Research Article

Chin-throat morphology of Nepalese adults with normal occlusion and aesthetic facial profile – A cephalometric study

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ABSTRACT

Objective(s): The present study was undertaken to obtain normative value for chin-throat morphology in Nepalese adult male and female adult subjects with normal occlusion and aesthetic facial profile and study variation of chin-throat morphology between the two sexes.

Materials and Method: In this cross-sectional study, lateral cephalograms of adult subjects with normal occlusion and pleasing facial profiles were selected from the archives of the Department of Orthodontics, Dhulikhel Hospital, Kathmandu University School of Medical Sciences, Nepal. Manual tracing and measurement of 3 parameters evaluating chin-throat morphology i.e. lip-chin-throat angle, chin-throat length and chin-throat-neck angle were done. Descriptive analysis was carried out and Student's t-test was used to find the difference in measurements between the male and female subjects.

Result: The mean values of lip-chin-throat angle, chin-throat length and chin-throat-neck angle were 105.56 ± 8.69 degrees, 40.48 ± 5.95 mm and 121.69 ± 13.86 degrees respectively. The mean value of the lip-chin-throat angle was 106.09 ± 8.60 degrees in male subjects and 105.12 ± 8.92 degrees in female subjects. Similarly, the mean value of chin-throat length was 40.08 ± 5.39 mm for males and 40.80 ± 6.47 mm for females. Also, the mean value of the chin-throat-neck angle was found to be 121.14 ± 16.99 degrees for males and 122.16 ± 10.92 degrees for females.

Conclusion: Normative values for chin-throat morphology of Nepalese adults were established. In addition to it, sexual dimorphism was observed for chin-throat morphology while comparing the mean values for male and female subjects. However, the differences were statistically insignificant.

KEYWORDS: Cephalometry, Chin-throat morphology, Nepalese adults, Normal occlusion

INTRODUCTION

An aesthetically pleasing profile is a function of harmonious balance among various parts of the face i.e., nose, lips, chin and throat.[1] However, most of the attention is paid to the relationship between nose and lips while evaluation of chin-throat morphology is largely ignored in routine orthodontic practice. Various parameters evaluating chin-throat morphology are lower lip-chin-throat angle, chin-throat length and chin-throat-neck angle. The lip-chin-throat angle and chin-throat length are useful indicators of mandibular and/or chin deformities and must be considered during diagnosis and treatment planning for patients seeking horizontal correction of these deformities. The lip-chin-throat angle is acute in thin individuals, mandibular anteroposterior excess (macrogenia) and Class III malocclusion. Whereas it will be obtuse in individuals with excessive submental adipose tissue, protrusive lower incisor, lower lip procumbency, chin deficiency, low hyoid position, Class II malocclusion and mandibular anteroposterior deficiency (microgenia). Similarly, chin-throat length is increased in individuals having Class III malocclusion

and mandibular anteroposterior excess (macrogenia) while decreased in Class II malocclusion and mandibular anteroposterior deficiency (microgenia).[2,3]

While treating patients having Class III malocclusion with prognathic mandible, larger lip-chin-throat angle and shorter chin-throat length clinician must keep in mind that surgical procedures that reduce the prominence of the chin e.g. mandibular setback can result in worsening of the patient's profile. Instead, other surgical alternatives e.g. mandibular subapical osteotomies or maxillary advancements can be planned which can correct occlusion quite effectively while leaving profile in their best possible harmony.[4,5]

In addition to the above two parameters, another important parameter evaluating chin-throat morphology is the chin-throat-neck angle also referred to as the "Cervicomental angle " or "Submental-cervical angle" or "Chin-throat angle" or "Chin-neck angle" or "Submental-neck angle "by different authors. Surgical procedures like superior repositioning of the maxilla by LeFort I osteotomy and esthetic correction of the mandible and/or chin e.g. mandibular and/or chin setback, mandibular advancement, advancement genioplasty, etc. can affect submental-cervical morphology.[6]

Mandibular and/or chin setback procedures may lead to an increase in the submental-cervical angle which in turn can potentially deteriorate submental-cervical aesthetics. On the other hand, mandibular advancement and/or advancement genioplasty can result in the improvement of submental-cervical aesthetics.[7,8]

Dayan et al[9] compared pre and post-photographs of 17 patients and evaluated the influence of the chin implant on the cervicomental angle and concluded that placement of a chin implant in a microgenic face will result in a more youthful appearance by reducing the cervicomental angle.

