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Establishment Of Standardised Anb Norm For North Karnataka Population

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Abstract:
Background: *Cephalometric analysis plays a vital role in orthodontic diagnosis and treatment planning. The ANB angle, introduced by Steiner, is widely utilized to assess sagittal skeletal relationships between the maxilla and mandible. However, this angle is known to vary across populations due to genetic, ethnic, and environmental influences, affecting craniofacial morphology. This study aims to evaluate the normalised ANB angle specific to the North Karnataka population to establish population-specific cephalometric norms, thereby enhancing diagnostic accuracy and orthodontic treatment outcomes.*
Materials and Methods: *This is a cross-sectional observational study involving systematic cephalometric analysis of pre-treatment patients. The study was carried out using 294 lateral cephalometric radiographs from individuals ranging 18 – 30years from the North karnataka population. These samples were selected based on strict inclusion and exclusion criteria to ensure that the sample accurately reflects the regional demographics. Patients with dental and skeletal class I malocclusion were included in the study. Cephalometric landmarks were traced manually on cephalograms using 0.3mm hb pencil and steiner's analysis was carried out to determine the SNA, SNB and ANB angles.*
Results: *We found a significant difference between our values and standard caucasian values for SNA and ANB angles. Gender comparison suggested females showed significantly higher values of SNA and ANB angles.*
Conclusion: *The present results when compared to diverse indian and global population suggested significant variation and indicated requirement for population specific standard values. This would refine orthodontic diagnosis and enable more tailored treatment planning based on population subgroups.*
Key Word: *Orthodontic diagnosis & treatment planning, cephalogram, cephalometric analysis, steiner's analysis, ANB angle, SNA angle, SNB angle.*

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I. Introduction

Cephalometric analysis is a fundamental method in orthodontics to assess craniofacial relationships, especially the sagittal position of the jaws. The ANB angle, defined by Steiner, is an established parameter to evaluate the maxillo-mandibular relationship. However, its values vary widely across populations due to genetic, ethnic, and environmental factors. Studies in Caucasian populations show the ANB angle tends to decrease from childhood to adulthood in Class I cases, while Class II cases generally persist; as noted by Wellens et al. (2017), "diagnostic accuracy depends on accounting for individual and population-specific variability" [1]. Investigations in Indian populations have highlighted notable differences; research on the Solan population revealed distinctive anteroposterior soft tissue relationships related to skeletal patterns. Furthermore, comparison with the Sudanese population revealed that soft tissue norms differ among ethnic groups, indicating the unreliability of applying one population's norms universally for diagnosis and treatment planning[2]. Studies in Vidarbha found deviations from traditional cephalometric norms, emphasizing the region's unique morphological traits [3]. To improve cephalometric precision, Paddenberg et al. emphasized that "advanced morphometric approaches allow individualised normalisation, improving the clinical relevance of cephalometric measurements"[4]. This technique shifts focus from fixed normative values to adaptable, shape-based assessments.

According to Atit B. M et al there was a significant difference observed in norms of standard caucasian values when the author compared it with Maratha ethnic population [5]. Also, according to Rathore A. S. et al. difference was noticed in the norms of Mewari population when comparison was done with Caucasians [6]. Despite rich literature, North Karnataka's population lacks specific data on the normalised ANB angle. This study aims to fill that gap, providing population-specific reference values to refine orthodontic diagnosis and enable more tailored treatment in this distinct demographic.

II. Material And Methods

This is a cross-sectional observational study involving systematic cephalometric analysis of pre-treatment patients**.** A total of 294 lateral cephalometric radiograph samples (147 male and 147 females) were collected from our hospital OPD in Department of Orthodontics at SDM College of Dental Sciences and Hospital, Dharwad, Karnataka, India using strict inclusion and exclusion criteria to match regional demographics. The population taken into consideration ranged from 18 – 30 years, who reported to the department of orthodontics and dentofacial orthopedics to treat their underlying malocclusion from September 2025 to March 2026. Ethical approval was obtained (SDMCDS IEC. No. 2025/S/OR./76). A detailed history of patient as well as the family history was recorded. Their skeletal and dental characteristics were recorded.

