PHOTOGRAMMETRIC COMPARISON OF FACIAL AESTHETICS AND MALAR PROMINENCE IN NORTH INDIAN AND SOUTH INDIAN POPULATION

Dissertation

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Of

MASTER OF DENTAL SURGERY

In

ORTHODONTICS AND DENTOFACIAL ORTHOPAEDICS

By

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DECLARATION BY THE CANDIDATE

I hereby declare that this dissertation entitled ***"PHOTOGRAMMETRIC COMPARISON OF FACIAL AESTHETICS AND MALAR PROMINENCE IN NORTH INDIAN AND SOUTH INDIAN POPULATION"*** is a bonafide and genuine research work carried out by me under the guidance of **Dr. Rohit Khanna**, Professor, Department of Orthodontics and Dentofacial Orthopaedics, Babu Banarasi Das College of Dental Sciences, Babu Banarasi Das University, Lucknow, Uttar Pradesh.

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The face is the most attractive and variable part of the human body which gives us the perception of individuality. The facial aesthetics play an important part in our society, the variability and beauty of the face is expressed by different sizes, forms and shapes of individual features of different parts of the face [1]. The world is full of evidence showing efforts put in by human race to make themselves beautiful and attractive.

Facial harmony is defined as "orderly and pleasing arrangement of facial parts in profile". Regularity and evenness are important features of esthetically pleasing profile but irregularities and acute curves tend to disrupt the harmonious profile [2]. Facial harmony and balance are determined by facial skeleton and its soft tissue drape, along with their relative proportions that provides the visual impact of the face.[3] Angle was one of the first orthodontist to write about facial harmony.

"All who hope to attain success in treatment of dental irregularities should cultivate the habit of observing and carefully studying the normal and abnormal human face, together with their relations to and dependence upon the teeth".

According to him the form and beauty of the face depends on the occlusal relation of the teeth with underlying bony structures and soft tissue following the underlying hard tissues. There was a shift towards soft tissue paradigm which considered assessment of soft tissue as a priority over hard tissues in diagnosis and treatment planning in orthodontics.[4]

From the profile view, this proportionality should also be evaluated by dividing the face into upper, middle, and lower thirds. The upper face includes forehead prominence, middle third includes nose and malar prominence whereas lower one third includes lip and chin area. Various facial prominences like that of glabella, malar prominence, nose, lips, and chin are related to each other. When either of them is out of proportion, it makes other prominences more protrusive or less. [5]

Fore head projection is evaluated by the position of nasion or glabella points, midface facial attractiveness is evaluated by sagittal projection of the body of malar bone called malar eminence. It is a recognizable feature of the midface contour and prominence of the superiolateral part of the cheek. The balance between dentoalveolar and malar support has significant influence over the nasal base-lip contour (Nb-LC) [6] Increasing malar prominence enhances the angularity and fullness of the midface. Pop culture portrays people with high malar prominence and angular faces as beautiful and exotic.[7] On the other hand, people with midface deficiency tend to have a gaunt or hollow midface leading to increased show of the sclera inferior to the pupil.[8]The hollow midface creates a perpetually tired, worn out, older and sad appearance [6,7,8] Aging augments the hollowness as soft tissue atrophy and sagging reduce malar soft tissue prominence and moves the soft tissue prominence to a more inferior position.[9]

Nasal form, its prominence and orientation of nasal tip along with position of lips and dentition portrays the attractiveness of face. Additionally the form and prominence of the chin also plays an important role in governing facial esthetics.[4] A large nose decreases the apparent size of the chin and malar prominences. Flat malar prominences make the nose large and unseemly. Likewise, a large nose can be masked by augmenting the malar prominences and chin.

As an Orthodontist, we can improve the aesthetics of lower third of face with the help of orthodontics alone but with the combination of orthodontics and surgery, we can partially improve the facial aesthetics of middle third of face as well, although both these modalities will not change the structures of high midface or upper third of face. The relationship of unbalanced structures of this region with other areas of face that are improved as a result of orthodontics or ortho-surgical approach must be anticipated and explained to the patients beforehand. This will help us in formulating treatment plan based on realistic expectations of the patient.

Analysis of hard and soft tissue facial profile is important as its relationship would help in deciding the objectives of diagnosis and treatment planning. The perception of an attractive face is largely subjective, with ethnicity, age, gender, culture, and personality influencing average facial trait [10]. Interestingly, facial features are usually studied in profile. Various methods have been used to evaluate the soft facial characteristics such as craniofacial anthropometry [11], photogrammetry,[12] cephalometric radiography, stereophotogrammetry, computed tomography and laser scanning [1].

Different soft tissue analysis have been developed to evaluate soft tissues characteristics on Lateral Cephalogram. Merrifield[3], Burstone[13], Holdaway[14], Rickets[15], Powell[4] and Arnett[16] have given analysis to assess soft tissue profile of the patients. Powell and Humpherys [4] described the esthetic angles formed by the nasofrontal, nasofacial, nasomental and the cervicomental planes.

Soft tissue profile can be reliably measured from facial photographs. It is simple to take and is relatively non-invasive and cost-effective method. It also avoids inconvenience to the participants and saves valuable time. It provides a permanent record for the actual appearance of the participants. As the outline of the photograph do not change and the soft tissue becomes incompressible on the bone, thus the data obtained from the analysis of photogrammetric profile can provide the clinicians(like maxillofacial and plastic surgeons or orthodontists) a information related to various soft tissue segments of the facial region and accordingly helps in formulating an aesthetic treatment plan for the patients,[1] however a major disadvantage of photographic assessment is that we cannot measure the thickness of soft tissue which can only be seen on a radiograph. A more advance 3D photography has created the potential for comprehensive facial evaluation. [17]

Stoner[12] started to use analysis of the soft tissues of the face on photographic records. Graber [18] stated that the photograph assumes even greater importance when dentists do not have equipment for taking cephalographs, he considered facial photographs as an essential diagnostic tool. Stoner and Fernandez-Riveiro et al [19] standardized the photographic technique and started taking photos in natural head position (NHP) to make an adequate comparison among groups.

Leonard and Walker [20] conducted a study on a sample of white American females from 15 years to 30 years, to assess the relative position of the malar eminence (orbital) with respect to point A. They found that the retrusive maxilla (low SNA angle) is closely related to a backwardly situated orbital rim and malar eminence, whereas the prominent point A does not carry with it a prominent malar or orbital rim. Frey ST [5] conducted a study to determine whether a visual classification of anterior malar support using vector relationships was supported by cephalometric analysis, found highly significant differences in anterior malar projection (angle SNO) between patients with negative and positive vector relationships.

It is well established that the ideal norms for facial aesthetics are not appropriate for application to diverse race and ethnic group, as the facial features are largely influenced by race, ethnic group, age, sex, culture etc [21]. Soft tissue profile characteristics using photogrammetry have been reported for North American population[4],Spanish[20], Brazilllian Caucasians[22], Croatian[23] and Turkish[13] populations, and were different from the original norms given for particular cephalometric analysis.

In Indian subcontinent, North Indians (the descendants of Aryans) and South Indians (the descendants of Dravidians) differ considerably in soft tissue characteristics as assessed by cephalometric analysis [24].This study is conducted to evaluate and compare the proportion in attractive people using photographs in North Indian and South Indian faces by means of facial measurements on profile photographs with the help of nemoceph software.

Aim of the study:

To Evaluate and compare facial aesthetics and malar prominence on facial profile photographs of North Indian and South Indian population.

Objective of Study:

1. To evaluate the facial aesthetics and malar prominence in male and females of north Indian population.
2. To evaluate the facial aesthetics and malar prominence in male and females of south Indian population.
3. To compare the facial aesthetics and malar prominence in male and females of north Indian and south Indian population.

START WITH SOME LITTLE INTRODUCTORY LINES……….

Pack H and Pack S (1970)[25] stated that Soft tissue profile can provide valuable information in development of meaningful concept of facial asthetics, furthermore as a supplement to other diagnostics records a photographic profilometric analysis can yield useful clinical data

Leonard MS and Walker GF (1977)[20] conducted a study on white American females to find the relative position of the malar eminence to the maxilla and other cephalometric landmarks. The subjects were divided into three groups based on SNA angle viz, (1) represented those with retrognathic maxillae, (2) a normal or average position of maxilla and (3) those with some degree of maxillary protrusion. They found the relationship between the malar eminence and the maxillary point A. WHICH RELATION SHIP ?.......

HoIdaway (1984)[14] described the treatment planning method based upon prediction and the desired treatment objectives with the help of VTO (fullform of VTO). The purpose was to establish balance profile and pleasing facial aesthetics and to evaluate the orthodontic correction necessary to achieve this goal. He said that for patients in whom growth is expected, forecasting growth with a visual treatment plan with the input of soft tissue visualization will be useful. Growth responses are generally predictable within certain limit and can be measured. For relatively short treatment periods, sliding the VTO tracing upward and forward along the basion- nasion line was satisfactory.

Arnett G (1993)[16] presented an organized, comprehensive clinical facial analysis to discuss the soft tissue changes associated with orthodontic and surgical treatments of malocclusion. Nineteen key facial traits were analyzed in frontal view and profile view on patients with natural head position, centric relation and relaxed lip posture. With this analysis the normal facial traits are maintained and abnormal characteristics are corrected with orthodontics and surgery.

Arnett G et al (1999)[26] conducted a study on 46 adult white models with Class I occlusion to initiate a new soft tissue cephalometric analysis tool. They assessed clinically in natural head position, seated condyles, and with passive lips. This analysis could be used by the orthodontist and surgeon as an aid in diagnosis and treatment planning. The novelty of this approach was an emphasis on soft tissue facial measurement.

Ismail SFH et al (2002)[27] compared 3-dimensional (3-D) effects on the face of extraction and non-extraction orthodontic treatment. Samples for their study was composed 24 patients which included 12 patient treated with extractions and 12 who were treated without extractions. Pre and post treatment lateral cephalograms and optical surface scans were also compared. Results of the study showed that at the end of the treatment, the non-extraction group showed more convex cheeks whereas in extraction group the lower part of the cheeks showed a gradual flattening.

Hwang S H et al (2002)[28] compared the soft tissue profiles obtained from Korean and European-American adults with normal occlusions and well-balanced faces, in order to understand the ethnic differences in the soft tissue profile between these two ethnic groups. The Korean had a lower angle of nasal inclination and a higher degree of lip protrusion compared to the European-American adults. Chin protrusion of the Koreans was less prominent than that of the European-Americans.

Riveiro P.F et al (2003) [29] analysed the soft tissue facial profile from photographic records . In this investigation the soft tissue facial profile of a young adult European Caucasian population (212 individual, 50 males and 162 females, 18-20 years of age) was studied by means of standardized photographic records taken in the natural head position (NHP). Angular measurements were analysed digitally. Sexual dimorphism was found for several angles: nasofrontal (G-N-Prn: $P < 0.01$), vertical nasal (Cm-Sn/N-Prn: $P < 0.01$), nasal (N-Prn/TV: $P < 0.01$), nasal dorsum (N-Mn-Prn: $P < 0.05$), and mandibular contour (C-Me/G-Pg: $P < 0.01$). Wide individual variations in nasolabial and mentolabial angles were also observed.

Jain SK et al (2004) did photometric, vertical and angular measurements of 100 adult Himachali males and compared with North American population. Analysis of 100 frontal view photographs showed that the distance between nasion to subnasale varied from 11 to 17 mm with an average of 13.7 mm while the distance between SN-MN varied from 11 to 22 mm with an average of 16.9 mm. Percent ratio of these length N-SN and SN-MN to full length i.e nasion to menton(N-MN) varied from 36.3 to 52% with an average of 44.63% for N-SN and 48% to 63.7% with an average of 55.37%. Interfacial evaluation as done by calculating the angles of aesthetic triangle i.e. nasofrontal, nasofacial, nasomental and mentocervical well correlates with the study of North American population done by Powell and Humphries (1984) with a specific remark that values of Himachali males for all the angles are towards the higher side except the nasofacial angle, the average of which is slightly lower. Lower Nasofacial angle shows the projection of nose in Himachali population is less than North Americans.(removed the lines…)

Dimaggio FR et al [31] studied photographic soft tissue profile of 110 children having Angle Class I dental relationship (67 boys, 43 girls), 42 children with Angle Class II (28 boys, 14 girls), and 29 children with Angle Class III (14 boys, 15 girls). Landmark coordinates were obtained by using dedicated software and linear distances and angles were automatically computed. They found that facial convexity was larger in boys than in girls; Sn-N-Sl and nasolabial and interlabial angles differed significantly between the sexes. Girls had significantly less labial protrusion than boys. Facial height was significantly greater in children with Dental Class II, without sex differences. They also found that angles were significantly influenced by dental class. Facial convexity was smaller in children with dental Class II. Lips were more prominent in children with dental Class II than those with dental Class III.

Kale-Varlk S (2008)[32] Standardized right lateral facial photographs of 111 Anatolian turkish (64 females, 47 males) with class I skeletal pattern. Age range was 21 to 40 years. Descriptive statistics for 8 angular measurements were computed. Male and female values were compared with Mann-Whitney U test. Intraclass correlation coefficients (ICCs) were calculated for repeated measurements. Intraobserver reliability of the photogrammetric measurements was quite high with 6 measurements having ICCs above 95% and the other 2 measurements having ICCs of 77% and 87%. Sexual dimorphism was found for 4 measurements: Nasofacial (G-Pog/N-Prn: $P < 0.001$) and middle facial height (N-Trg_Sn: $P < 0.05$) angles were higher in men, whereas nasal (N-Prn-Sn: $P < 0.01$) and nasolabial (Cm-Sn-Ls: $P < 0.05$) angles were higher in women. Nasofrontal (G-N-Prn), nasal (N-Prn-Sn), and nasolabial (Cm-Sn-Ls) angles revealed large individual variations.

Malkoc S et al (2008) [33] targeted to develop angular photogrammetric standards for Class I Anatolian Turkish males and females. They took A random sample of 100 Turkish individuals (46 males and 54 females; ages 19–25 years).The camera was used in its manual position and photographic records were taken of the subjects in natural head posture. The photographic records, 35 mm slide format, were digitized and analyzed using the Quick Ceph Image software program for Windows. Twelve measurements were digitally analyzed on each photograph. For statistical evaluation a Student's t-test was performed and the reliability of the method was analyzed. The results were compared with reported norms of facial aesthetics. The nasofrontal (G–N–Prn), nasal (Cm–Sn/N–Prn), vertical nasal (N–Prn/TV), and nasal dorsum (N–Mn–Prn) angles showed statistically insignificant gender differences (P> 0.05). The nasolabial angle (Cm–Sn–Ls) demonstrates large variability. Gender differences were present in the mentolabial (Li–Sm–Pg) and cervicomental (G–Pg/C–Me) angles. The mentolabial angle showed a high method error and large variability. Facial (G–Sn–Pg) and total facial (G–Prn–Pg) convexity angles were similar, while Cm–Sn–Ls angle range was larger compared with other angles.

