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Evaluation Of The Relationship Between Cranial Base Angle And Mandibular Rotation In And Around Kundrathur Population: A Cephalometric Study

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ABSTRACT

Objective: *To investigate the role played by the cranial base flexure in influencing the sagittal and vertical position of the jaws in and around the Kundrathur population.*

Materials and Methods: *Digital Lateral cephalograms of 108 ethnic subjects were taken and divided into three categories (Group A: NSAr > 125˚, Group B: NSAr-120˚-125˚, Group C: NSAr < 120˚) according to the value of NSAr. Measurement of eight angulars (SNA, SNB, NPg-FH, ANB, NAPg, SN-GoGn, Y-Axis, ArGo-SN) were taken and compared with the ethnic population.*

Results: *t-test was used to analyze the difference in the means of all the variables between the three groups. Significance was determined only when the confidence level was P < 0.05. Several parameters (SNA, SNB, NAPg, ANB, Y-Axis, GoGn-SN) showed a significant positive correlation with NSAr. Standard values were compared with the Tamil ethnic population in and around the kundrathur population.*

Conclusions: *Most of the kundrathur population has increased cranial base angle with clockwise rotation of the mandible and when comparing male and female gender, the female has more effects on mandibular position and also affects mandibular plane angle and y-axis. This study shows cranial base angle has a determinant role in influencing the mandibular position and it also affects both the mandibular plane angle and y-axis. Flattening of the cranial base angle caused a clockwise rotation of the mandible. The jaw relation tends to change from class III to class II, with progressive flattening of the cranial base and vice-versa. So when evaluating in ethnic Tamil population, the kundrathur population had an increase in the value of the saddle angle which cause the backward position of the mandible. When mandibular length (Ar-Gn) was correlated with NSAr angle, there is no correlation is seen, this suggests the impact of cranial base angle affects the position of the mandible and not the linear aspect of the mandible. No significant correlation was found between the inclination of the posterior border of the ramus (ArGo-SN) and the cranial base angle.*

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I. INTRODUCTION:

Orthodontists and craniofacial anthropologists have long been fascinated by the cranial base area of the craniofacial complex. Young[1] discovered a link between cranial base morphology and jaw prognathism as early as 1916. Moss and Greenberg, Scott, Stramrud, Melson, Ohtsukhi[2,3], et al. discovered that the cranial base angle stabilizes between 5 and 7 years of age and that any change in its value after that is barely noticeable. The maxilla appears to be attached to the anterior segment and the mandible to the posterior segment of the cranial base. The agreement of various authors such as Renfroe et al[3] demonstrated that cranial base morphology has a significant influence on the position of the maxilla and mandible, thus determining an individual's skeletal pattern. Increased cranial base flexion increases Class-III tendency, while decreased cranial base flexion increases Class-II tendency. Thus, an orthodontist should be able to predict a child's future skeletal pattern from the value of cranial base angle at a young age.

The purpose of this study is to look into the relationship between the cranial base angle and mandibular rotation.

1. To estimate the values of various craniofacial skeletal parameters for individuals with a wide range of cranial base angles.
2. To compare and correlate the value of the cranial base angle with eight angular measurements.

II. MATERIALS AND METHODS:

Materials

For this study, a sample consisting of 108 Digital lateral cephalograms was collected and segregated based on ethnic population from the records of the patients reported at the Department of Orthodontics, in Madha dental college and Hospital - kundrathur based on the following criteria:

1. None of the subjects had undergone orthodontic treatment in the past
2. The age range of the subject was between 12 and 16 years
3. There was no facial disharmony whatsoever due to any systemic problem or any major accident in the past affecting the bones of the facial skeleton.

Methods

Once the Digital lateral cephalograms were collected, an estimation of the values of the cranial base angle was done for each case. Based on their values, the total sample is divided into three categories:

Group A: NSAr > 125° (n = 45)

Group B: NSAr-120°–125° (n = 30)

Group C: NSAr < 120° (n = 33)

In this study, the point "Articulare" rather than "Basion" were used to represent the posterior extent of the cranial base to estimate the degree of flexure of the cranial base angle (NSAr). Bhatia and Leighton [12] show that the growth patterns studied using Basion or Articulare are very similar. More cephalometric points [Table 1] are plotted, and angles [Table 2] are drawn. Eight angulars (SNA, SNB, NPg-FH, ANB, NAPg, SN-GoGn, Y-axis, ArGo-SN) were drawn.