Inclusion criteria:
1. Subjects with Angle's class I skeletal and dental occlusion with minimum crowding, rotation or spacing.
2. Overjet and overbite < 3mm
3. Competent lips.
4. Individuals' native to or with ancestry rooted in North Karnataka.
5. Subjects with no history of orthodontic treatment or craniofacial surgery.
6. Participants with good-quality lateral cephalometric radiographs available.
7. Individuals with no congenital craniofacial anomalies or syndromes.
8. Subjects with normal dental development and no significant dental pathology affecting jaw relationships.

Exclusion criteria:
1. Individuals outside the defined age range or from other geographic/ethnic populations.
2. History of previous orthodontic treatment, orthognathic surgery, or trauma affecting craniofacial structures.
3. Presence of congenital anomalies like cleft lip/palate or syndromic conditions.
4. Full arch Crossbite or impacted tooth cases.
5. Poor-quality or incomplete cephalometric radiographs.
6. Severe dental or skeletal deformities not representative of the normal population.
7. Systemic diseases or conditions affecting bone growth or morphology.

Procedure methodology

The lateral cephalogram was obtained from standard cephalostat. A distance of 5 feet object to source was standardised at 75kvp and 10mA with exposure time of 1.25 seconds on carestream 9600 PC. The distance between midsagittal plane to the x-ray source is 60 inches for cephalometric procedure to be carried out. The central ray is directed towards the external auditory meatus which is perpendicular to the plane of the film. The films were traced manually twice by operator to minimise intraoperator error. For manual tracing, 0.3 mm of lead hb pencil and a 0.05 mm of lead acetate sheets are used. Manual tracing was done for all the lateral cephalograms and Steiner's analysis was carried out. Standardised tracing of all landmarks and measurement will help us determine normalised SNA, SNB and ANB angle values.

Landmarks used in the study: Angular measurements for sagittal plane(anterior-posterior)
1. SNA: Sella-nasion-point A, representing maxillary position in relation to anterior cranial base.
2. SNB: Sella-nasion-point B, representing the mandibular position in relation to anterior cranial base.
3. ANB: Point A – nasion – point B, representing the maxillamandibular discrepancy to the anterior cranial base.

Statistical analysis

Comparison of observed values with standard caucasian values was analysed by one sample t test. Comparison between the genders was analysed by unpaired t test. These were statistically compared with norms from other populations to identify significant differences and establish population-specific reference ranges.

III. Result

The data collected based on sample size estimation were statistically analysed and compared with standard caucasian values. In our study the obtained values for north karnataka population were: ANB value of 3.50, SNA value was 80.54 and SNB value was 77.02. We found a significant difference between our values and standard caucasian values as shown in table 1. In table 2, upon gender comparison by unpaired t test we found that females showed significantly higher values of SNA and ANB angles compared to males. SNB angle suggested no statistically significant difference between males and females. Table 3 and 4: shows comparison of each values with corresponding values for other population across the globe as well as within india.

Table 1: Establishment of standardised ANB Norm.

Compared to standard causation values						One sample t test	p value		Mean Difference	95% CI from difference	
	Caucasian values	N	Mean	Std. Deviation	95% CI					Lower	Upper
ANB ANGLE	2	299	3.50	.868	.098	29.833	.000	**S**	1.498	1.40	1.60
SNA ANGLE	82	299	80.54	4.295	0.486	-5.871	.000	**S**	-1.458	-1.95	-.97
SNB ANGLE	80	299	77.02	4.404	0.499	-11.688	.000	**S**	-2.977	-3.48	-2.48

S – Significant

Table 2: Comparison between the male and female – North Karnataka population.