Milosevicy et al (2008)[34] evaluate the variables defining the soft tissue facial profile of a Croatian (Caucasian) sample, by means of angular measurements typically used for aesthetic treatment goals. Additionally, gender differences were tested. The soft tissue facial profiles of 110 dental students (52 males and 58 females) between 23 and 28 years of age at the University of Zagreb, Croatia, with a dental Class I occlusal relationship and harmonious soft tissue profile were studied by means of standardized photographs taken in the natural head position (NHP). To compare males and females, a Student's t-test was used. The reliability of the method was analysed using Dahlberg's formula.There were distinct gender differences. All angles were larger in females:

nasofrontal (G–N–Nd in females = 139.11°and in males 136.38°,P = 0.030), nasolabial (Cm–Sn–Ls, females = 109.39°,males = 105.42°,P = 0.018), mentolabial (Li–Sm–Pg, females = 134.5° and in males = 129.26°, P = 0.019), and nasal tip angle (N–Prn–Cm, female = 84.12°, male = 79.85°, P = 0.001). The greatest variability was found for mentolabial angle.

Cephalometric and photographic measurements of facial attractiveness after orthodontic treatment was correlated in Chinese and US patients by **Oh H S et al (2009)**[35] Forty-five Chinese and US orthodontic clinicians ranked end-of-treatment photographs of separate samples of 45 US and 48 Chinese adolescent patients for facial attractiveness. Separately for each sample, the photographic rankings were correlated with the values of 21 conventional hard- and soft-tissue measures from lateral cephalograms taken at the same visits as the photographs. Among US patients, higher rank for facial attractiveness on the photographs was strongly associated with higher values for profile angle, chin prominence, lower lip prominence, and Z-angle, and also with lower values for angle of convexity, H-angle, and ANB. Among Chinese patients, higher rank for facial attractiveness on the photographs was strongly associated with higher values for Z-angle and chin prominence, and also with lower values for angle of convexity, H-angle, B-line to upper lip, and mandibular plane angle. Chinese patients whose %lower face height values approximated the ethnic "ideal" (54%) tended to rank higher for facial attractiveness than patients with either higher or lower values for %lower face height. The absolute values of the correlations for the 7 US measures noted above ranged from 0.41 to 0.59; those of the 7 Chinese measures ranged from 0.39 to 0.49.The P value of the least statistically significant of these 14 correlations was 0.006, unadjusted for multiple comparisons. On the other hand, many cephalometric measures believed by clinicians to be indicators of facial attractiveness failed to correlate with facial attractiveness rank for either ethnicity at even the $P < 0.05$ level, including SN-pogonion angle, lower incisor to mandibular plane angle, and Wits appraisal. So there was less association than expected or desired between objective measurements on the lateral cephalograms and clinicians' rankings of facial attractiveness on sets of clinical photographs.

Oghenemavwe E.L. et al (2010) [36] conducted a study to determined facial soft tissue norm for Urhobos adults by means of vertical and angular measurements. Standardized photographic record of 120 (60 male, 60 females) Urhobos young adults between 18 and 35 years were taken in the natural head position using a digital camera. The measurements of the vertical and angular parameters were done with the aid of a ruler and protractor. The Urhobos males had a mean percent ratio of 42.27±3.71 for middle face and 57.73±3.63 lowers face. The mean values of nasofrontal angle was 117.75±9.07º, 40.77±6.29º for nasofacial angle, 121.95±7.93º for nasomental angle and 93.33±3.27 for mentocervical angle. The females had a mean percent ratio of 43.51±3.66 for middle face height and 56.49±3.69 for lower face height. The nasofrontal angle was 127.859.50º, nasofacial angle 35.607.46º, nasomental angle 126.55±6.93º and mentocervical angle 90.88±3.58º. There was sexual dimorphism in all measured parameters except the lower face.

Anibor E and Okumagba M.T (2010) [37]– done a photometric facial Analysis of the Urhobo Ethnic Group in Nigeria to determine the aesthetic triangle for Urhobo ethnic group in Nigeria. The subjects aged 18-25 years were selected. Significant differences were observed between Urhobo males and females in Nasofrontal and Mentocervical angles ($p < 0.05$) but not in the Nasofacial and Nasomental angles ($p > 0.05$).The Urhobo subjects have a mean Nasofrontal angle of 116.28 degrees (0); Nasofacial angle of 38.50; Nasomental angle of 127.20 and Mentocervical angle of 87.350. The findings of this study formed a baseline data for the Urhobo people.

Reddy M et al (2011)[38] studied angular photgrammetric measurements of the soft tissue facial profile of 150 north Indian males and females between 18 and 25 years of age having class I dental relationship. The photographic records of the subjects were taken in natural head posture. The obtained records were digitized and analyzed using the Nemoceph NX software program. The results were compared with established soft tissue profile photogrammetric norms. They found that facial convexity, maxillary lip contour, nasal tip, nasolabial, nasomental and nasofacial angles showed statistically insignificant gender differences where as nasofrontal, total facial convexity, cervicomental and mandibular lip contour angle demonstrated significant gender differences. They concluded that the average values obtained in their study can be considered in the diagnosis and treatment planning of patients.

Saxena T. et al (2012)[39] tried to determine soft tissue thickness value of people of Bareilly. They evaluated total 40 (19 males , 21 females) individuals by using spiral computed tomographic (CT) scan with 2 mm slice thickness in axial sections and soft tissue thickness was measured at seven midfacial anthropological facial landmarks. They found that soft tissue thickness value decreased with age and values were less in female than males. They also concluded that CT scan gives good representation of soft tissue thickness values and can be considered as good tools for facial reconstruction.

Ukoha U.U et al (2012)[40] studied one hundred and twenty subjects aged between 18 and 28 years at the Anambra State University, Uli, Nigeria. The frontal and right lateral view photographs of their faces were taken and traced out on tracing papers. On these, two vertical distances, nasion to subnasal and subnasale to menton, and four angles, nasofrontal (NF), nasofacial, nasomental (NM) and mentocervical, were measured. On comparing the linear and angular measurements, it was found that the Igbo Nigerian adult male had a middle face that was shorter than the lower one (41.76%vs.58.24%), a moderate glabella (NF=133.97°), a projected nose (NM=38.68°).

Sachan et al [2012] [41] studied soft-tissue cephalometric norms in a north Indian ethnic population on 60 individuals (30 males and 30 females) with normal occlusion and proportional facial profile. Results showed that men had greater soft-tissue facial angle (92.10°) than women (89.92°). Also, they had more nose prominence (18.10 mm) than women (16.44 mm). Skeletal profile convexity (A to N-pog) of men (0.40 mm) was less than women (1.76 mm). Basic upper lip thickness was higher in men (16.60 mm) compared to women (14.24 mm), while H-angle was higher in women (16.68°) as compared to men (14.30°). In the lower face area, inferior sulcus to the H line distance was more in men (7.30 mm) than women (4.80 mm). Men had greater soft-tissue chin thickness (14.10 mm) than women (12.84 mm).

Martin L F and Vigorito J W (2012) [42] in his work included sixty four adult Caucasian Brazilian individual of both genders. Lateral cephalograms and facial frontal photographs of all individuals were taken .The facial types were determined by the Vert Index (cephalometric) and the Facial Index (photographs) and observed that the facial type determination by the photometric method (Facial Index) showed to be reliable when compared to cephalometry (assessed by the Vert Index). They concluded that the facial photometric analysis should be adjuvant, or supplemental, and not substitute for the cephalometric method, since, especially in cases where the values of Vert are borderline between two facial types, the soft tissues can mask the bone characteristics.

Almeida Castro Morosin et al (2012) **[43]** done numeric facial analysis to determine facial attractiveness. They took Frontal and lateral standard facial photographs, in natural head position, of 85 Brazilian Caucasian women. The sample mean age was 23 years and 9 months. A group of 5 orthodontists, 5 layman and 5 plastic artists classified the photographs according to their own attractiveness graduation in: pleasant, acceptable and not pleasant. The numeric facial analysis was then performed using a computerized method. Linear, proportional and angular measurements were compared among groups. According subjective analysis the sample was consisted of 18.8% of pleasant, 70.6% of acceptable and 10.6% of not pleasant. In most measurements there were no differences among groups. Just in three of them significant statistical difference was observed and in two of them the comparison value was within decision limit. All the differences were found related to the lower third of the face and to facial pattern. They concluded that numeric facial analysis, by itself, is not capable of detecting facial attractiveness, considering that beauty judgment seems to be very personal.

Ferdousi MA et al (2013) **[1]** measured some craniofacial angles of the Bangladeshi Garo males and females on standardized facial profile photographs and compare them with each other and with norms of different ethnic group proposed by the other investigators. The study was carried out with a total number of 100 Christian Garo adult male and female subjects. Statistical analysis showed that the females had significantly higher values than the males in three facial angles ($p<0.05$): the nasofrontal angle (G-N-Pro, females=137.97˚±4.80˚; males = 129.57˚±7.96˚), the nasomental angle (N- Prn-Pg, females =132.79˚±5.10˚; males = 129.75˚±7.32˚) and the angle of facial convexity (G-Sn-Pg, females =169.26˚±4.43˚; males =158.65˚± 12.17˚) but no differences between the nasofacial (G-Pg/ N-Prn) and nasolabial angle (Cm-Sn-Ls).

Alberto Rossett et al (2013) **[44]** used three-dimensional (3D) stereophotogrammetry for measurement of facial anthropometry. They obtained 3D stereophotogrammetric facial acquisitions of 400 healthy young adult subjects, then had them scored by an Evaluation Jury. Each subject received an esthetic evaluation ranging from 0 to 40. Individuals with a score larger than 28 were considered very attractive (VA), and individuals with a score lower than 12 were considered not attractive (NA). Fifteen subjects per group were chosen by chance, with a final total group of 60 subjects: 15 VA males, 15 NA males, 15 VA females, and 15 NA females. For each subject, a set of facial distances was obtained from the stereophotogrammetric facial reconstruction, and 10 ratios were computed. The effects of sex and attractiveness were tested by analysis of variance. Additionally, Student's t tests verified if the ratios were statistically different from the golden ratio. Results: For nine ratios, no significant effects of sex or attractiveness were found. Only the eye mouth distance/height of the mandible ratio was significantly influenced by sex (P 5 .035) and attractiveness (P 5 .032). Seven out of 10 ratios were statistically different from the hypothetical value of 1.618, and only three of them were similar to the golden ratio they concluded that Ratios between 3D facial distances were not related to attractiveness.

Forteset H N R at al (2014) **[45]** conducted a study to identify which linear, angular and proportionality measures could influence a profile to be considered esthetically pleasant or unpleasant, and to assess sexual dimorphism. They studied 150 standardized facial profile photographs of dental students of both sexes. To identify parameters, plastic surgeons, orthodontists and lay person answered a questionnaire characterizing each profile as pleasant, acceptable or unpleasant. With the use of a score system, the 15 most pleasant and unpleasant profiles of each sex were selected. The photographs were scanned into AutoCAD computer software. Linear, angular and proportion measurements were obtained using the software tools. The average values between groups were compared by the Student's t-test and the Mann-Whitney test at 5%. The linear measures LL-S, LL-H, LL-E, LL-B and Pn-H showed statistically significant differences ($p < 0.05$). Statistical differences were also found in the angular measures G'.Pn.Pg', G'.Sn.Pg' and Sn.Me'.C and in the proportions G'-Sn:Sn-Me' and Sn-Gn':Gn'-C ($p < 0.05$). Differences between sexes were found for the linear measure Ala-Pn, angles G'-Pg'.N-Pn, Sn.Me'.C, and proportions Gn'-Sn:Sn-Me' and Ala-Pn:N'-Sn. ($p< 0.05$). study conclude that The anteroposterior position of the lower lip, the amount of nose that influences the profile, facial convexity, total vertical proportion and lip-chin proportion appear to influence pleasantness of facial profile. Sexual dimorphism was identified in nasal length, nasofacial and lower third of the face angles, total vertical and nasal height/length proportions.

Frey ST (2013) **[5]** conducted a study to determine whether a visual classification of anterior malar support using vector relationships was supported by cephalometric analysis. The sample comprised 40 white subjects between the ages 10-12 years, without cranio-facial syndromes or previous orthodontic treatments; Sample was equally divided into two groups based on visual assessment of negative and positive vector relationship. The results of the study showed that there was no statistically significant difference between genders.

Prasanna LC et al (2013) **[46]** studied on 200 adult individuals with normal craniofacial configurations; of which 100 males and 100 females of northern and southern India. They included parameters for data collection were Total facial height (nasion to gnathion, upper facial height (nasion to prosthion), bizygomatic width (distance between two zygions, and height of the individual. Total and upper facial indices were calculated, on the basis of international anatomical descriptions based on Bannister's classification. The correlation between total body height, total facial index and upper facial index was determined by using the regression formula. Statistically significant differences (p=0.001) were noticed on comparing the parameters of total facial index between north and south Indian females (107.7±7.69 and 85.39±6.33 respectively), north Indian males (101.4±1.95) and females (107.7±7.69) and south Indian males (100.28±1.77) and females (85.39±6.33), and a significant difference was obtained between facial indices of total Indian males and females (p=0.003). Standard comparison parameters of upper facial index between north Indian males (58.99±2.11) and south Indian males (58.46±2.05) and between north Indian males (58.99±2.11) and north Indian females (60.4±3.59) showed statistically significant differences. Upper facial index showed highly significant results between north Indian females (60.4±3.89) and south Indian females (52.3±3.43), south Indian males and females (58.46±2.05 and 52.3±3.43 respectively), and between total Indian males and females (p=0.001).North Indian females have longer upper facial heights than facial widths and therefore, their faces become longer. In contrast, the facial widths of south Indian females are larger than their upper facial heights, which cause their faces to be presented as broad to round.

Pattanaik S, Pathuri S (2014)[47] studied on 90 individuals (45 males, 45 females) of age group 18-25 years of native coastal Andhra Pradesh, with acceptable pleasing profile, normal Class I occlusion having ideal anterior bite. Standard profile photographs were taken and angular photogrammetric analysis was carried out through AutoCAD software and significant difference in Naso-frontal angle (G–N–Nd; males: 130.64 ± 6.27o; females: 140.33o ± 6.85o; P = 0.000) and Mento-labial angle (Li–Sm–Pg: females: 127.38o ± 5.35o; males: 124.82o ± 6.57o; P = 0.043) was found. They concluded that males of Coastal Andhra Pradesh have mild convex profile and prominent nose whereas females have mild convex profile due to recessive chin. A higher upper lip prominence was seen in males.

Anibor E. and Okobia R. (2014)[48] carried out study to provide data and compare the mean facial angle between male and female of 100 Ibo subjects aged between 18 and 30 years. The subjects had the right-side photographs of their faces taken with a digital lens camera. Computer assisted analysis of the facial photographs was done. The following soft tissue points were introduced on the photographic images: the tragion (Tr), nasion (N) and pogonion (P). Significant differences were found between Ibo males and females in the measurements of the facial angle ($P < 0.05$). The mean facial angles of Ibo male and female subjects were 83.1 and 81.1 degrees respectively.

Ajami S Najafi Z H and Mahdavi S (2015)[49] done photogrammetric Analysis of the Soft Tissue Facial Profile of Iranian Young Adults. Standardized profile photographic records were taken from 34 men and 37 women. Twelve measurements were analyzed on each photograph by AutoCad software. For statistical evaluation a Student's t-test was used and the reliability of the method was assessed by using Intra-class Correlation Coefficient (ICC) within a four week interval.The results showed gender dimorphism in the nasofrontal, the nasal and the vertical nasal angles. Another significant finding was the large variability for the mentolabial angle.

