation among class I subjects and alternate groups. In any case, ANS-PNS, Art-ANS and Cd– ANS demonstrated measurably critical variant. All distances were essentially expanded higher in Class II groups as comparison to Class I and for those of Class I and Class III subjects no remarkable changes were found.

Mandibular skeletal parameters

The linear measurements of Art– Pog,Cd– Pog, and Me–Go in mandible were greater in class III group in comparison to Class I but Class II values were comparable in relation to class I values. On the basis of this results, we can conclude that prognathia of mandible was evident in class III subjects which was also represented by highest SNB angle in class III group. The maxilla-mandibular proportion, as characterized via ANS– PNS/Me– Go.

		class I			class II			
Column1	Column 2	Column 3	Column4	Column 5	Column 6	Column7	Column 8	Column 9
variable	mean	sd	se	mean	sd	se	t	P
witts	0.6	0.507093	0.1309307 3	1.884776	1.884776	0.4866471	2.549	0.01
SNA	83.8	2.426049	0.6264031 9	82.13333	1.959106	0.5058389 2	-2.07	0.04
SNB	80.6	3.018988	0.7794992 3	75	1.85164	0.4780914 4	-6.124	0.0001
ANB	3.2	1.146423	0.2960051 5	7.133333	1.125463	0.2905932 6	9.482	0.0001
N-S-BA	129.8667	3.50238	0.9043106 6	133.0667	3.494213	0.9022018 9	2.505	0.01
N-S-AR	122.1333	4.138092	1.0684508 9	126	4.780914	1.2344268	2.731	0.02
N-S	61.46667	2.669047	0.6891448 6	63.2	3.648875	0.9421353 7	1.485	0.1487
S-BA	40.06667	2.939064	0.7588629 8	46.53333	19.00326	4.9066200 8	1.302	0.2034
cd-ANS	80.6	4.747932	1.2259107 4	84.93333	3.369329	0.8699571 2	2.883	0.0075
cd-Pog	99.8	4.753946	1.2274635 1	95.66667	3.976119	1.0266295 6	-2.583	0.01
Ar-ANS	78.13333	4.823553	1.245436	82.26667	3.807261	0.9830306 2	2.605	0.01
Ar-Pog	94.46667	4.9406	1.2756573 2	88	3.585686	0.9258201	-4.103	0.0003
ANS-PNS	47.93333	3.614784	0.9333333 3	46.66667	3.394674	0.8765009 8	-0.989	0.331
Me-Go	62.66667	4.117327	1.0630892 4	60	4.440077	1.1464230 1	-1.706	0.09

TABLE 2. Comparison of Skeletal Variables Between the Class I and Class II Sample Groups

Discussion

The growth of cranial base is affected by the growth of brain which in turn influences the spatial orientation of jaw bases. The maxilla is affected more than mandible as mandible is farther from cranial base. But articulation of mandible with the cranial base at the temporomandibular joint does pave the way for the potential influence of

growth of cranial base on the position of the mandible as well.[7]

In the present study, lateral cephalograms of 45 subjects were divided into three categories according to the ANB angle and Wits analysis to see whether any relation exists between cranial base angle and malocclusion. Also, two methods of sample grouping were followed to see whether it exerts any influence on the results.

		class I			class III			
Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9
variable	mean	sd	se	Mean	sd	se	t	P
Witts	0.6	0.507093	0.13093073	-2	1.85164	0.47809144	-5.245	0.0001
SNA	83.8	2.426049	0.62640319	79.06667	3.348063	0.86446607	-4.434	0.0001
SNB	80.6	3.018988	0.77949923	80.33333	3.940027	1.01731049	-0.208	0.8367
ANB	3.2	1.146423	0.29600515	-1.53333	0.99043	0.25572803	-12.1	0.0001
N-S-BA	129.8667	3.50238	0.90431066	127.8667	1.9223	0.49633578	-1.939	0.06
N-S-AR	122.1333	4.138092	1.06845089	123.6667	5.313953	1.37205673	0.882	0.3854
N-S	61.46667	2.669047	0.68914486	63.93333	2.153624	0.55606326	2.786	0.0095
S-BA	40.06667	2.939064	0.75886298	39.73333	4.233652	1.09312425	-0.288	0.7757
cd-ANS	80.6	4.747932	1.22591074	79.73333	3.390463	0.87541373	-0.575	0.5696
cd-Pog	99.8	4.753946	1.22746351	101.8	4.427189	1.14309521	1.192	0.2431
Ar-ANS	78.13333	4.823553	1.245436	77.06667	3.283436	0.84777955	-0.708	0.4848
Ar-Pog	94.46667	4.9406	1.27565732	97.46667	2.445599	0.63145084	2.108	0.0441
ANS-PNS	47.93333	3.614784	0.93333333	51.06667	3.239635	0.83647029	2.5	0.01
Me-Go	62.66667	4.117327	1.06308924	64.26667	4.300609	1.11041248	1.041	0.3069