		Male			**Female**					Significance by unpaired t test		
SEX	N	Mean	Std. Deviation	Std. Error Mean	N	Mean	Std. Deviation	Std. Error Mean	Differences between males and females	t value	p value	
ANB ANGLE	150	3.06	.861	.070	149	3.94	.618	.051	-0.8796	-10.144	.000	S
SNA ANGLE	150	80.01	4.124	.337	149	81.07	4.410	.361	-1.06049	-2.148	.033	S
SNB ANGLE	150	76.96	4.260	.348	149	77.09	4.557	.373	-0.12725	-.249	.803	NS

S – Significant

Table 3: Comparison of ANB, SNA, SNB Values of North Karnataka population with Caucasians, Israelis, Korean, Mexican, Japanese, Negroes, german using steiner's analysis

Cephalometric Analysis	Caucasian (Steiner's analysis)	North karnataka	Israelis (Ruth et al)[7]	Korean (Park et al)[8]	Mexican (Garcia et al)[9]	Japanese (Miura et al)[13]	African (Drummond et al)[16]	German (Paddenberg-schubert et al)[4]	Sudanese (Salama et al)[19]
ANB	2	3.5	3.43	2.5	2.8	4.5	5.5	3	3.03
SNA	82	80.5	81.63	81.15	83.6	81.3	84.7	81	84.54
SNB	80	77	78.2	78.7	80.8	76.8	79.2	78	81.51

Table 4: Comparison of ANB, SNA, SNB Values of North Karnataka population with North India, Gujarati, Assam, Kerala, Solan, Chattisgarh using steiner's analysis

Cephalometric Analysis	Caucasian (Steiner's analysis)	North Karnataka	North India Punjab (Kharbanda et al)[21-22]	Gujarati (Patel et al)[23]	Assam (Baruah et al)[24]	Kerala (John KK et al)[25]	Solan (Aggarwal et al)[2]	Vidharbha (Vora et al)[3]	Chattisgarh (Chandra et al)[19]
ANB	2	3.5	3.27	3.01	3.01	2.27	3.8	2.9	1.9
SNA	82	80.5	82.6	81.26	84.5	84.14	81.5	83.82	84.07
SNB	80	77	79.21	78.25	81.41	81.85	77.5	81.1	82.2

IV. Discussion

In the human population, the significance of lower facial third is not just restricted to mastication, speech, deglutition or respiration, it also has a huge impact on the psychosocial well-being of an individual as it equivalently contributes to the facial appearance. Diverse rationales within various distinct ethnic groups on the basis of variable factors i.e sex, race or age have been reported in the past. Hence, the need for this appropriate region- specific baseline so that normal anatomic variation is not mistaken as a gross skeletal deformity.

The angular variations in steiner's can be influenced due to various anatomic factors like cranial base morphology, anatomic position of jaw bases relative to the cranium, facial profile characteristics, jaw rotations. The Sella- Nasion reference line cannot be considered as a fixed anatomical reference for entire population across the globe, due to persisting differences in cranial base flexure, orientation of SN Plane, anterior cranial base length, position of nasion (N). For a particular race, any changes in these can alter the SNA & SNB angles even though the size and projection of jaw bases are similar. In our study, the obtained angular measurement of SNA and SNB showed marginally increased maxillomandibular discrepancy with higher ANB angle. In north karnataka population, the maxillary and mandibular jaw bases were found be more retrusively placed with respect to cranium in horizontal relation compared to caucasians.

Gender comparison exhibits female population has a higher maxillomandibular discrepancy. In comparison to females, males have a more posteriorly positioned maxilla and mandible in relation to the cranial base. However, the decrease in SNA is proportionately lesser than the decrease in SNB, which leads to a lower ANB in males. SNB angle suggested no statistically significant difference between either of the gender for mandibular positioning.