To establish the soft tissue profile norms of northern Gujarat population **Hiren Chokshi et al (2015)[50]** done photogrammetric analysis of 50 subjects with age ranges of 18-25 years. Subjects were divided into two groups in which 25 were males and 25 were females. The profile photographs of the all subjects were taken in natural head position. The soft tissue landmarks were marked and linear photogrammetric analysis was carried out. Student's t-test showed sexual dimorphism of labial, nasal, and chin areas.

Males had greater heights and lengths. At the tragus point, nasal, and facial depths are greater in the males. This study conclude that males have greater facial heights, long nose and chin lengths and prominences and a greater nasal and facial depth in the tragus point.

Feng Wu et al (2015)[51] compared facial characteristics of attractive Chinese men to normal men they collected three-dimensional coordinates of 50 facial landmarks in 40 healthy reference men and in 40 "attractive" men, soft tissue facial angles, distances, areas, and volumes were computed and compared using analysis of variance. When compared with reference men, attractive men shared several similar facial characteristics like relatively large forehead, reduced mandible, and rounded face. They had a more acute soft tissue profile, an increased upper facial width and middle facial depth, larger mouth, and more voluminous lips than reference men. They found that Attractive men had several facial characteristics suggesting babyness. Nonetheless, each group of men was characterized by a different development of these features. Esthetic reference values can be a useful tool for clinicians, but should always consider the characteristics of individual faces.

Yi Feng wenet al (2015)[52] conducted comprehensive and systematic search of PubMed, ISI Web of Science, Embase, and Scopus to identify facial photogrammetric studies published before December, 2014. Subjects of eligible studies were Africans, Asians or Caucasians. A Bayesian hierarchical random effects model was developed to estimate posterior means and 95% credible intervals (CrI) for each measurement by ethnicity/race. Linear contrasts were constructed to explore inter-ethnic/racial facial variations. They identified 38 eligible studies reporting 11 angular and 18 linear facial measurements. Risk of bias of the studies ranged from 0.06 to 0.66. At the significance level of 0.05, African males were found to have smaller nasofrontal angle (posterior mean difference: 8.1°, 95% CrI: 2.2°–13.5°) compared to Caucasian males and larger nasofacial angle (7.4°, 0.1°–13.2°) compared to Asian males. Nasolabial angle was more obtuse in Caucasian females than in African (17.4°, 0.2°–35.3°) and Asian (9.1°, 0.4°–17.3°) females. Additional inter-ethnic/racial variations were revealed when the level of statistical significance was set at 0.10.

Moshkelgosha V et al (2015)[53] done observational study included 110 females and 130 males high school students aged 16-18 years to obtain objective average measurements of the profile and frontal facial soft tissue In each case, two standard photographs of profile and frontal views were taken 27 landmarks were digitized on photographs. The mean, standard deviation, and range for a total of 43 facial indices were calculated digitally by computer software. The Student's t-test was used to compare males and females. The ratio between the lower and middle facial thirds was one to one, but the height of the upper facial third was proportionally smaller than the other two-thirds in both sexes. Boys had greater nasal length, depth, and prominence than girls with statistically significant differences. Both upper and lower lips were more prominent in girls than in boys. All measurements of the chin showed sexual dimorphism characterized by greater chin height and prominence and deeper mentolabial sulcus. Boys had greater facial dimensions than girls. Mouth width, nasal base width, and intercanthal distance were significantly greater in boys. The labial, nasal, and chin areas showed sexual dimorphism in most of the parameters used in this study. Boys had larger faces, greater facial heights, longer nasal, labial, and chin lengths, and greater nasal, labial, and chin prominence.

Kaptein YE et al (2015)[54] assessed the vertical location of the malar prominence relative to other facial landmarks, determined consistency among individuals, and compared this with values used in artistry. Studied population consisted of a convenience sample of 67 patients taken from an otolaryngology practice at a large urban medical center. Coordinates of the malar prominence were referenced to distinct facial landmarks from which the ratio of chin-to-malar prominence to chin-to-eye canthus was determined. Average chin to malar prominence distance was 0.793±0.023 (SD) of the chin to eye canthus distance.Variability due to the specific image chosen [coefficient of variation (CV) = 1.19%] and combined inter/intrareader variability (CV = 1.71%) to validate the methodology. Variability among individuals (CV = 2.84%) indicates population consistency. No difference was found between gender and age groups or between whites and Hispanics. Individuals of other/unknown ethnicities were within the range common to whites and Hispanics. Our population's value is not different from the value of 0.809 used in artistry, which is based on the Golden Ratio.

In A photogrammetric analysis of soft tissue facial profile of Himachal population on 200 subjects **Bhandari et al (2015)[55]** reported that himachali males and females show considerable sexual dimorphism with less prominent nose as compared to Caucasian population. Males and females show considerable less protrusive lower lip as compared to Caucasian population. males have larger superior, middle, and inferior facial third as compared to Himachali females but found lesser as compared to Caucasians males have larger upper and lower lip length as compared to Himachali females but found lesser as compared to Caucasians. Males have more chin height as compared to Himachali females but found lesser as compared to Caucasians. Females had more convex profile, less protrusive upper lip, and more tipped nose .The comparison between Himachali population and Caucasian population suggested that Himachali population had more prominent nose, more protrusive upper and lower lip and more convex profile, lesser height of superior, middle and inferior facial third, smaller upper and lower lip length and smaller chin height.

Nishigandha Sadamat et al (2016) [56] find out the soft tissue profile by photometric method in Maharashtrian adult population and compared with other ethnic groups. 201 subjects from age group of 25-30yrs (100 Males and 101Females) were studied and parameters were measured by using protractor. The resultants means of facial angles for Male population were Nasofrontal -1340,Nasofacial 35.10, Nasomental 125.70 and Mentocervical -112.60 and in Females Nasofrontal -1380, Nasofacial -34.60, Nasomental 127.40 and Mentocervical -107.70 by statistical analysis. **ShvetaDuggal et al (2016)** [57] conducted a cross-sectional study on 150 samples (referred to as candidates). Frontal photographs were analyzed. An orthodontist, a prosthodontist, an oral surgeon, a dentist, an artist, a photographer and two laymen (estimators) subjectively evaluated candidates' faces using visual analog scale (VAS) scores. As an objective method for facial analysis, we used balanced angular proportional analysis (BAPA). Using SAS 10.1 (SAS Institute Inc.), the Turkey's student zed range test and Pearson correlation analysis were performed to detect between-group differences in VAS scores (Experiment 1), to identify correlations between VAS scores and BAPA scores (Experiment 2), and to analyze the characteristic features of facial attractiveness and gender differences (Experiment 3); the significance level was set at P=0.05. Experiment 1 revealed some differences in VAS scores according to professional characteristics. In Experiment 2, BAPA scores were found to behave similarly to subjective ratings of facial beauty, but showed a relatively weak correlation coefficient with the VAS scores. Experiment 3 found that the decisive factors for facial attractiveness were different for men and women. Composite images of attractive

Indian male and female faces were constructed. Photogrammetric study, statistical analysis, and average composite faces of an Indian population provide valuable information about subjective perceptions of facial beauty and attractive facial structures in the Indian population.

Laishrambijaya Devi et al (2016) [58] evaluated the soft tissue facial profile using angular photogrammetric norms and gender difference from standardized photographs of adult Bengali population. The study was conducted among 100 dental students aged 18-25 years with Angle's class I occlusion, normal overjet-overbite, normal growth and development, normal maxillary and mandibular arches with all teeth excluding third molars. The dental students were selected from family with a minimum of three consecutive Bengali generations. Individuals with pleasing facial profile were judged by 1 layman, 8 post-graduate students and 2 orthodontists. Profile photographs were obtained at natural head position. Soft tissue landmarks were marked. Comparison of mean soft tissue profile measurement between male and female subjects using unpaired t-test showed statistically significant gender differences (<0.01) in facial, total facial, nasolabial and upper lip angles. They concluded that derived mean values can be considered as normal values for Bengali population. It can be used for comparison of subjects with malocclusion.

Melo AR et al (2017)[59] evaluated Frontal and profile view photographs of 30 black individuals for facial attractiveness and classified as esthetically unpleasant, acceptable, or pleasant by 50 evaluators. Evaluators included as (10) orthodontist, (10) laymen, and black individuals from the samples. The evaluators identified the structures as pleasant and unpleasant. The structures most identified as esthetically pleasant were harmony, face, and mouth, in the frontal view; and harmony and nose in the profile view. The ratings by the examiners in the sample and laymen groups showed statistically significant correlation in both views. The orthodontists agreed with the laymen on the evaluation of the frontal view and disagreed on profile view, especially regarding whether the images were esthetically unpleasant or acceptable. Based on these results, the evaluation of facial attractiveness according to the Subjective Facial Analysis criteria proved to be applicable and to have a subjective influence; therefore, they suggested that the patient's opinion regarding the facial esthetics should be considered in orthodontic treatment planning.

MATERIAL AND METHODS

PLACE OF STUDY

Neonatal intensive care unit (NICU) of department of U.P University of Medical Sciences, Saifai, Etawah, U.P.

STUDY POPULATION

Term newborns with perinatal asphyxia admitted in Neonatology unit (NICU) of department of Pediatrics of UP university of Medical Sciences, Saifai, Etawah.

STUDY DURATION

January 2017 to June 2018 over a period of 18 months.

INCLUSION CRITERIA

Inborn term neonates (37-42 completed weeks) who fulfill the any one of the following critera were included in our study:

1. Failure to initiate and sustain breathing at birth (WHO criteria)

2. Apgar score <7 at 1 minute of age (NNPD criteria)

EXCLUSION CRITERIA

1. Neonates whose parents not willing to give consent for participation in study.

2. Preterm(<37 week of gestation) & Out born Neonates.

3. Neonates with congenital malformations & congenital infections.

4. Neonates with confirmed or suspected clinical Meningitis.

5. Neonates with non vigorous MSL (Meconium stained liquor)

6. Neonates with primary disease of liver (Neonates with deranged baseline LFT as per age reference values assumed to have primary disease of liver).

7. Neonates with primary disease of kidney (Neonates with deranged baseline KFT as per age reference values in presence of normal maternal KFT assumed to have primary disease of kidney).

8. Maternal USG during pregnancy showing any structural abnormality of fetal kidney or liver.

9. Neonates with surgical conditions like NEC (Necrotising enterocolitis) & TEF (trachea esophageal fistula).

10. Neonates with structural disease of liver or kidney confirmed by ultrasonography.

11. Neonates with sepsis (positive sepsis screen and or positive blood culture). Presence of two abnormal parameters in a sepsis screen was considered positive sepsis screen.

SEPSIS SCREEN[91,92]

Parameters	**Abnormal values**
TLC(total leukocyte count)	<5000/mm^3 or >20000/mm^3
ANC(Absolute neutrophil count)	The lower limit for normal ANC begins at 1800/mm^3 at birth, rises to 7200/mm^3 at 12 hours of age & then declines & persists at 1800/mm^3 after 72 hours of age.
Immature/Total neutrophils	≥0.2 (20%)
CRP	≥ 1 mg/dl
Micro-ESR	≥15mm in first hour

Presence of two abnormal parameters in a screen is associated with sensitivity of 93-100%.

STUDY DESIGN

This was an observational descriptive cross sectional study.

SAMPLE SIZE

This was an observational study. Following formula was used to calculate sample size[93]

$$n = 4pq/E^2$$

where n = required sample size, P = positive character, q = (1-p), E = allowable error.

In this study we consider P (incidence of perinatal asphyxia) = 5% (Among the institutional birth incidence of birth asphyxia is 5 %) & we had taken 4 % allowable error. After putting appropriate values in formula we got sample size 118. Total 118 asphyxiated term newborns were used for final stastistical calculation.

STUDY TOOLS

1. New ballard scoring chart
2. APGAR score chart
3. AAP nomogram
4. Randox Imola autoanalyser (for LFT, KFT, Serum electrolytes)
5. Sysmex XN-series (for CBC)
6. Electronic wieghing machine(PHOENIX company)
7. Urobag(sterimed company)

8. Sterile blood collection vials
9. Blood culture bottle with BHI(brain heart infusion) broth
10. Measurement tape, glucometer & test strips
11. Battery operated torch

Gestational age assessment by New Ballard Scoring[94]

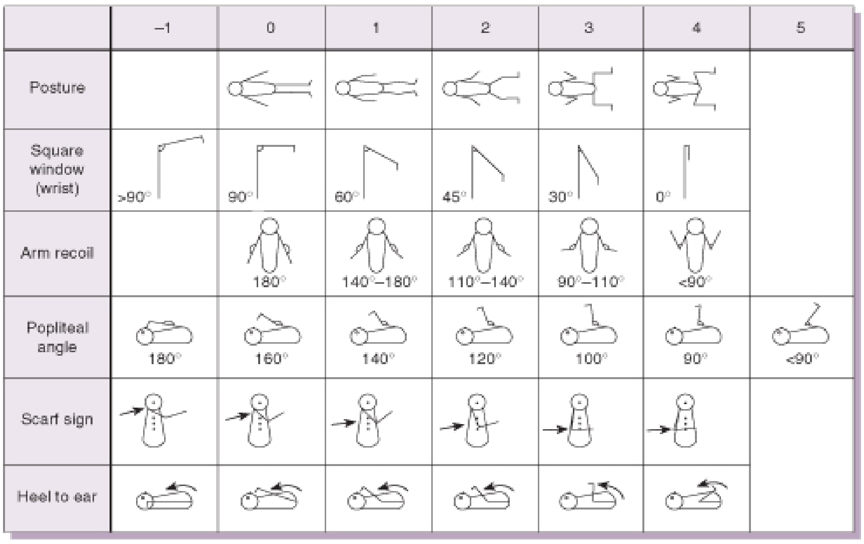
The Ballard Maturational Assessment, Ballard Score or Ballard Scale is a commonly used technique of gestational age assessment. It assigns a score to various criteria, the sum of all of which is then extrapolated to the gestational age of the fetus. These criteria are divided into physical and neurological criteria. This scoring allows for the estimation of age in the range of 26 weeks-44 weeks. The New Ballard Score is an extension of the above to include extremely pre-term babies i.e. up to 20 weeks. The scoring relies on the intra-uterine changes that the fetus undergoes during its maturation. Whereas the neurological criteria depend mainly upon muscle tone, the physical ones rely on anatomical changes. The neonate (less than 37 weeks of age) is in a state of physiological hypotonia. This tone increases throughout the fetal growth period meaning a more premature baby would have lesser muscle tone. It was developed in 1979. The neuromuscular criteria are Posture, Square window, Arm recoil, Popliteal angle & Scarf sign. The physical criteria are Skin, Ear/eye, Lanugo hair, Plantar surface, Breast bud & Genitals. The sum total of all 12 criteria represents neuromuscular & physical maturation of fetus. When compared to the grid on score sheet, the score denotes gestational age by maturational examination.