Recently, there has been an increase in the number of patients undergoing combined orthodontic and orthognathic surgery for improvement of overall facial appearance. Hence, a critical evaluation of the chin-throat relationship must be considered during diagnosis and treatment planning for these patients.

The normative value of different parameters evaluating chin-throat morphology for different populations has been established previously by different authors. These authors however limited themselves to one or two parameters. Normative values of lip-chin-throat angle and chin-throat length were suggested by Worms et al[4] and Reyneke and Ferrerti[2] while Marino et al[10] Ellenbogen and Karlin[11], Sommerville et al[12], Epker and Stella[13], Moreno et al[6] and Haddad and Ghafari[14] reported the normative value for chin-throat-neck angle. Also, a comparison of chin-throat morphology between male and female subjects has not been done previously. The availability of population and gender-specific normative data can be very useful in diagnosis, treatment planning and postsurgical evaluation of patients requiring esthetic correction of the chin and lower jaw. However, we could not find any published study evaluating chin-throat morphology in the Nepalese population when an electronic literature search using key words "chin-throat morphology", "lip-chin-throat angle", "chin-throat length", "chin-throat-neck angle", "normal occlusion" and "Nepalese population" was done. Hence, the present study was undertaken to obtain normative value and study variation of chin-throat morphology of Nepalese adult male and female subjects with normal occlusion and aesthetic facial profile.

MATERIALS AND METHODS

Ethical approval for the study was taken from the Institutional Review Committee, Kathmandu University School of Medical Sciences, Nepal (IRC no: - 82/2021). Since earlier studies have not been done with similar objectives, a total enumeration sampling method was used and all the samples matching our inclusion criteria were selected from the archives of the Department of Orthodontics, Dhulikhel Hospital, Kathmandu University School of Medical Sciences, Nepal.

INCLUSION CRITERIA:

- Good quality lateral cephalograms of Nepalese adult subjects with clearly visible soft tissue outline and without any artefacts that might interfere with the location of the cephalometric landmarks.
- Cephalogram of subjects with aesthetically pleasing profile (i.e. having balanced facial and cervical proportions as defined by Moreno et al[6]) and normal occlusion (Angle's Class I molar relationship with minor or no crowding with Skeletal Class I jaw bases).
- Cephalograms with subjects in natural head position, teeth in centric occlusion and their lips relaxed.
- Cephalograms of subjects with all 28 permanent teeth present. The presence or absence of third molars was not considered essential.

EXCLUSION CRITERIA:

- Cephalograms of subjects who had undergone orthodontic treatment, prosthodontic treatment and craniofacial/plastic surgery.

The lateral cephalograms of each subject were manually traced on a sheet of fine grade 0.003"x8"x10" matte acetate tracing paper with a 3H pencil using a standard protocol. A total of 4 commonly used anatomical landmarks were plotted on each cephalogram and 3 different lines were drawn.(Figure 1)

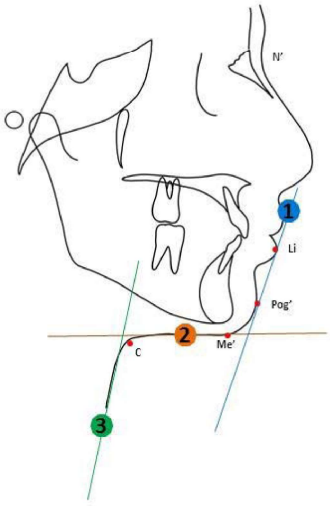

Figure 1: Different landmarks and lines used in the study [Li:Labrale inferius (median point in the lower margin of the lower membranous lip), Pog':Soft tissue pogonion (most prominent point on the soft tissue contour of the chin), Me':Soft tissue menton (lowest point on the soft tissue contour of the chin), C: cervical point (intersection point of submental and cervical tangent lines), Line 1: line drawn from " labrale inferius(Li)" to "soft tissue pogonion (Pog')", Line 2: "submental tangent(Sm)" line, Line 3: "cervical tangent (Ce)" line]

Calibration of the actual size of each image in millimeters was done based on the measurement of a known distance (10 mm) between the two fixed points of the ruler on the cephalogram. Using a millimeter ruler and protractor, three (1 linear and 2 angular) parameters evaluating chin-throat morphology i.e., lip-chin-throat angle, chin-throat length and chin-throat-neck angle (Table 1) were measured to the nearest 0.5 mm and 0.5 degrees. These measurements were done in accordance with the methods described by Worms et al[4] and Moreno et al[6]. After adding a magnification factor to the obtained linear measurements final values were recorded.