TABLE 3. Comparison of Skeletal Variables Between the Class I and Class III Sample Groups

		class II			class III			
Column1	Column2	Column3	Column4	Column5	Column6	Column7	Column8	Column9
variable	mean	sd	se	mean2	sd3	se4	t	P
SNA	82.13333	1.959106	0.505839	79.06667	3.348063	0.864466	-3.062	0.004
SNB	75	1.85164	0.478091	80.33333	3.940027	1.01731	4.475	0.0001
ANB	7.133333	1.125463	0.290593	-1.53333	0.99043	0.255728	-22.389	0.0001
N-S-BA	133.0667	3.494213	0.902202	127.8667	1.9223	0.496336	-3.166	0.0037
N-S-AR	126	4.780914	1.234427	123.6667	5.313953	1.372057	-1.264	0.2166
N-S	63.2	3.648875	0.942135	63.93333	2.153624	0.556063	0.67	0.5082
S-BA	46.53333	19.00326	4.90662	39.73333	4.233652	1.093124	-1.353	0.187
cd-ANS	84.93333	3.369329	0.869957	79.73333	3.390463	0.875414	-4.213	0.0002
cd-Pog	95.66667	3.976119	1.02663	101.8	4.427189	1.143095	3.992	0.0004
Ar-ANS	82.26667	3.807261	0.983031	77.06667	3.283436	0.84778	-4.006	0.0004
Ar-Pog	88	3.585686	0.92582	97.46667	2.445599	0.631451	8.447	0.0001
ANS-PNS	46.66667	3.394674	0.876501	51.06667	3.239635	0.83647	3.632	0.0011
Me-Go	60	4.440077	1.146423	64.26667	4.300609	1.110412	2.673	0.01

TABLE 4. Comparison of Skeletal Variables Between the Class II and Class III Sample Groups

The class I test indicated great concurrence with distributed cephalometric standards for dental as well as skeletal relationship.[8]These information harmonize with those given by Hamdan and Rock.[9]They used fourteen distinctive examinations for determinations of the mean of methods for commonly used cephalometric factors.

Information for the Class II and Class III groups demonstrated the normal varieties of dento-alveolar as well as skeletal base pattern with each group of the skeletal pattern coordinating with the incisor relationship. The incisor angulation varieties were as likely relied upon so as to make up for basic skeletal discrepancy in particular class of malocclusion. Such as, while contrasted and class I esteems the mandibular incisors were retroclined in class III subjects.

Anterior cranial base length was estimated from Nasion to Sella but the posterior cranial base length estimation had some dilemma to measure from Ba or Ar. Bjork[2] used Ar point to estimate cranial base length instead of Ba point because Ar point is quite simple to identify by the clinician.[10]

Varjanneet al[11] have advocated the use of Ba point instead of Ar point to estimate cranial base length because of the isolated position of the Ar from cranial base. Kerr and Adams[12]also preferred Ba over Ar to estimate saddle angle. Bhatia et al[13] have distributed figures for angles between Nasion –sella- articulare and nasion –sella- basionjust as the distances between sella-articulare and sella- basion. Strikingly, they establish the development designs, as depicted by utilization of Ba or Ar, selected fundamentally the same as.

The current outcomes, utilizing the two proportions of posterior cranial base, don't sustain the idea that the angle of cranial base, by giving a variety in the anteroposterior position of mandibular articulation, is a noteworthy determinant in establish the essential malocclusionclasses.[10]in fact, just the group of class II demonstrated a critical contrast in parameters N– S– Ba and N– S– Art in contrast with class I. In this manner, it is beyond the realm of imagination to expect to substantiate the statement of Dibbets[14] that the three Angle classes II, I, and III speak to self-assertive markers on a morphological continuum.

Enlow[7] has appeared of the maxilla to be affected by the cranial base, which thusly is impacted by the development of the cerebrum. The mandible, by the excellence of its isolation from the region, demonstrations in an increasingly free manner in spite of the fact that its articulation at the glenoid fossa provides the potential for impact from the cranial base.

The results collected from the pooled data shows that cranial base angle was related to SNA and SNB angle in harmony with those of Bjork[2] and Kasai et al[5], who showed the connection between facial prognathism and cranial base angle

Conclusion

In assessment of orthodontic problems involving anterio-posterior mal-relationships of the maxilla and mandible, the difficulty is usually related to the result of various factors i.e. size, form and positions of the jaw other factors like head posture, breathing mode and cranial base flexion have been attributed to the development of skeletal malocclusion.

Many authors have investigated the cranial base flexion relationship with skeletal malocclusion with positive findings. Proffit et al.[16] reported Class III malocclusion mostly associated with reduced cranial base angle.

Similar results were seen in research conducted by Bjork[2] and hopkin et al.[10]

In this retrospective study author has established the relationship between the cranial base angle and various malocclusion.

The following conclusions can be drawn from this present study:

1. The study shows that the saddle angle do not necessarily be correlated with malocclusion.
2. In different malocclusion groups jaw lengths are unique as we see in Class II malocclusion where the maxillary length was greater whereas in class III malocclusion the mandibular length is comparatively high.

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