(a)

Skin	Sticky friable transparent	Gelatinous red, translucent	Smooth pink, visible veins	Superficial peeling &/or rash, few veins	Cracking pale areas, rare veins	Parching deep cracking no vessels	Leathery cracked
Lanugo	None	Sparse	Abundant	Thinning	Bald areas	Mostly bald	
Plantar surface	Heel–toe 40–50mm:–1 <40mm: –2	>50mm no crease	Faint red marks	Anterior transverse crease only	Creases ant. 2/3	Creases over entire sole	
Breast	Imperceptible	Barely perceptible	Flat areola no bud	Stippled areola 1–2 mm bud	Raised areola 3–4 mm bud	Full areola 5–10 mm bud	
Eye/ear	Lids fused loosely: –1 tightly:–2	Lids open pinna flat stays folded	Slightly curved pinna; soft; slow recoil	Well-curved pinna; soft but ready recoil	Formed & firm instant recoil	Thick cartilage ear stiff	
Genitals male	Scrotum flat, smooth	Scrotum empty Faint rugae	Testes in upper canal Rare rugae	Testes descending Few rugae	Testes down Good rugae	Testes pendulous Deep rugae	
Genitals female	Clitoris prominent Labia flat	Prominent clitoris Small labia minora	Prominent clitoris Enlarging minora	Majora & minora equally prominent	Majora large Minora small	Majora cover clitoris & minora	

Maturity rating	
Score	Weeks
–10	20
–5	22
0	24
5	26
10	28
15	30
20	32
25	34
30	36
35	38
40	40
45	42
50	44

(b)



Maturity rating	
Score	Weeks
–10	20
–5	22
0	24
5	26
10	28
15	30
20	32
25	34
30	36
35	38
40	40
45	42
50	44

Figure 1. Gestational age assessment by New Ballard Scoring

APGAR SCORING[95,96,97]

The Apgar score provides an accepted and convenient method for assessing the status of the newborn infant immediately after birth and the response to resuscitation if needed. The Apgar score alone cannot be considered to be evidence of or a consequence of asphyxia, does not predict individual neonatal mortality or neurologic outcome and should not be used for that purpose. The Apgar score comprises five components: color, heart rate, reflexes, muscle tone and respiration, each of which is given a score of 0, 1 or 2. Thus the Apgar score quantitates clinical signs of neonatal depression such as cyanosis or pallor, bradycardia, depressed reflex response to stimulation, hypotonia and apnea or gasping respirations. The score is reported at 1 minute and 5 minutes after birth for all neonates and at 5 minutes intervals thereafter until 20 minutes for neonates with a score less than 7.

It is important to recognize the limitations of the Apgar score. The Apgar score is an expression of the infant's physiologic condition at one point in time, which includes subjective components. There are numerous factors that can influence the Apgar score, including maternal sedation or anesthesia, congenital malformations, gestational age, trauma and inter observer variability. In addition, the biochemical disturbance must be significant before the score is affected. Elements of the score such as tone, color and reflex irritability can be subjective and partially depend on the physiologic maturity of the infant. The score also may be affected by variations in normal transition. The healthy preterm infant with no evidence of asphyxia may receive a low score only because of immaturity. The incidence of low Apgar scores is inversely related to birth weight, and a low score cannot predict morbidity or mortality for any individual infant. As previously stated, it also is inappropriate to use an Apgar score alone to diagnose asphyxia.

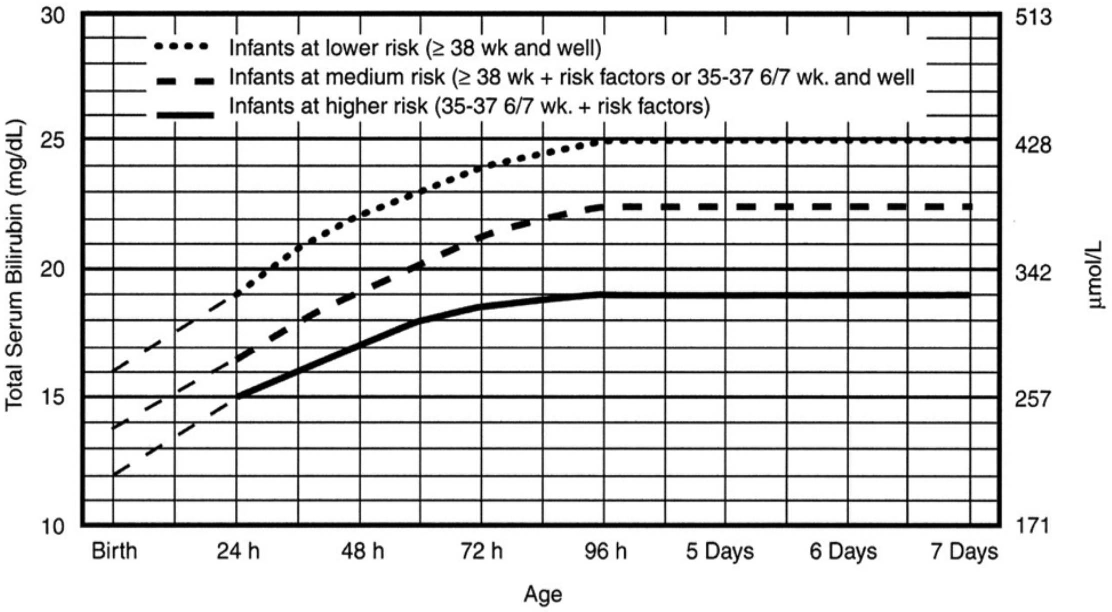
The 5-minute Apgar score, and particularly a change in the score between 1 minute and 5 minutes, is a useful index of the response to resuscitation. If the Apgar score is less than 7 at 5 minutes, the Neonatal Resuscitation Program guidelines state that the assessment should be repeated every 5 minutes for up to 20 minutes. A 1 minute Apgar score of 0–3 does not predict any individual infant's outcome. A 5 minutes Apgar score of 0–3 correlates with neonatal mortality in large populations but does not predict individual future neurological dysfunction. Population studies have uniformly reassured us that most infants with low Apgar scores will not develop cerebral palsy. However, a low 5 minutes Apgar score clearly confers an increased relative risk of cerebral palsy reported to be as high as 20-fold to 100-fold over that of infants with a 5 minutes Apgar score of 7–10.

APGAR SCORE CHART

Sign	**Score**		
	0	**1**	**2**
Colour	Pale blue	Pink body, blue extremities	Completely pink
Reflex Irritability	None	Grimace	Vigorous cry
Heart rate	Absent	<100	>100
Respiratory effort	Absent	Slow(irregular)	Crying
Muscle tone	Flaccid	Some flexion of extremities	Active motion
Score interpretation			
Score	Status		
7-10	**Normal**		
4-6	**Moderately depressed**		
0-3	**Severely depressed**		

AAP (American Academy of paediatrics) NOMOGRAM[98]

Jaundice is an important problem in the first week of life. It is a cause of concern for the physician and a source of anxiety for the parents. High bilirubin levels may be toxic to the developing central nervous system and may cause neurological impairment even in term newborns. Nearly 60% of term newborn becomes visibly jaundiced in the first week of life. In most cases, it is benign and no intervention is required. Approximately 5-10 % of them have clinically significant hyperbilirubinemia mandating the use of phototherapy. Jaundice attributable to physiological immaturity of neonates to handle increased bilirubin production. Visible jaundice usually appears between 24-72 hours of age. Total serum bilirubin (TSB) level usually rises in full-term infants to a peak of 6 to 8 mg/dl by 3 days of age and then falls. A rise to 12mg/dl is in the physiologic range. TSB concentrations have been defined as non-physiologic if concentration exceeds 5 mg/dl on first day of life in term neonate, 10 mg/dl on second day or 12-13 mg/dl thereafter. Any TSB elevation exceeding 17 mg/dl should be presumed pathologic and warrants investigation for a cause and possible intervention, such as phototherapy. In this study we followed American Academy of Pediatrics (AAP) guidelines for initiating phototherapy in term and near term infants. For paucity of evidence these phototherapy guidelines are given only for first week of life. We follows the same guidelines for neonates with hyperbilirubinemia post first week of life, however these babies are probably less prone for bilirubin induced brain damage with similar TSB.



- The dashed lines for the first 24 hours indicate uncertainty due to a wide range of clinical circumstances and a range of responses to phototherapy.
- Immediate exchange transfusion is recommended if infant shows signs of acute bilirubin encephalopathy (hypertonia, arching, retrocollis, opisthotonos, fever, high pitched cry) or if TSB is ≥5 mg/dL (85 µmol/L) above these lines.
- Risk factors - isoimmune hemolytic disease, G6PD deficiency, asphyxia, significant lethargy, temperature instability, sepsis, acidosis.
- Measure serum albumin and calculate B/A ratio (See legend)
- Use total bilirubin. Do not subtract direct reacting or conjugated bilirubin
- If infant is well and 35-37 6/7 wk (median risk) can individualize TSB levels for exchange based on actual gestational age.

Figure 2. AAP (American academy of paediatrics) NOMOGRAM

RANDOX IMOLA AUTOANALYSER (RX IMOLA)

Randox imola was a fully automated clinical chemistry analyser, with a combined throughput of 560 tests per hour. Capable of handling the workload high volume facilities, the RX Imola provides rapid, comprehensive and accurate results the first time, every time. The analyzer had a dual reagent probe that minimizes carry over and five-speed mixing arms that eliminate foaming. The RX Imola delivers up to 400 photometric tests per hour and 240 ISE tests per hour at a minimum reaction volume of 150µl. Randox imola autoanalyser was used in our study for assessment of LFT, KFT & serum electrolytes**.**

SYSMEX XN-SEREIS HEMATOLOGY SYSTEM

Sysmex XN-sereis Hematology System was an integrated co-primary hematology system with two analytical modules capable of processing 200 samples per hour. It provided advanced clinical parameters, including NRBCs (Nucleated RBC) with every CBC, Immature granulocytes within the reticulocyte profile and an all-new fluorescent platelet channel for Immature Platelet Fraction (IPF). The series-wide compact design delivers a smaller footprint for increased physical productivity. Optional concentrated reagents simplify consumable inventory management. A floor-standing wagon for system and reagents was optional. Sysmex XN-sereis Hematology System was used in our study for complete blood count.

ELECTRONIC WIEGHING MACHINE (PHOENIX COMPANY)

Electronic weighing machine of phoenix company was used for daily weight measuring. This electronic weighing machine measures maximum 30 kg & minimum 200gm with the sensitivity of 10 gm.

FIGURE 3. PHOENIX ELECTRONIC WEIGHING MACHINE

BLOOD COLLECTION TUBES & BLOOD CULTURE BOTTLES

Serum plain vial of AV labotube company was used for collection of blood for LFT & KFT. EDTA K3 vial of NIMS company was used for collection of blood for Complete blood count. Coagulation tube with 3.2% sodium citrate of NIMS company was used for collection of PT/INR. For collection of blood culture, Blood culture bottle containing brain heart infusion broth with 0.05% SPS(sodium polyanetholesulfonate) of microxpress company was used. For collection of blood culture sample, Rigourous disinfection of the skin using bactericidal agents, such as 70% isopropyl alcohol followed by 10% Providone-Iodine solution was performed after palpation of the site. The use of a closed collection system, consisting of a sterile Blood Taking Unit (tubing with needles on both ends) and an evacuated bottle containing culture medium was preferable for collection using a sterile syringe. Each bottle contains a rubber stopper held in place by a topped screw cap surrounded by a plastic band. The rubber stopper must not be taken off the bottle. Blood was added by puncturing the rubber stopper with the needle attached to the syringe containing the blood specimen or with the needle of the blood Taking Unit. Blood specimens of 2 ml generally was added to bottles containing 20 ml of medium to achieve a 1:10 blood medium ratio. The approximate amount of blood added is determined by noting the level of the liquid in the bottle relative to the graduation marks before and after addition of the blood. Each specimen should be cultured aerobically and anaerobically. For aerobic growth filtered air must be allowed to enter the bottle through a Venting Unit after blood collection. Following blood collection, the bottles were shaken to thoroughly mix the blood and medium and are then labeled. All bottles should be transported to the laboratory as soon as possible. A total incubation period of 7 days was generally sufficient for routine isolation procedures.[99]

METHODOLOGY

This Observational study was conducted in the Neonatal intensive care unit (NICU) of UPUMS, saifai, Etawah, India, for a period of 18 months. The study was approved by the Ethical Committee of the UPUMS, saifai, Etawah. Parents gave their written, informed consent for the enrollment of their children in the study. A total of 146 full-term asphyxiated neonates, born in UPUMS, saifai & fulfilling the inclusion criteria were enrolled.

Complete antenatal, perinatal and postnatal history were recorded in a predefined study proforma. Full medical history including perinatal history and especially the history of anesthesia during caesarean section and drug intake by mother or infant were recorded. Complete physical & systemic examination including detailed neurological examination were done at time of admission.

Gestational age, birth weight, findings on physical examination and systemic examination were recorded on a predesigned pretested study proforma. Gestational age of newborn was assessed by New ballard score. Birth weight of baby was taken by electronic weighing machine after removing all the clothings of baby. The electronic weighing machine used in our study was phoenix electronic scale.

Neonates were grouped according to Apgar score at one minute as moderate asphyxia (Apgar score <7 at 1 minute) or severe asphyxia (Apgar score 3 or less at 1 minute) on basis of NNPD criteria and also graded into HIE stages by the

Levene staging system for HIE. Sarnat and sarnat described their HIE grading system in a study relating electroencephalographic findings to the clinical condition of the infants. Since then it had been used by several authors and is now the basis for most modern evaluation schemes. The classification system modified by Levene has three stages – mild HIE(I), moderate HIE(II), severe HIE(III) are based on clinical observation.[100] In HIE stage I, no seizures are experienced and The neonate is irritable, tone is decreased & sucking is poor. In HIE stage II, neonate is lethargic, marked hypotonic, unable to suck & seizures are usually seen within 12 hours after birth. In HIE stage III, neonate is comatose, severe hypotonic, unable to maintain spontaneous respiration & seizures are prolonged.

LEVENE CLASSIFICATION FOR HIE[100]

Feature	**Mild/HIE-I**	**Moderate/HIE-II**	**Severe/HIE-III**
Consciousness	Irritable	Lethargy	Comatose
Tone	Hypotonia	Marked hypotonia	Severe hypotonia
Seizures	No	Yes	Prolonged
Sucking/respiration	Poor suck	Unable to suck	Unable to sustain spontaneous respiration

Neonates having a congenital malformation and a primary disease of liver or kidney, neonates with bacterial sepsis or receiving potentially hepatotoxic or nephrotoxic drug therapy were left out from our study. Hepatobiliary & urinary tract were observed for congenital malformation within 24 hours of birth by ultrasonography. Maternal renal functions (serum urea & serum creatinine) prior of delivery were also be measured.

A.)INTERVENTIONS

After admission in NICU baseline venous blood samples were withdrawn under aseptic conditions. Venous Blood samples were collected in 3 appropriate different type of vials namely plane vials (impregnated with clot activator), EDTA vials & PT/INR vials (impregnated with 3.2% sodium citrate). 2 ml of venous blood was collected in each plane vial (for CRP, serum electrolytes, LFT & KFT), EDTA vial (for CBC & band cell) & PT/INR vial (for PT/INR). All blood samples were send to central laboratory of the hospital within 30 minutes of collection for estimation of biochemical parameters. The Investigations were done for this study are as follows:

a.) Routine investigations:-

1. CBC (Complete blood count) :-. This was analysed by sysmex xn-series autoanalyser in central laboratory of the hospital.

2. Band cell:- In central laboratory of the hospital blood smear was prepared from sample & then band cells(immature neutrophils) counted from this smear by the standard methods with the help of microscope.

3.CRP(C-Reactive protein):-In central laboratory of the hospital agglutination test with CRP latex reagent was performed. It gave result in form of qualitative assessment of CRP i.e. CRP Positive or CRP Negative.

4. Serum electrolytes(Serum Na^+/serum K^+/serum Ca^{++}:- In central lab of the hospital serum was separated from the sample in approximately 45 minutes & then analysed by randox imola automated analyser in 45 minutes.