Numerous studies on various ethnic groups across different geographic locations has been done such as Israelis[7], Korean[8], Mexican[9], japanese[10-15], african ancestry[16-18], german[4], sudanese[19] using Steiner's analysis. Caucasian values seem to be at the least for ANB values especially when compared to Japanese and people of african origin. In african race, the maxillary base is positioned quite ahead to the cranial base, whereas the mandibular position is comparatively behind the cranial base exemplifying of a more class II jaw base with convex profile[16]. The Israeli group showed a decreased SNA, SNB and increased ANB values when compared to the caucasian population but the present study showed decreased SNA, SNB and increased ANB when compared to the Israeli population[7]. The Korean group showed a decreased SNA, SNB and increased ANB when compared to the caucasians whereas when compared to our study showed increase in SNA, SNB and decreased ANB[8]. The Mexican American group (residing in USA) showed an increased SNA, SNB and ANB when compared to the caucasians. This study showed an decreased SNA, SNB and increased ANB when compared to the Mexican American population[9]. The german population showed decreased SNA, SNB, and increased ANB when compared to Caucasian population.This study showed decreased SNA, SNB and increased ANB when compared to german population[4]. The sudanese population showed increased SNA, SNB & ANB when compared to caucasian population. when compared our study to sudanese population, it showed decreased SNA, SNB and increased ANB angle[19]. These significant deviations from standard caucasian values and when compared to north Karnataka values suggests it cannot be standardised for rest of the population.

Diversity is witnessed across indian subcontinent as well. Various studies have been conducted across india on the basis of ethnic subgroups to establish region specific cephalometric norms using analysis like Down's, steiner's, Mcnamara's etc for North Indian's[20-22], Gujarati's[23], Assam[24], kerala[25], solan[2], chattisgarh[26]. The west indian gujarati ethnic group have higher maxillomandibular discrepancy whereas the east indian's have lesser suggestive that the maxilla-mandibular placement is population specific anatomic variation rather than gross dysmorphy[23&26]. The north indian population showed increased SNA, ANB and decreased SNB when compared to caucasian population. The present study showed decreased SNA, SNB and increased ANB when compared to Punjabi's[21-22].The gujarati population showed increased SNA, ANB and decreased SNB when compared to caucasian population whereas in our study, it showed decreased SNA, SNB and increased ANB when compared to gujarati population[23]. The Assamese showed increased SNA, SNB & ANB when compared to caucasian population. The present study showed decreased SNA, SNB and increased ANB when compared to assamese[24]. The kerala population showed increased SNA, SNB and ANB angle when compared to caucasians. Here, in our study showed decreased SNA, SNB and increased ANB when compared to kerala population[25]. The solan population showed decreased SNA, SNB and increased ANB when compared to caucasians. When compared to north karnataka population, our study showed further decreased SNA, SNB as well as ANB when compared to solan population[2]. The chattisgarh population showed increased SNA, SNB and decreased ANB when compared to caucasians. The present study showed decreased SNA, SNB and increased ANB when compared to chattisgarh population[26].

Variation in the ethnic values for all the racial population of different region confirms the preset cephalometric values of caucasians majorly deviate from rest of the demographics. This cross-sectional study has enabled assessment of anatomical variations at a single time point, suitable for developing normative cephalometric data for clinical implications. North karnataka being a very diverse community with multiple ethnic subgroups, the results of our study are understood and can be interpreted based on this community. Study with a larger sample size which could identify each of these subgroups is recommended to elucidate, if there are any further difference among subgroups of north Karnataka population.

V. Conclusion

In 1931, B. Holly Broadbent and hofrath introduced roentgen cephalometry revolutionizing orthodontics. Cephalometric analysis transformed orthodontics from large empirical practice into a data-driven quantitative field. These analysis help clinicians find a balance between occlusion, facial aesthetics, and long-term stability. The cephalogram analysis extensively helps clinicians to establish accurate skeletal pattern and dental relationships while allowing us to study abnormal craniofacial relationship for better diagnosis and treatment planning. This ensures individualised treatment planning rather than "one-size-fits-all" norms. As we are aware, existing variation on the basis of differential factors like age, gender, ethnic & racial group among divergent populations, it is necessary to establish standard cephalometric norms specific to individual groups. As, the standard cephalometric norm preset for caucasian population can only act as a reference and cannot serve as a global benchmark for all other population due to inherent variation in different racial groups. Hence, the present study on north Karnataka population was done which indicates that their maxillomandibular relationship to the cranial bases is more retrusively placed to that of caucasians. The obtained region-specific calibrated value for north karnataka population can be used for cephalometric interpretations, clinical case evaluation and precise diagnosis and treatment planning. This would help orthodontists tailor treatment according to individual's facial balance rather than to a single reference population.

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