Table 1: Cephalometric Parameters (Linear and Angular) used in the study

S.No.	Parameters	Description
1.	Lip-chin-throat angle (degrees)	Angle between line drawn from " labrale inferius(Li)" to "soft tissue pogonion (Pog')" and "submental tangent (Sm)" line
2.	Chin-throat length (mm)	Distance between "Cervical point (C)" and "soft- tissue menton (Me')"
3.	Chin-throat-neck angle (degrees)	Angle between "submental tangent(Sm)" line and cervical tangent (Ce) line

All the assessments (tracing as well as measurement) were done by the same investigator (RKM). Also, five cephalograms were only analyzed daily to minimize errors due to human fatigue. To evaluate the errors due to landmark identification, tracing and measurement of 15 cephalograms were randomly selected. After a gap of three weeks, all the landmarks were replotted. Manual tracing and measurements were repeated on these cephalograms.[15]

STATISTICAL ANALYSIS

All the statistical analyses were carried out using the Statistical Package for Social Sciences (SPSS) (version 21.0; IBM, Armonk, NY, USA). The intraclass correlation coefficient (ICC) was calculated to determine intra-observer reliability and reproducibility for repeated measurements. The normality of data distribution was checked using the Shapiro-Wilk test. The mean and standard deviation (SD) for all the parameters were calculated for both sexes. Differences in the means were analyzed using Student's t-test with a level of significance set at $p<0.05$ to study sexual dimorphism.

RESULTS

Out of a total of 1000 cephalograms analyzed, 46 lateral cephalograms of adult subjects (21 males and 25 females) were included in the final sample. These subjects fell in the age range of 18 to 32 years. ICC for repeated cephalometric measurements was > 0.9 which is indicative of a very high intra-observer reliability[16,17]. Data was found to be normally distributed. Descriptive data for the 3 parameters are presented in Table 2.

Table 2: Mean, standard deviation and range for different parameters used in the study

Variable	Mean ± SD	Range
Lip-chin-throat angle (degrees)	105.56 ± 8.69	83.0 - 125.0
Chin-throat length (mm)	40.48 ± 5.95	28.22 - 52.50
Chin-throat-neck angle (degrees)	121.69 ± 13.86	93.0 - 153.0

SD, Standard deviation

The mean values of lip-chin-throat angle, chin-throat length and chin-throat-neck angle were 105.56 ± 8.69 degrees, 40.48 ± 5.95 mm and 121.69 ± 13.86 degrees respectively. The mean value of lip-chin-throat angle was higher in male subjects (106.09 ± 8.60 degrees) as compared to female subjects (105.12 ± 8.92 degrees). Whereas, the mean values of chin-throat length and chin-throat-neck angle were higher for females (40.80 ± 6.47 mm and 122.16 ± 10.92 degrees respectively) as compared to male subjects (40.08 ± 5.39 mm and 121.14 ± 16.99 degrees respectively). However, these differences were statistically not significant. (Table 3)

Table 3: Comparison of the mean value for different parameters used in the study between male and female subjects

Variable	Group	N	Mean	SD	P value†
Lip-chin-throat angle (degrees)	Male	21	106.09	8.60	0.70
	Female	25	105.12	8.92	
Chin-throat length (mm)	Male	21	40.08	5.39	0.69
	Female	25	40.80	6.47	
Chin-throat-neck angle (degrees)	Male	21	121.14	16.99	0.80
	Female	25	122.16	10.92	

SD, Standard deviation; †Student's t-test

DISCUSSION

Chin-throat morphology is an important factor in establishing optimal facial esthetics. Evaluation of chin-throat morphology along with its relationship to other parts of face i.e. nose, lips, etc. must be considered during diagnosis, treatment planning and evaluation of treatment outcomes in patients undergoing combined orthodontic and/or orthognathic surgeries. The availability of population and gender-specific normative values for chin-throat morphology can help the clinician to determine the extent of deviation of an individual's facial measurements from the normal values.