5. Blood culture& sensitivity:-

Sample for blood culture was collected before the first dose of antibiotics under strict aseptic conditions in brain heart infusion(BHI) available in the department in the ratio of 10:1(culture media:blood). Provisional report of blood culture was collected within 3 days & final report was collected within 7-10 days.

b.)Liver function tests (LFT) & Kidney function tests (KFT):

LFT & KFT parameters were analysed by by randox imola automated analyser. Deranged LFT & KFT were assessed on basis of Neonatal reference values Table.[101,102] Derangements of bilirubin level & level of increase in bilirubin level that required treatment in the form of phototherapy/exchange transfusion were assessed by AAP nomogram. .

All the above biochemical parameters i.e Routine investigations, LFT & KFT were investigated on day 1 (at time of admission i.e. baseline sample), day 3 & day 10 except blood culture & sensitivity which was send only at time of admission. Early discharged (<10 days) neonates were called for follow up till 10^{th} of life.

d.)RADIOLOGICAL INVESTIGATIONS:

1. Chest x ray:- It was done by allengers-hf mars-15 in the NICU. X ray was done if clinical findings were present in respiratory system examination & findings on chest x ray were correlated clinically to rule out respiratory pathology.

2.USG abdomen :-USG abdomen of all enrolled neonate was done by AMS-12M machine in Radiology department of this hospital to rule out the suspected primary disease of liver/kidney i.e. any structural abnormality of fetal liver/kidney. Kidney size, echotexture and corticomedullary differentiation were noted on ultrasonography.

B.)MONITORNG:

Daily weight monitoring was done on electronic scale after removing all the clothes of baby. Daily urine output monitoring was done12 hourly by applying self-adhesive pediatric uro bags. Daily random blood sugar measurement was done by Glucometer & test strips impregnated with glucose oxidase. Daily HIE grading of neonates were assessed by Levene classification of HIE. A detailed neurological examination was done in all cases at time of discharge.

All biochemical parameters of liver function & kidney function tests were measured on postnatal days 1, 3, and 10. On day 1, normal values of serum ALT 6-40 U/L, serum AST 30-100 U/L, serum LDH 170-580 U/L, serum ALP 110-300 U/L, total protein 4.5-8.4 g/dl, serum albumin 1.8-3 g/dl, PT 10.6-16.2 sec, INR ≤1.2, serum urea 3-12 mg/dl, serum creatinine 0.03-0.5 mg/dl. On day 3, normal values of serum ALT 6-40 U/L, serum AST 30-100 U/L, serum LDH 170-580 U/L, serum ALP 110-300 U/L, total protein 4.5-8.4 g/dl, serum albumin 2.5-3.4 g/dl, PT 10-15.3 sec, INR ≤1.2, serum urea 3-12 mg/dl, serum creatinine 0.03-0.5 mg/dl. On day 10, normal values of serum ALT 10-40 U/L, serum AST 22-71 U/L, serum LDH 170-580 U/L, serum ALP 48-406 U/L, total protein 4.5-8.4 g/dl, serum albumin 1.9-4.9 g/dl, PT 10-13.6 sec, INR ≤1.2, serum urea 3-12 mg/dl, serum creatinine 0.03-0.5 mg/dl. Serum bilirubin levels were assessed by AAP nomogram. Oliguric renal failure was defined as urine output <1ml/kg/hour for past 12 hour in a baby more than 24 hours of age.[103] Plasma creatinine concentration is of limited value in assessing renal function in the first week of life because it is a function of maternal renal function and almost identical to the maternal concentration.

NEONATAL REFERENCE VALUES TABLE FOR LFT[101]

Parameters	**Age group**	**Normal values**

Serum ALT	0-7 days	6-40 U/L
	8-30 days	10-40 U/L
Serum AST	0-7 days	30-100 U/L
	8-30 days	22-71 U/L
Serum LDH	< 1year	170-580 U/L
Serum ALP	0-5 days	110-300 U/L
	5-30 days	48-406 U/L
Total Protein		4.5-8.4 g/dl
Serum albumin	1 day	1.8-3.0 g/dl
	<6 days	2.5-3.4 g/dl
	8 days-1year	1.9-4.9 g/dl
Prothrombin time	1day	10.6-16.2 seconds
	5 day	10-15.3 seconds
	30 day	10-13.6 seconds
INR		>1.2

NEONATAL REFERENCE VALUES TABLE FOR KFT[102]

Parameters	Age group	Normal value
Serum urea	Cord blood	21-40mg/dl
	Premature	3-25mg/dl
	Newborn	3-12mg/dl
	Infant	5-18 mg/dl
Serum creatinine	0-4 years	0.03 -0.5 mg/dl

Asphyxiated babies with normal liver functions were grouped as A1 and Asphyxiated babies with abnormal liver functions were grouped as A2. Asphyxiated babies with normal kidney functions were grouped as B1 and Asphyxiated babies with abnormal kidney functions were grouped as B2. Newborn infants who had deranged LFT & KFT were managed conservatively as per the standard NICU protocols. The initial management of asphyxiated neonates consisted of nursing them in a thermo neutral environment. Immediate clinical assessment was made by recording respiratory rate(RR), heart rate (HR), capillary filling time (CFT), blood pressure, temperature & spo_2. In fluid management 10% dextrose was administered during the first 48 hours of life followed by Isolyte P from day 3. These neonates were monitored daily to detect derangements in clinical, metabolic and hemodynamic milieu so as to ensure prompt management. The management of asphyxiated neonates involved monitoring of seizure and also maintenance of normal metabolic milieu, including glucose, serum electrolytes, acidosis, pH, and calcium. The neonatal shock was managed with vasopressors, and target was blood pressure at 50th centile as per gestational age. The neonatal seizures were managed with phenobarbitone (maximum loading of 20 mg/kg and minimum loading of 10 mg/kg followed by maintenance dose of 3–5 mg/kg/day) and Phenytoin (maximum loading of 20 mg/kg and minimum loading of 10 mg/kg followed by maintenance dose of 3–5 mg per kg/day) as second line of anticonvulsants. Anticonvulsants were started after ruling out any metabolic abnormality. Arterial blood gas analysis was done when required. Any neonate with severe respiratory distress and respiratory failure was given invasive ventilation as per protocols of NICU. Cranial ultrasound of all asphyxiated neonates was done at the time of discharge.

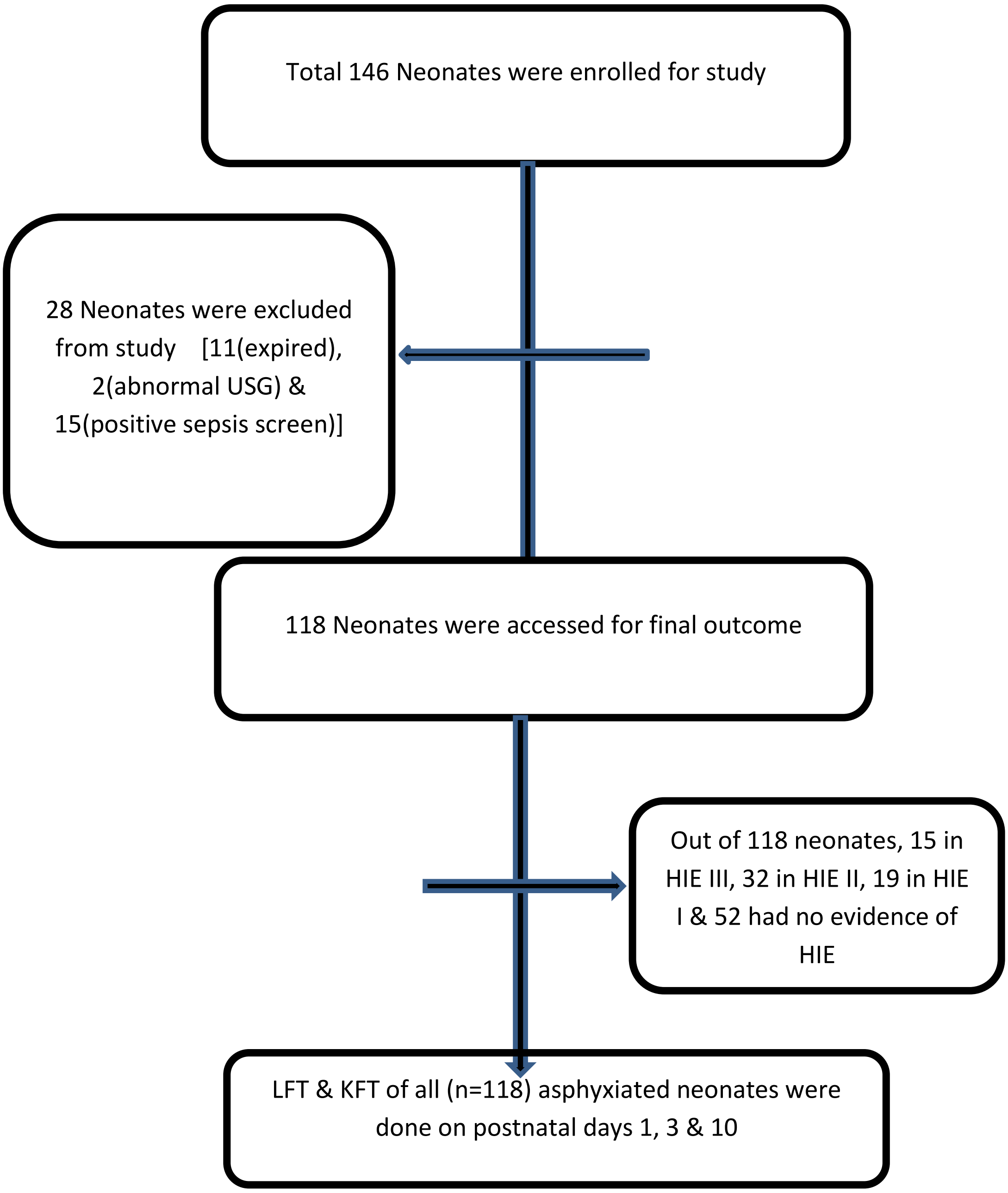
DATA ANALYSIS

All the data was collected, compiled, analysed and interoperated statistically through relevant statistical methods like student't test (unpaired t test).

SOFTWARE

The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 22.0 statistical Analysis Software. The values were represented in Number (%) and Mean ± SD.

PARTICIPANTS FLOW DIAGRAM



Out of total 146 enrolled neonates, 11 asphyxiated neonates were expired before postnatal days 10, 2 asphyxiated neonates had abnormal sonographic scan & 15 asphyxiated neonates had positive sepsis screen. These asphyxiated neonates

(28) were excluded from our study. Total 118 asphyxiated neonates were included in final statistical calculation. Out of 118, 15 neonates in HIE III, 32 neonates in HIE II, 19 neonates in HIE I & 52 neonates had no HIE manifestations.

Aim of the study:

To Evaluate and compare facial aesthetics and malar prominence on facial profile photographs of North Indian and South Indian population.

Objective of Study:

1. To evaluate the facial aesthetics and malar prominence in male and females of north Indian population.
2. To evaluate the facial aesthetics and malar prominence in male and females of south Indian population.
3. To compare the facial aesthetics and malar prominence in male and females of north Indian and south Indian population.

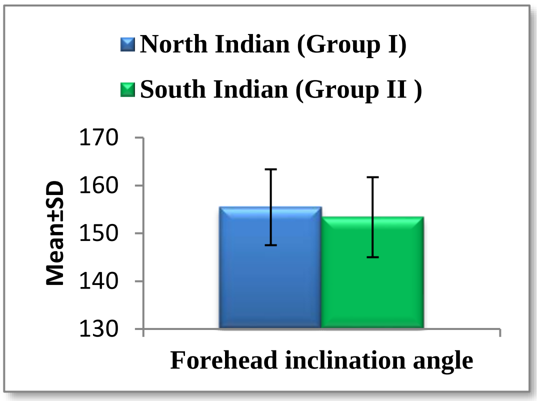
DISCUSSION

One of the most important components of orthodontic diagnosis and treatment planning is the evaluation of the patients facial soft tissue[16] The shape of the human face depends on both the structure of the hard tissue (bone) and the soft tissue that covers it. The success of orthodontic treatment is frequently related to the improvement gained in the patient's facial appearance. The morphology of the human face varies with individuals and even more with races and ethnic groups [10]. Variations in facial parameters have been studied extensively for different ethnic groups and races. Well established norms for facial aesthetics are not appropriate to such diverse race and ethnic groups, as facial features are largely influenced by race, ethnic group, age, sex, culture etc. Powell and Humphreys [4]provide a detailed analysis of facial contours, proportions, and angles on profile. These angles facilitate preoperative assessment and planning in facial rejuvenation. Various methods have been used to evaluate the soft facial characteristics such as craniofacial anthrometry[11], photogrammetry[12], cepahlometric radiography, stereophotogrammetry, computed tomography and laser scanning. The soft tissue profile characteristics using photogrammetry have been reported for North American population[4], Brazilllian Caucasian[25], Croatian[26] and Turkish populations[16], and were different from the original norms given for particular cephalometric analysis. As we know India is a diverse country and there is always interregional difference in facial profile. In Indian subcontinent, north Indian (the descendants of Aryans) and south Indians (the descendants of Dravidians) population, mangoloid featured north Eastern races differ considerably in soft tissue characteristics. As the data in Indian study, specially comparison of facial profile of south Indian and north Indian population is still lacking we had tried to fill this gap by photogrammetric analysis. Photogrammetric analysis is noninvasive, easy and cost effective, provides a permanent record of the face that can be accessed at a later time, and offers consistency in longitudinal studies in which different observers with different direct measuring techniques might participate.[53] The accuracy of photogrammetric measurements is affected by the differential distortion of photographs that is two-dimensional representations of three-dimensional structures.[17]Therefore, repeatability of photogrammetric landmark measurements is a more suitable method for evaluating the reliability than comparing absolute values to other methods of facial evaluation. Many studies investigating the reliability of facial photogrammetry physically marked the landmarks to be identified prior to capturing the images.[61]This process may improve the reliability of facial measurements.[12] Photogrammetry was found to have good repeatability, though measurements obtained from photographs were more variable than anthropometric measurements. So soft tissue measurements are useful for characterizing facial morphology and can be reliably measured from facial profile photographs. In present study we have evaluated and compared the soft tissue facial prominences including malar eminence of adult population of North and South India and compared males and females of respective regions by means of facial profile photographs and accessed it on nemoceph software. This study consisted of the digital photographs of 200 subjects including 100 North Indian and 100 South Indian population within the age range of 18-30 years (mean age 24 years) having normal occlusion and pleasing profile. Profile photographs were taken by orienting the patient's head in the natural head position with lips relaxed and teeth in centric occlusion. Natural head position is a standardized and reproducible orientation of head.

The subjects chosen were all above 18 years to ensure that the complete growth had taken place in both sexes to avoid any variation in the mean value of various parameters.