TABLE: 1

Sella (S)	The center of the shadow of the pituitary fossa (Sella turcica)
Nasion (N)	The deepest point of the frontonasal suture
Articulare (Ar)	It is the point of intersection of the images of the posterior border of the mandible and the inferior border of the basilar part of the occipital bone
Gonion (Go)	The point is formed by the intersection of the mandibular plane and the posterior border of the ascending ramus of the mandible.
Gnathion (Gn)	A point formed by the intersection of the mandibular plane with the facial plane.
Point A	The deepest midline point on the pre-maxilla between the anterior nasal spine and the crest of the maxillary alveolar process
Point B	The deepest midline point on the mandible between the pogonion and the crest of the mandibular alveolar process
Pogonion (Pg)	The most anterior point on the bony chin in the median plane
Porion (Po)	The superior point of the external acoustic meatus
ANS	Anterior nasal spine; this is the tip of the bony anterior nasal spine
PNS	Posterior nasal spine; the intersection of a continuation of the anterior wall of the pterygopalatine fossa and the floor of the nose marking the dorsal limit of the maxilla
Menton (Me)	The most inferior midline point on the mandibular symphysis (unilateral)
Orbitale (Or)	The lowest point on the inferior margin of the orbit

Table 2: Angles and measurements:

Angles	**Connecting points**
NSAr (saddle angle)	Is the angle formed between nasion, sella and articulare. It represents the crania base flexure
SNA	Angle formed between the lines SN and NA
SNB	Angle formed between the lines SN and NB
ANB	Angle formed between the lines NA and NB
NA Pg	Angle formed between the lines NA and APg
NPg-FH	Angle formed between the facial plane NPg and FH plane
SN-GoGn	Angle between the SN plane and the mandibular plane, represents the mandibular plane angle
Y-axis	Angle formed between the S Gn line and FH plane
ArGo-SN	Angle formed between Ar-Go and SN plane

Statistical analysis:

Various angular variables were measured and their mean and standard deviations were calculated in all the three groups. All the variables were then individually correlated with NSAr for finding the correlation between cranial base flexure in and around kundrathur population and between two genders.

III. RESULTS:

TABLE 3: MEAN AND SD OF ALL PARAMETERS IN THREE GROUPS:

Type of	Variables	Group A		Group B		Group C	
Variable		Mean	SD	Mean	SD	Mean	SD
Angular (°)	NSAr	132.9	4.6	124.73	1.9	118.63	3.5
	SNA	82.18	4.4	83	3.5	84.73	4.7
	SNB	77.02	4.3	79.5	3.4	84.43	4.0
	ANB	6.16	2.8	4.17	1.9	0.4	3.2
	N-A-Pg	9.16	4.0	6.03	3.5	−0.77	7.8
	FH– NPg	89.52	3.2	90.4	3.8	92.43	2.2
	SN-GoGn	32.67	6.2	30.73	6.9	31.4	5.7
	Y-axis	61.2	5.8	59.33	4.2	58.53	3.8
	SN-ArGo	89.64	4.8	90.13	4.5	87.7	4.1

Table 4: Relationship between NSAr and other parameters in total sample

NSAr	Frequency of observations	SNA	SNB	NPg FH	ANB	NAPg	WITTS	SN- GoGn	Y-axis
112	5	90	85	91	3	7	-1.5	27	56
115	3	82	87	92	-4	-7	-9.5	30.1	55
116	8	83	83	90	1.3	1.2	-3	30	57.1
117	4	83	82	91	1.2	-1	-3	24	54.1
118	12	82	80	89	1	0.8	-4.5	32	58.1
120	6	81	80	89	0.4	-1.6	-4.5	30.1	56.3
121	6	80	78	88	3.3	4.5	2	29	55.7
122	4	82	80	90	3	7	2.1	25.1	56.3
124	8	81	76	87	3.5	6.6	1	28.8	58.7
125	6	81	77	89	5	4	2.4	32.2	58.7
126	6	82	77	88	6	8	2.5	26	59.3
127	5	81	76	87	4	5	3	28	56.3
128	6	80	75	87	4.2	6.3	1	34	58.7
129	3	77	72	85	4.5	9	3.1	27	59.7
130	4	82	77	88	5.3	9	4	29.3	57.3
131	7	84	75	86	5.7	7.7	1.9	27.1	62.3
132	4	83	76	87	4.5	6.7	2.3	30.8	57
133	6	77	71	88	5.3	8.5	3	31	61
134	4	82	72	86	4	7	2.5	35.6	57
	Co-efficient correlation	-0.35	-0.55	-0.31	0.59	0.61	0.58	0.20	0.27