For evaluating chin-throat morphology we measured three parameters in this study i.e. lip-chin-throat angle, chin-throat length and chin-throat-neck angle. Worms et al4 suggested that the normative values of lip-chin-throat angle and throat length are 110 ± 8 degrees and 57 ± 6 mm respectively. Similarly, normal values of lip-chin-throat angle and chin-throat length given by Reyneke and Ferrerti2 is 110 ± 8 degrees and 42 ± 6 mm respectively. In our study, we found that the mean values of lip-chin-throat angle and chin-throat length were 105.56 ± 8.69 degrees and 40.48 ± 5.95 mm respectively which were smaller than the normative values reported by above two authors.

The mean chin-throat-neck angle in our study was found to be 121.69 ± 13.86 degrees (range 93.0 - 153.0). These values are in accordance with measurements reported by Sommerville et al.[15] However, a wide variation has been reported by different authors over the years, like

- 90 degrees [Marino et al[13]]
- 105 - 120 degrees [Ellenbogen and Karlin[14]]
- 124 degrees (range, 90-153 degrees) [Sommerville et al[15]]
- 110 - 120 degrees [Epker and Stella[16]]
- 118 ± 8.2 degrees (range, 101-135degrees) [Moreno et al[6]]
- 116 ± 6.87 degrees [Haddad and Ghafari[17]]

According to the findings of a recent survey by Naini et al8, the chin-throat-neck angle (submental-cervical angle) between 90-105 degrees was deemed acceptable with 95 degrees being the most attractive.

The variations among different parameters evaluating chin-throat morphology in the present study as well as the ones reported in the literature can be attributed to racial differences, the use of different reference points and differences in the method of constructing these parameters.

While comparing the mean values of different parameters evaluating chin-throat morphology between male and female subjects, we found that the mean value of lip-chin-throat angle was found higher in male subjects while the mean values of chin-throat length and chin-throat-neck angle were found to be higher in female

subjects. However, the difference between the mean values of these 3 parameters for males and females was statistically insignificant. These findings are in contrast to the results of a study by Sommerville et al13 who found that the mean value of submental-neck angle was higher in males (126 degrees) as compared to female subjects (121 degrees). However, we could not find gender-specific normative data for lip-chin-throat angle and chin-throat length from previous studies.

LIMITATIONS AND FUTURE SUGGESTIONS

In the present study, lateral cephalograms of 46 adult subjects with Class I occlusion and pleasing facial profiles visiting a tertiary-level hospital in Central Nepal were evaluated and normative data for chin-throat morphology were obtained. This study sample may not be a complete representation of the Nepalese population. Also, the ethnicity of the subjects was not taken into consideration. Hence, future studies with a larger sample size and a multicentre approach encompassing different ethnic groups are recommended.

CONCLUSIONS

- The mean values of the lip-chin-throat angle, chin-throat length and chin-throat-neck angle were 105.56 ± 8.69 degrees, 40.48 ± 5.95 mm and 121.69 ± 13.86 degrees respectively. The mean value of the lip-chin-throat angle was 106.09 ± 8.60 degrees in male subjects and 105.12 ± 8.92 degrees in female subjects. Similarly, the mean value of the chin-throat length was 40.08 ± 5.39 mm for males and 40.80 ± 6.47 mm for females. Likewise, the mean value of the chin-throat-neck angle was found to be 121.14 ± 16.99 degrees for males and 122.16 ± 10.92 degrees for females.
- The mean values of the lip-chin-throat angle, chin-throat length and chin-throat-neck angle of Nepalese adults were found to vary in comparison to the norms reported for different populations by previous investigators.
- Sexual dimorphism was observed in all the 3 parameters. However, the differences were statistically insignificant.
- The findings obtained from the present study have not been previously reported in the Nepalese population. Thus, this data can be used as a baseline for future research. This is one of the biggest strengths of this study.

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