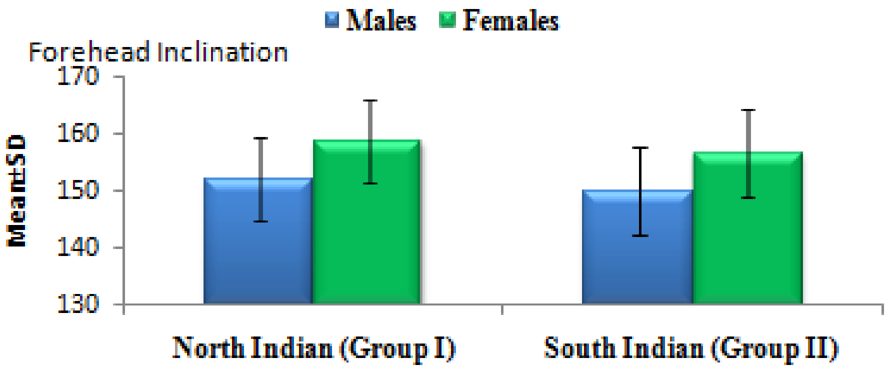
In present study we used different angular parameters given by Powell and Humphreys for facial assessment and hindered method for analysis of malar eminence. We also considered soft tissue cheek bone prominence by corneal vector relationship. The total 9 parameters (7 angular, 1 linear and 1 vector measurements) were measured as observed in material and methods.

Forehead inclination angle: Inner angle formed between the Glabella-Nasion line and a line tangent to forehead.



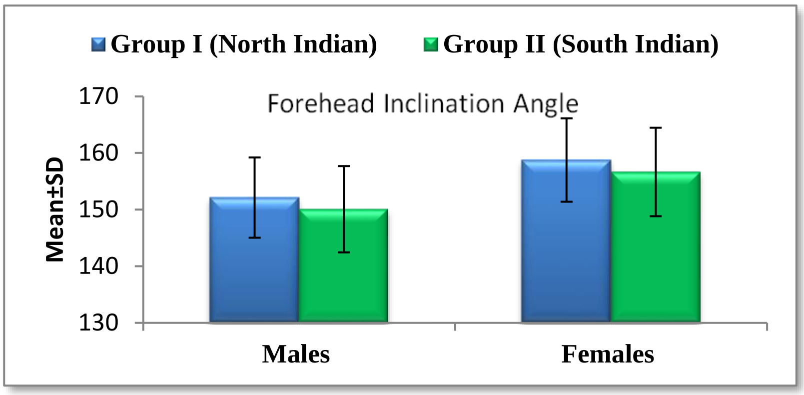
Graph 1: Comparison of Forehead inclination between overall Group I (north Indian population) and Group II (south Indian population)

Comparison of Forehead inclination in the present study was done between Group I and II , it was found higher mean value in Group II but difference was found to be statistically non-significant (p=0.62) than Group I, indicating no mean difference in both the group. The above finding was in accordance to Hwang et al.[28] as they concluded the slope of the Forehead showed no significant difference between the Korean and European- American adults.



Graph 2: Comparison of Forehead inclination angle between north Indian (Group Ia vs Group Ib) population and south Indian (Group IIa vs Group IIb).

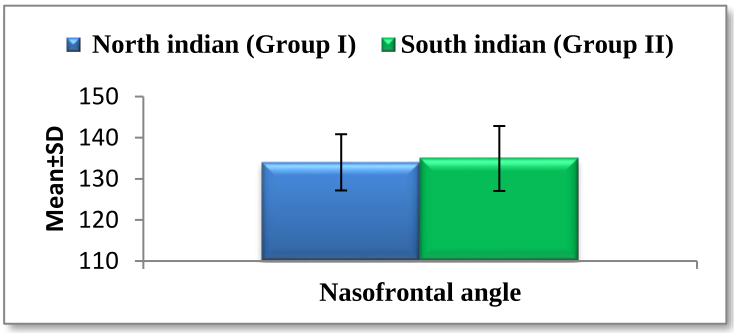
On comparing forehead inclination amongst Group Ia and Group Ib of north Indian population, this angle was higher in Group Ia as compared to Group Ib. Similarly in south Indian population, males (Group IIa) had higher value than females (Group IIb) and result was statistically significant in both the population groups ($p<0.001$). Our statement is strengthened by Hwang et al[28] who did a cephalometric study for ethnic difference in the soft tissue profile of Korean and European- American adult with normal occlusions and well balance faces, Hwang et al. term forehead prominence as a frontonasal angle, and they found mean value of this angle was 153.47°±7.07° in males and 159.45°±3.57° in females in European adults and 150.31°±4.92° in males , 159.33°±3.70° in females of Korean adults. Significant gender differentiation was found between these two population groups, and concludes that smaller angle indicates more anterior positioning of the forehead in men. (forehead is more prominent in males).



Graph 3: Comparison of Forehead inclination between males (Group Ia vs Group IIa) and females (Group I b vs Group IIb).

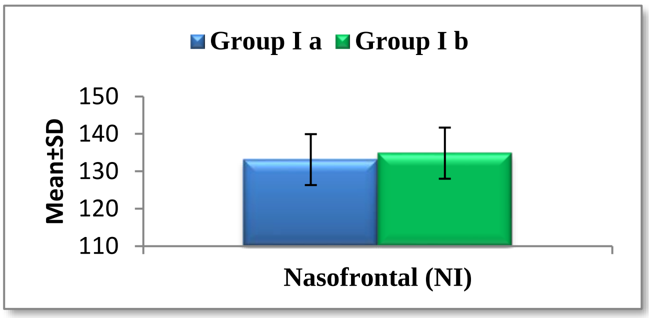
In present study non-significant difference was found between males of both population (Group Ia vs Group IIa) and females of both population (Group Ib vs Group II b), Hwang, kim and Mcnamara[ ] who did a cephalometric study for ethnic difference in the soft tissue profile of Korean and European- American adult they also found non-significant difference Korean and European- American population.

Nasofrontal angle: formed by drawing a line tangent to glabella through the nasion that will intersect a line drawn tangent to the nasal dorsum. Nasofrontal angle depends on prominence of nose and glabella. Forehead prominence and well formed nose creates an acute Nasofrontal angle, Powell and Humphries[4] in 1984 gave a value of avg. 125°-135°. The short nose and slanted forehead will produce obtuse readings for the same.



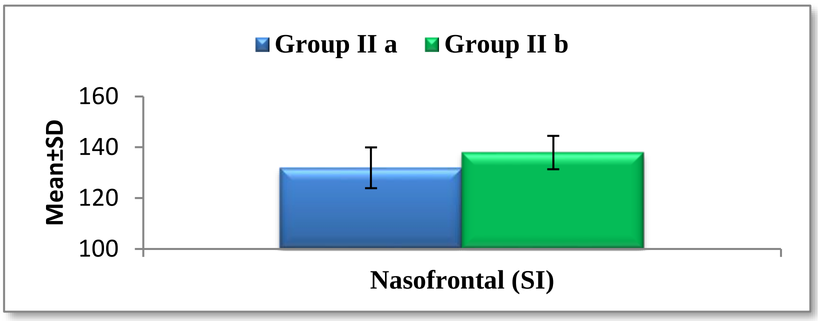
Graph 4: Comparison of Nasofrontal angle between Overall Group I (north Indian population) and Overall Group II (south Indian population)

In present study, when comparison of Nasofrontal angle was done between overall Group I (North Indian population) and overall Group II (South Indian population), it was found higher in Group II but the difference was found to be statistically non-significant, our finding was similar to Jain et al (2004) who reported the Nasofrontal angle in Himachali population and was found avg.134°. In another study by Anibor E and Okumagba M.T[37] where this angle was found lower (avg. 116.28°) in Urhobo ethnic Group of Nigeria.



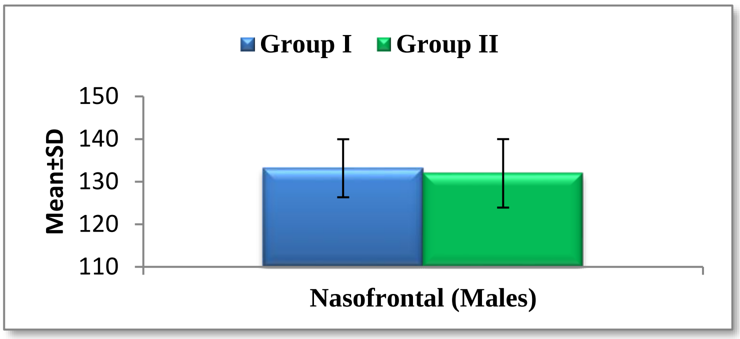
Graph 5: Comparison of Nasofrontal angle between north Indian males (Group Ia) and north Indian females (Group Ib).

When we compared Nasofrontal angle amongst Group Ia(males) and Group Ib(females) of north Indian population, this angle was higher in Group Ib (females) as compared to Group Ia (males) and the difference between them was statistically found non-significant, this finding was similar to that of Epker[ ] where he did not report any sexual dimorphism in Caucasians Population (130°) on frontal and lateral views. Various studies conducted in different population showed significantly higher Nasofrontal angle in females. Malkoc et al.[33] in Turkish adults found (146.03°, in males and 148.61° in females), Anibor Okumagba[37] in Negroid population, Devi B.L et al[58] in Bangali population (128.06° in males , 139.56°in females), Leung et al [62]in southern Chinese populations and Bhandari V et al[55] found in Himachal population (India). Mowlavi et al[ ], concluded that acute Nasofrontal angle contributes to prominent glabella in male population.



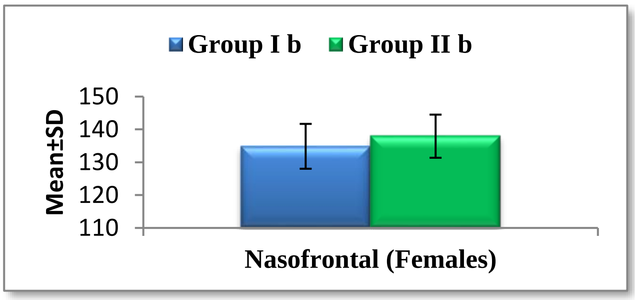
Graph 6: Comparison of Nasofrontal angle between south Indian males (Group II a) and south Indian females (Group II b).

When comparison of Nasofrontal angle between Group IIa (south Indian males) and Group IIb (south Indian females) was done, significantly high mean value was found in Group IIb (Females) than Group IIa (males). This finding was supported by Pattnaik S. et al[] in southern Indian population, Reddy et al.[] in north indian population, Fernandez- Riveiro[] in European Caucasian population, Anicmilosevic et al[] in Croatian population, and Moshkelgosha V et al[] in adolescent Persian, all showed a wider variability in various populations. All these studies showed sexual dimorphism as they said the females had a wider Nasofrontal angle than the males and concluded that girls had more posteriorly inclined forehead than the boys who have relatively straighter forehead.



Graph 7: Comparison of Nasofrontal angle between males of both Populations (Group Ia vs Group IIa).

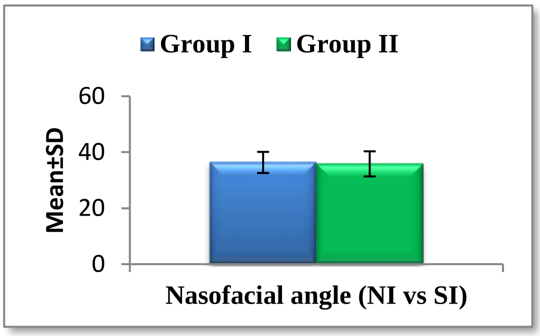
When we compared Nasofrontal angle in males of both population (Group Ia and Group IIa), we found the mean value was higher in Group Ia than Group IIa and the difference between them was statistically non-significantly. Our finding indicates that the south Indian males had more prominent forehead than north Indian males who may had straighter forehead. Ukoha U.U[] did a study on Igbo Nigerian adult male, and compared it with Himachali Indians, North American, Urhobo Nigeria and Itsekiri Nigeria, he found Nasofrontal angle was acute in North American male (avg. 123°), urhobo and Itsekiri Nigeria population (132°) and higher value seen in Himachali population and Igbo population (134°). A Meta analysis, done by Wen Y F et al[] found Nasofrontal angle in African males was more acute then Caucasian males.



Graph 8: Comparison of Nasofrontal angle between females of both population (Group Ib vs Group IIb).

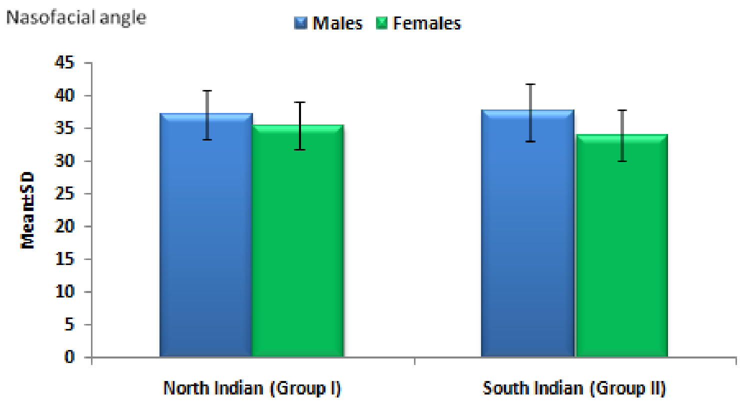
When we compared Nasofrontal angle in Group Ib and Group IIb, Group IIb (south Indian females) had significantly higher mean value than Group Ib (north Indian population), This showed that north Indian females had more prominent glabella or larger nose then south Indian female population.

Nasofacial angle: The Nasofacial angle formed between the anterior facial plane and the line tangent to the dorsum of the nose. This angle is important as it is used as one of the methods to assess the projection of the nose.



Graph 9: Comparison of Nasofacial angle between Overall Group I (north Indian population) and Group II (south Indian population).

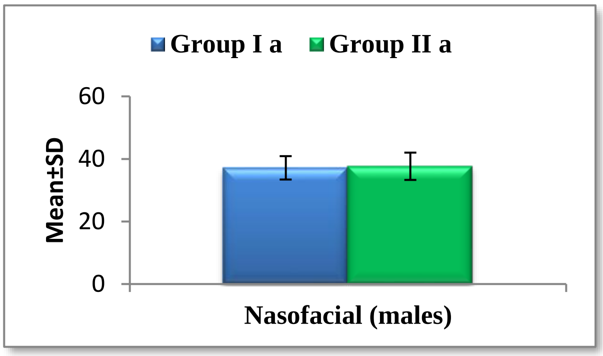
In present study, when we compared the Nasofacial angle amongst Group I (north Indian population) and Group II (south Indian population), this angle was higher in Group I than Group II and it was statistically non-significant. EseAnibor et al[] who compared nasofacial angle in Urhobos with other tribes and races found that this angle was higher in Urhobo group (38.5°), Itsekeri (39.3°) and Ibo (38.95°) population and more acute angle was found in North American population (35.0°) and Himachali population (33.26°).They interpretated that Himachali population had less prominent nose than all other population. In our study mean value of Indian population was closure to the North American population, Pacinato et al[] stated that the ideal nasofacial angle should be 36º, which may be vary due to the variable position of glabella and the prominence of nose. Meta analysis done by Wen feng Yi et al []shows that this angle was larger in Africans compared to Asian.



Graph 10: Comparison of Nasofacial angle in north Indian (Group Ia vs Group Ib) and south Indian (Group IIa vs Group IIb) population.