IV. DISCUSSION:

In this study, digital lateral cephalograms of 108 subjects were divided into three categories based on the values of angle NSAr of each subject because studies that have found the skeletal pattern based on the cranial base angle are few[4,5,6,&7]. This study found that as the cranial base angle decreases, the maxilla protrudes, and the angle SNA increases. This is consistent with the findings of Enlow[7], Profitt and Fields[8] when differences in angle SNA values were compared between Groups A, B, and C; no significant differences were observed at any level. This means that, despite a significant negative correlation between these two angles, the sagittal position of the maxillary apical base, as described by point A, is not significantly affected. As the cranial base angle decreases, the mandible protrudes and the angle SNB increases. Furthermore, as the cranial base angle decreases, the chin tends to protrude. Furthermore, when the values of angle SNB and NPg-FH are compared between Groups A, B,

and C, significant differences in the measure of these angles exist between the groups with extreme ranges of the cranial base angle. It is possible to conclude that changes in the cranial base angle have a significant impact on mandibular position. The above correlation suggests a link between cranial base flexure magnitude and mandibular position. This means that, while there is a significant negative correlation between these two angles, the sagittal position of the maxillary apical base, as described by point A, is not significantly affected. It is obvious that as the cranial base angle decreases, the mandible protrudes and the angle SNB increases. Furthermore, as the cranial base angle decreases, the chin protrudes. Furthermore, when the values of angles SNB and NPg-FH are compared between Groups A, B, and C, significant differences in the measurement of these angles exist between the groups with extreme ranges of the cranial base angle. It is possible to conclude that the mandibular position is affected. It can be concluded that changes in the cranial base angle have a significant impact on mandibular position. The above correlation suggests a link between cranial base flexure magnitude and mandibular position.

According to the findings, when the cranial base flexure is increased, the mandible retrudes in position when compared to the normal position, and vice versa. As a result, kundrathur in and around the population has increased cranial base flexure with mandibular backward position with a positive correlation of SNB, NAPg, ANB, Y-Axis, GoGn-SN which had more influences on mandibular position. When comparing the two genders, the female has a greater influence on the backward position of the mandible due to increased cranial base position.

The smaller the cranial base angle, the more forward the mandibular position, increasing the likelihood of a Class-III jaw relationship; the larger the cranial base angle, the more backward the position of the mandible, increasing the likelihood of a Class-II jaw relationship. In addition, unlike the maxilla, changes in the cranial base angle have a greater impact on the mandible. The observed correlation between the cranial base angle and the aforementioned parameters suggests that opening the cranial base flexure can result in a skeletal Class II jaw relation and closing the cranial base flexure can result in a skeletal Class III jaw relation.

In this study, the mean values of angle ANB, wits, and angle N-A-Pg in the three groups support the above contention. When the values of ANB angle, wits, and NAPg angle were compared in each individual group. Kerr[11] and Adams concluded that the size and shape of the cranial base influence mandibular position by determining the anterioposterior position of the condyles relative to the facial profile. According to Enlow, Harris et al., Bacon et al.[14-16,] the cranial base angle is larger in Class-II subjects.

However, an increase in the cranial base angle is strongly associated with an increase in the overall cranial base length, and this tendency is stronger near the upper extremities of the cranial base angle. An intriguing relationship exists between the cranial base angle and maxillary length. When mandibular length (Ar-Gn) was correlated with NSAr angle, an insignificant negative correlation was seen both in the overall data and in the individual groups. This suggests that an increase in the value of the saddle angle has the potential to cause mandibular retrusion in the Kundrathur population. The mandibular position is not compensated by mandibular length, which is why the values of angle SNB and angle NPg FH are influenced more than the values of angle SNA and N-PtA. There was no significant relationship found between the inclination of the posterior border of the ramus (ArGo-SN) and NSAr.

V. CONCLUSION:

It has been known for a long time that the cranial base angle influences craniofacial morphology. Based on this study, the following conclusions are drawn:

• The cranial base has a definite influence on the maxilla, As the cranial base angle reduces, the maxilla tends to protrude and the angle SNA increases.

• In the kundrathur ethnic population, as a whole more people have increased cranial base angle with the backward position of the mandible without compensating for the mandibular length and ramus height.

• When comparing the two genders, the female has an increased cranial base with backward positioning of the mandible when compared to males.

• The mandibular position is influenced to a greater extent by the cranial base angle than the maxillary position. The cranial base angle has a determinant role in influencing the mandibular position.

• Ethnic population in and around the kundrathur region shows, the population has more increased cranial base with clockwise rotation of the mandible when compared to the standard value.

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