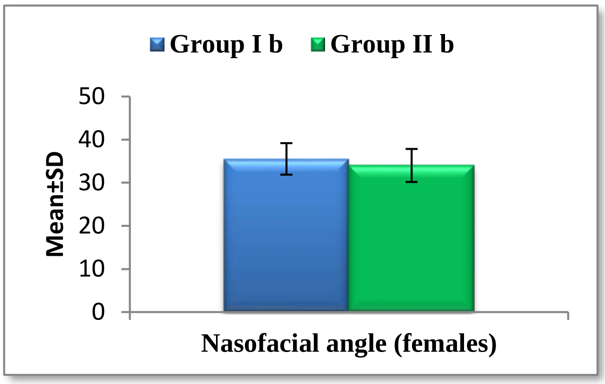
On comparing nasofacial angle amongst Group Ia (males) and Group Ib (females) of north Indian population, Statistically significant acute Nasofacial angle was found in Group Ib than in Group Ia. similarly highly significant acute Nasofacial angle was found in Group IIb than Group IIa. This finding s suggests that males of both groups had more prominent nose in relation to the forehead and chin than females. Our statement is strengthened by Lines et al[] and Fortes H.N. et al[] as they also found significant gender difference in their work; according to them the Nasofrontal angle is most acceptable within a range of 20°- 30°, similar finding was observed by Clements[].Various studies around the world found similar higher values for females than males like Anic-Milosevic et al[] (29.53°± 2.51°in males and 30.36°± 2.38° in females) in Croatian population, Devi et al[](males= 29.5°±2.5°, female= 30.4°± 2.4°)

in adult Bengali population, Reddy et al[] (34.38°± 1.77° in males and 33.36°± 2.38° in females) in north Indian population, Pattnaik S. et al[] in southern Indian population as 27.11° in males and 26.58° in females, Ferdousi et al []in adult Bangladeshi garo population (40.27°±4.54° in males and 38.67°±4.05° in females) but the difference were not found to be statistically significant. According to Hinds and Kent, the normal value for Nasofacial angle very between 23°- 37°. Higher Nasofacial angle suggests that the projection of the nose is more (Wamalwa et al []). In our study finding for Nasofacial angle indicated that more prominent nose was present in males of both the groups in north and south Indian population. Meta analysis conducted by Wen Y. F et al[] on various races showed a significant inter- ethnic/racial variations for Nasofacial angle.



Graph 8: Comparison of Nasofacial angle between males of both populations (Group Ia vs Group IIa)

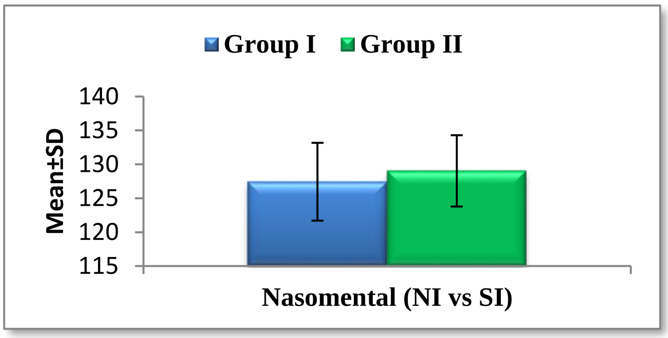
In present study, when interracial comparison of Nasofacial angle between Group Ia (North Indian males) and Group IIa (South Indian males) was done, non-significant difference in Nasofacial angle was found between Group Ia (37.16°±3.74) and Group IIa (37.65°±4.37°).



Graph 9: Comparison of Nasofacial angle between females of both populations (Group I b vs Group II b)

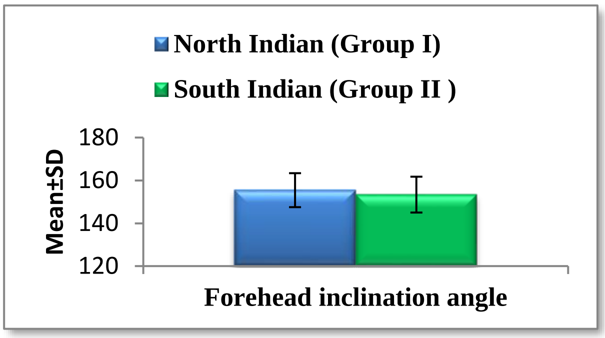
whereas, when we compared Nasofacial angle in Group Ib (north Indian females) and Group IIb (south Indian females), this angle was found significantly high in Group Ib (35.53°±3.65°) than Group IIb (34.01°±3.83°), suggesting that north Indian females had more prominent nose than south Indian females.

Nasomental angle: The Nasomental angle lies between the line drawn through the nasal dorsum intersecting a line drawn from the nasal tip (NT) to the soft tissue pogonion (pog').



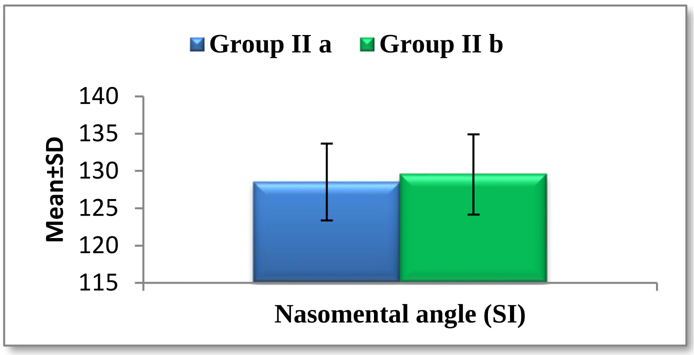
Graph 10: Comparison of Nasomental angle between Overall Group I (north Indian) and Overall Group II (south Indian) population.

In present study, when comparison of Nasomental angle amongst Overall Group I (north Indian) and Overall Group II (south Indian) was done, we found that this angle was significantly acute in Group I (north Indian) than in Group II (south Indian) population, in our study, the mean value of Nasomental angle was found almost similar to the North American population (Powell and Humphries). Jain et al [] did a study and found that Nasomental angle was in a range of 112°- 142° in Himachali population when he compared this angle with Caucasian population, they found in Himachali population had bigger chin size then Caucasian population, showing midface prominence due to prominent nose or retruded chin.



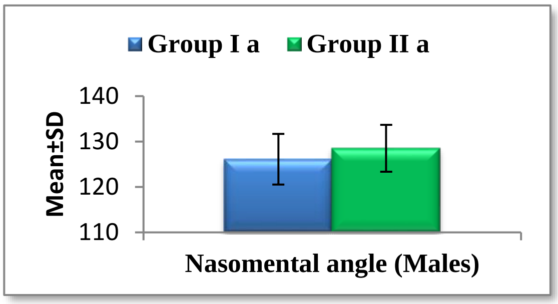
Graph 11: Comparison of Nasomental angle between Group Ia (Males) and Group Ib (Females) North Indian population.

In present study, sexual dimorphism was found for Nasomental angle, when we compared Nasomental angle in Group Ia (north Indian males) and Group Ib (north Indian females). Our observation was similar to finding attained by Ferdousi ET al[] in bangladeshi Garo population, who stated that male had smaller Nasomental angle than females (129.75°± 7.32° in males and 132°±5.10° in females). While Reddy et al[] in Indian population (127.71°±1.97° in males and 127.11 ±1.81 in females), Anicy-milosivecy et al[] in Caucasian population (130.47°±19° in males and 130.19°±3.47° in females), they found slightly higher Nasomental angle in males than females, this emphasized that north Indian females had bigger chin size than north Indian males.



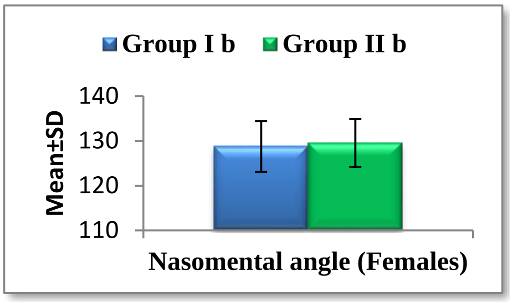
Graph 12: Comparison of Nasomental angle between Group IIa (Males) and Group IIb (Females) of south Indian population

Furthermore, when we compared Nasomental angle in Group II a and Group II b in south Indian population this angle was non-significantly higher in Group II b (129.53°±5.38°) than Group II a (128.52°±5.16°).



Graph 13: Comparison of Nasomental angle between males (Group Ia, Group IIa) of both population.

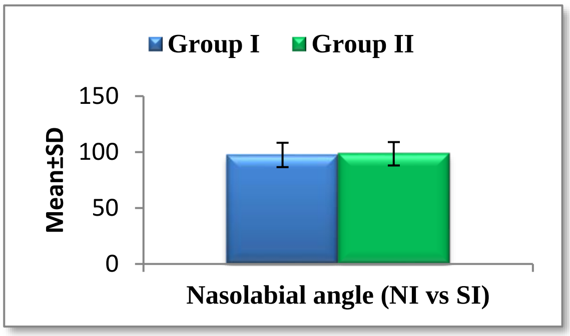
When Interracial comparison was done amongst Group Ia (north Indian males) and Group IIa (south Indian males), the nasomental angle was more acute in Group Ia than Group IIa, the difference was statistically significant. Ukoha U.U[] found different values of Nasomental angle in males of different populations they found that North American population and Igbo Nigeria both showed similar mean value for Nasomental angle (126°), Urhobo Nigeria (127°) and Himachali population showed avg. mean value (128°), as well as Itsekiri Nigeria (129°) population showed higher mean value. In our study it was found to be statistically significant.



Graph 14 : Comparison of Nasomental angle between Females (Group I b vs Group II b) of North Indian and South Indian population.

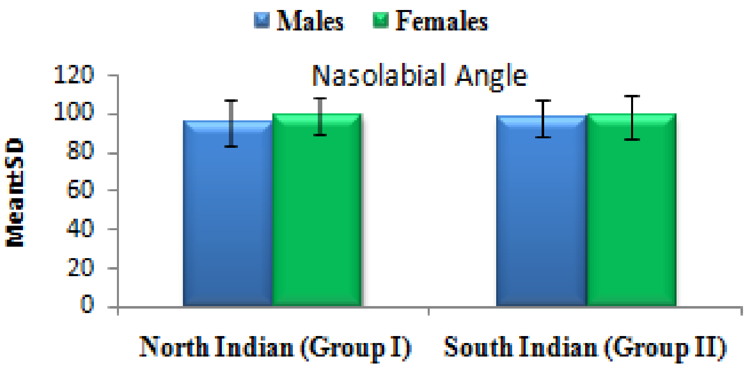
On Comparison between both Group Ib (north Indian females) and Group IIb (south Indian females), we found that the Nasomental angle in Group Ib was acute than Group IIb, that showed north Indian females had higher chin size than south Indian females but the result was statistically non-significant.

The Nasolabial angle formed between a line along the anterior part of the columella and a line subnasale to soft tissue pogonion. This is one of the facial profile parameters with greater clinical uncertainty and depends on inclination of upper anteriors.



Graph 15: Comparison of nasolabial angle between Overall Group I (north Indian) and Overall Group II (south Indian) population.

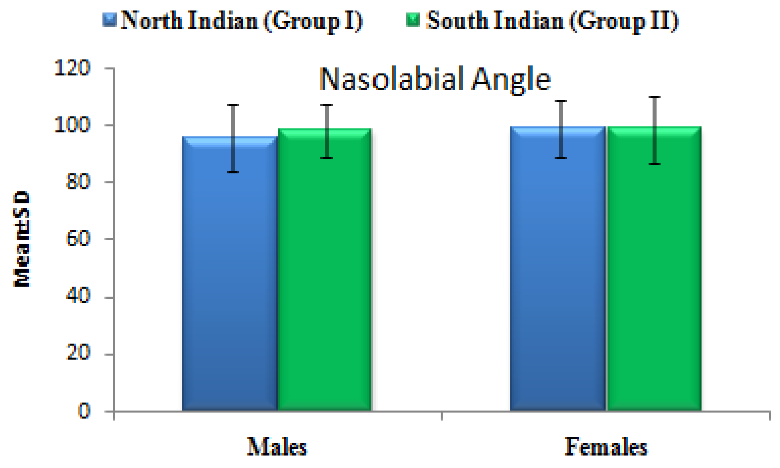
In the present study, when Nasolabial angle was compared between overall Group I (north Indian) and Overall Group II (south Indian), statistically non-significant higher mean value was found in south Indian group than in north Indian group. Wen Y.F et al []did Meta analysis and interpretated that this angle was a critical determinant of nasal tip aesthetics and a larger angle was found in African and Asian females.



Graph 16 : Comparison of Nasolabial angle amongst males and females of north Indian (Group I) and south Indian population (Group II).

When nasolabial angle was compared amongst Group Ia (males) and Group Ib (females) of north Indian population and Group IIa (males) and Group IIb (females) of south Indian population, in both the population group the Nasolabial angle was higher in females. Our finding was in accordance to many other studies like Pattanaik S. et al[] (98.56° in males and 99.67° in females) in Southern India population, Ferdousi M. A et al []in adult Bangladeshi Garo (91.28° ±12.98° in males and 91.92° ± 8.90° in females) and Mcnamara et al [] in adult Caucasians (102.2° ± 8° for males and 102.4° ± 8° for females) they all showed that Nasolabial angle was non-significantly higher in females than in males. While in other studies large variability with this angle was reported by S. Malkoc et al[] showed (75.40°- 126° for males and from 81.71° to 129.90 °for females) in Turkish population, Moshkelgosha V et al [] found (76.9° to

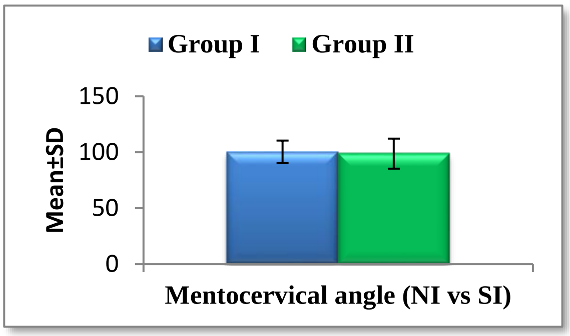
132.4° in boys and 92.6° to 129.7° in girls) in an Adolescent Persian population, Riveiro P.F et al [] was also found large variability between males (105°±13°) and in females (107°±8.5°) in adult European Caucasian population. Legan and Burstone [] reported Nasolabial angle was 74 ± 8° (range 60°-90°) in a Caucasian adult with a normal facial appearance. Contrary to present study Bhandari V. et al[] found obtuse Nasolabial angle in females than males of Himanchali population where it was approx. (97 in males and 101 in females), Anic- Milosevic [](105° in males and 109° in females) in Croatian population, Reddy et al [](102.32°± 4.69° in males and 101.50°± 4.39°in females) in north Indian population and Hiranaka Y[] in Asian adolescents (102.7°±11° for males and 101.6°±11° for females) and Devi et al [](107.37° males, 100.88° for females) reported sexual dimorphism with this angle in adult Bengali population. According to Bergman, this angle should be 102°±8° for both Orthodontic or surgical correction; it is important in assessing the upper lip position and is used as a part of extraction decision.



Graph 17 : Comparison of Nasolabial angle amongst males (Group Ia vs Group IIa) and females (Group Ib vs Group IIb) of north Indian and south Indian population.

When interracial comparison was done between males (Group Ia, Group IIa) and females (Group Ib, Group IIb) of both population groups, statistically non-significant difference was found in mean value of this angle between males and females. According to WenY F[], nasolabial angle was a critical determinant of nasal aesthetics and found more obtuse in Caucasian females than in African and Asian females.

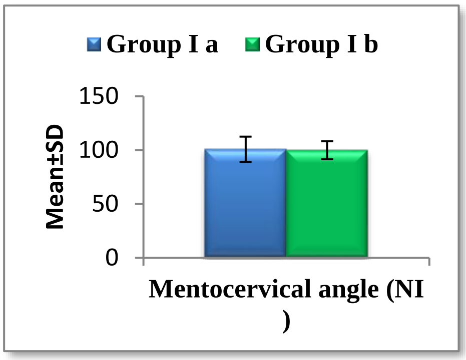
Mentocervical angle: lies between the vertical line drawn from the glabella to the soft tissue pogonion and a line drawn cervical point to the soft tissue menton.

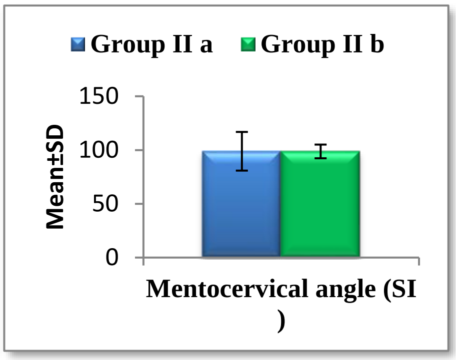


Graph 18: Comparison of Mentocervical angle between north Indian and south Indian population.

When we compared Mentocervical angle between overall Group I (north Indian) and Group II (south Indian), it was found significantly higher in Group II (south Indian population) than Group I. Result indicate that Group I (north Indian) population had higher chin prominence than Group II (south Indian) population.

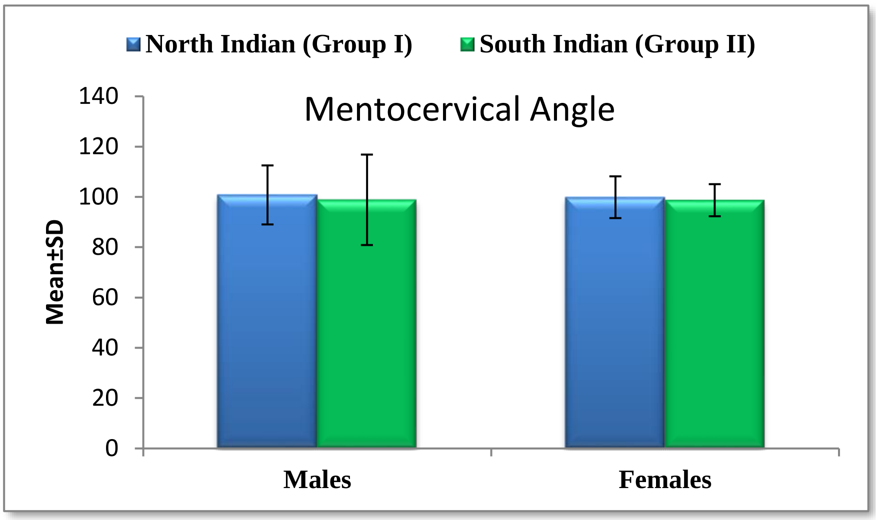
Jain et al[] did a photometric study in Himachali population and they found that higher Mentocervical angle (avg. 99.88°) and when they compared it to North American population (avg. 87°), they found that Himachali population had bigger size chin than North American population. Our study showed that Mentocervical angle was higher than Caucasian population but was similar to the Himachali population (India).





Graph 19: Comparison of Mentocervical angle between north Indian (Group Ia vs Group Ib) and south Indian population (Group IIa vs Group IIb)

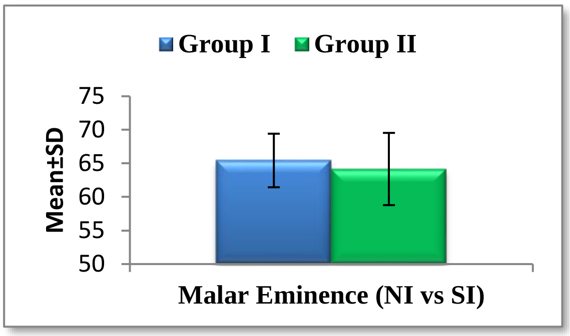
When we compared Mentocervical angle between Group Ia and Group Ib in north Indian population, this angle was non-significantly higher in Group Ia than Group Ib. In south Indian population, similarly Mentocervical angle was found non-significantly higher in Group IIa than Group IIb of South Indian population. Our finding was similar to Moshkelgosha V. et al [](100.4°±11.2°in boys and 97.2°±5.6°in girls) and Reddy et al[] (100.93°±1.77° in males and 94.11°±1.37° in females). This result was in contrast to the Malkoc S[], who found significantly more acute angle in females than males (104.86°±9.86° in males 95.65° ±7.74° in females), Riveiro P.F et al [] also found cervicomental angle was significantly more acute in males (79°) than females (84°). Park and Burstone[] who did not find any significant differences between males and females in their analysis for chin height. Our result was similar to the Reddy et al [], who did their work on north Indian population, which showed north Indian male had more prominent chin than North Indian females.



Graph 20: Comparison of Mentocervical angle between Males (Group Ia vs Group IIa) and Females (Group Ib vs Group IIb) of north and south Indian population.

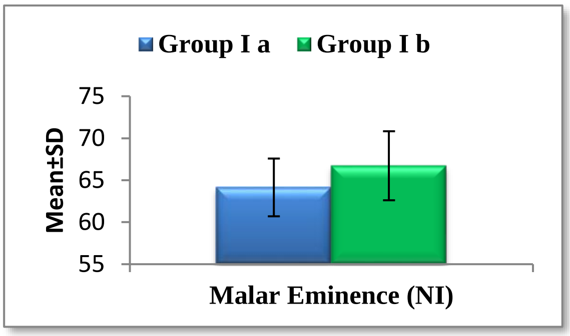
When Interracial comparison of Mentocervical angle was done between Group Ia (north Indian males) and Group IIa (south Indian males), this angle was found non-significantiy higher in Group Ia than in Group IIa. When we compared Group Ib (north Indian females) and Group IIb (south Indian females) more acute Mentocervical angle was present in Group IIb, and result was statistically non- significant. This showed more prominent chin of males in both populations compared to females, similarly Moshkelgosha V.et al []. who did study in adult Persian population and concluded that boys had greater chin size than Persian girls. Riveiro et al []. obtained the same finding in their study.

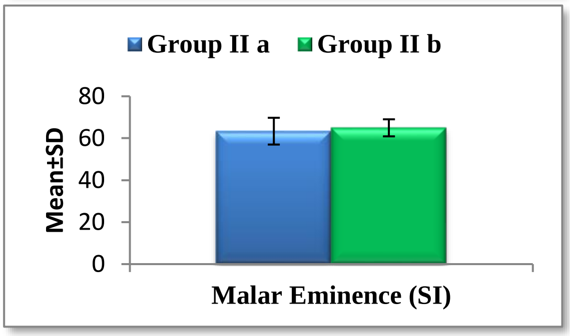
Malar eminences was the Posterosuperior angle formed by intersection of the line, drawn from the lateral commissure of the lip to the lateral canthus and the base of the ala to the tragus, it was appropriate area of malar augmentation.



Graph 20: Comparison of Malar eminence between north and south Indian population.

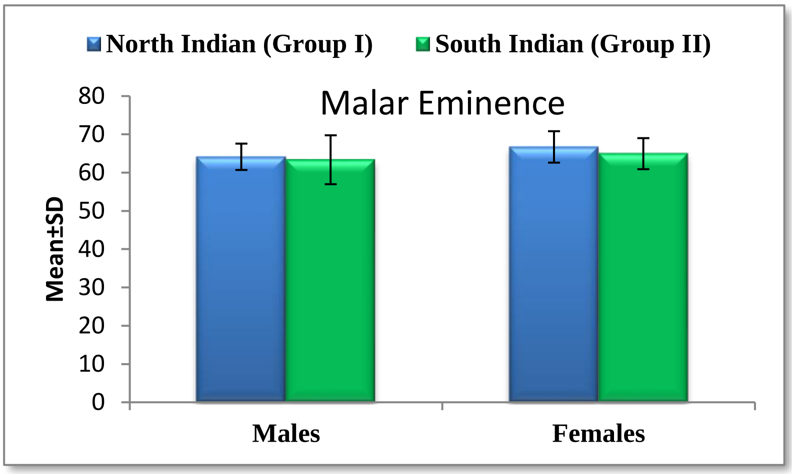
When comparison of Malar eminence angle in overall Group I and Group II was done, this angle was found significantly higher in north Indian population (65.45°±3.99°) than south Indian population (64.16°±5.38°) this showed more prominence cheek bone in north Indian population than south Indian population.





Graph 21: Comparison of Malar eminence between of north Indian population. (Group Ia vs Group Ib) and south Indian population (Group IIa vs Group IIb)

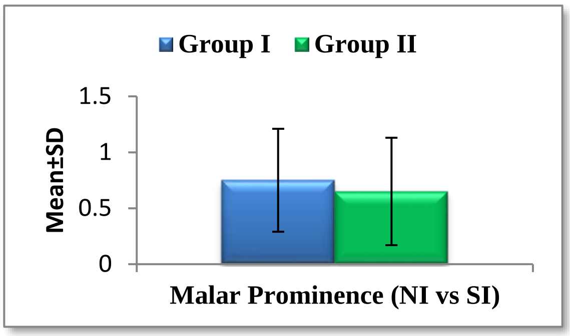
When we are compared Malar eminence between Group Ia (Males) and in Group Ib (females) in north Indian population, Group Ia showed statistically significant acute Malar eminence angle than Group Ib in north Indian population, In south Indian population, this angle was significantly acute in Group IIa (males) than in Group IIb (females), that showed more prominent cheek bone in females of north and south Indian population.



Graph 22: Comparison of Malar eminence between males (Group Ia vs Group IIa) and females (Group Ib vs Group IIb) of north Indian and south Indian population.

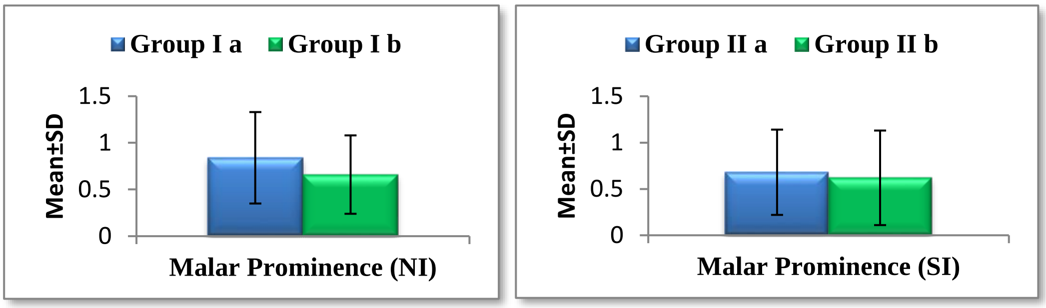
When we compared Malar eminence angle between Group Ia (north Indian males) and Group IIa, (south Indian males) this angle was higher in Group Ia than in Group IIa, the result was statistically significant. When we compared females if both population group i.e Group Ib and Group IIb, the Malar eminence angle was higher in Group Ib population group and the result was statistically significant. The finding showed that males and females of north Indian population had more prominent cheek bone than males and females of south Indian population.

Malar prominence was a maximum linear distance from the corneal plane to the soft tissue malar prominence. It is important indicator of soft tissue cheek prominence which is supported by the maxilla and malar bones, the associated muscles, subcutaneous tissues, the malar fat pad and the buccal fat pad.



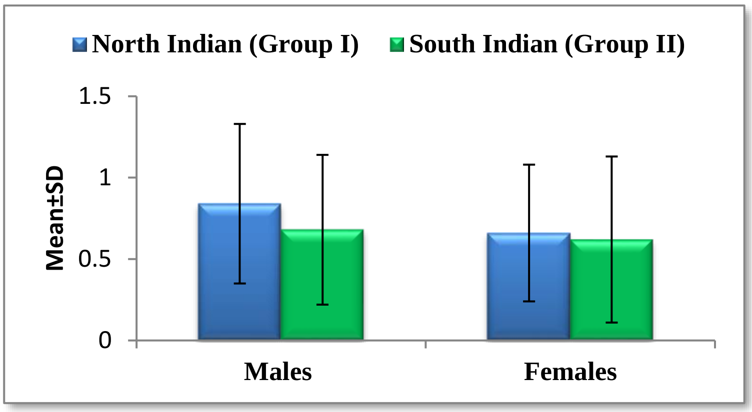
Graph 23: Comparison of Malar prominence between north Indian and south Indian population.

When we compared the Malar prominence in Overall Group I and in Group II, the Malar prominence was statistically significantly higher in north Indian population than south Indian population.



Graph 24: Comparison of Malar prominence between north Indian (Group Ia vs Group Ib) and south Indian population (Group IIa vs Group IIb)

When we compared Group Ia (males) between Group Ib (females), the Malar prominence was statistically significantly higher in Group Ia (males) than Group Ib in north Indian population. In south Indian group when compared Malar prominence between Group IIa and Group IIb, it was statistically significantly higher in Group Ib population .



Graph 25: Comparison of Malar prominence between males (Group Ia vs Group IIa) and females (Group Ib vs Group IIb)

In present study, when interracial comparison of Malar prominence between males (Group Ia, Group IIa) and females (Group Ib, Group IIb) of both the population groups, Statistically non-significant difference in Malar prominence was found between males and females. that showed north Indian population (Group Ia and Group Ib) have more prominent anterior midface protrusion than South Indian males and females.

Comparison of Malar prominence vector relationship in north and south Indian population-

Malar prominence vector relationship when compared amongst males (Group Ia, Group IIa) and females (Group Ib, Group IIb) of both population, no sexual dimorphism present between Group I and Group II, our finding was similar to Frey S.T[], who did a study to determine a visual classification of anterior malar support using vector relationships.

The present study was done for evaluation and comparison of the facial aesthetics and malar prominence in North Indian and South Indian population. Based on results the following conclusion can be drawn-

1. Malar prominence and Nasomental angle were higher in south Indian population than north Indian population, whereas Malar eminence was higher in north Indian populations. No significant differences were found for forehead Inclination angle, Nasofacial angle, Nasolabial angle and Mentocervical angle between north Indian and south Indian population.
2. Amongst the male population, the Malar prominence and Malar eminence were higher in north Indian males than in south Indian whereas Nasomental angle was higher in south Indian males. No significant difference were found for forehead inclination angle, Nasofrontal angle, Nasofacial angle, Nasolabial angle and Mentocervical angles between north Indian and south Indian males.
3. Amongst the female population, Malar eminence, Nasofacial angle were higher in north Indian females whereas Nasofrontal angle was higher in south Indian females. No significant difference was found for Malar prominence, forehead inclination angle, Nasomental angle, Nasolabial angle and Mentocervical angle between north Indian and south Indian females.
4. Sexual dimorphism was observed in north Indian population for Malar-eminence, forehead inclination angle and Nasomental angle which was found to be higher in females than males, whereas Nasofacial angle was higher in north Indian males. No differences were observed for Malar prominence, Malar prominence vector, Nasofrontal angle, Nasolabial angle, Mentocervical angle between males and females.
5. Sexual dimorphism was observed in south Indian population for Malar eminence, forehead inclination and Nasofrontal angle which was found to higher in south Indian females, whereas Nasofacial angle was higher in males. No significant difference was found in Malar prominence, Malar prominence vector, Nasomental angle, Nasolabial angle and Mentocervical angle between males and females.

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