Original Article
Cent Asian J Med Sci. 2020 December;6(4):214-222. https://doi.org/10.24079/CAJMS.2020.12.002

Central Asian Journal of Medical Sciences
CAJMS

Facial Soft Tissue Profile Analysis in Mongolian Children

Erdenebulgan Purevjav[1], Altanzul Radnaadorj[1], Ganjargal Ganburged[1], Badamtsetseg Mashbat[2], Amarsaikhan Bazar[3], Keiji Moriyama[4], Bayasgalan Gombojav[5]

[1]Department of Orthodontics, School of Dentistry, Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia; [2]Department of Dentistry, Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia; [3]Department of Prosthodontics, School of Dentistry, Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia; [4]Department of Maxillofacial Orthognathics, Tokyo Medical and Dental University, Tokyo, Japan; [5]Department of Graduate Education, Graduate School, Mongolian National University of Medical Sciences, Ulaanbaatar, Mongolia

Submitted: February 5, 2020
Revised: February 12, 2020
Accepted: November 24, 2020

Corresponding Author
Erdenebulgan Purevjav, DDS, MD
Department of Orthodontics, School of Dentistry, Mongolian National University of Medical Sciences, Ulaanbaatar 15120, Mongolia
Tel: +976-99137901
E-mail: p_bulgan@yahoo.com

Objectives: The present study aimed to evaluate the specific variables of facial soft tissue changes in Mongolian children using angular and linear measurements. **Methods:** We studied the lateral cephalograms of 541 subjects (228 male and 313 females) having normal occlusion between the ages of 6 and 15 years. Two orthodontists read all radiographs to determine their cerebral vertebral maturation index (CVMI). The radiographs were digitized and cephalometric measurements were made. **Results:** The Gl'-Sn-Pg' angle for all participants was 170.2 ± 5.4°. The Nasofrontal Gl′-N′-Tn′ angle was 147.2 ± 7.6° for all participants. It decreased with CVMI stage for girls ($p = 0.000$). The Nasofacial angle Tn- N'- Pog' angle averaged 20.4 ± 7.7° for all participants. The Nasomental angle N'- Tn-Pog' angle on averaged 144.9 ± 4.3° for all participants. It decreased with the CVMI stage for girls ($p = 0.000$). The Mentocervical Tn-Pog Me-NTP angle was significantly larger in boys than girls (107.8 ± 8.6° vs. 105.3 ± 7.8°, $p = 0.001$). The Nasolabial angle Ls-Sn-Col angle averaged 100.8 ± 10.6° for all subjects. It decreased with the CVMI stage for both boys ($p = 0.043$) and girls ($p = 0.021$). The distance between the E line and TUL was significantly larger in boys than girls (1.7 ± 2.1 vs. 1.2 ± 2.0 mm, $p = 0.004$). It also significantly decreased with the CVMI stage for both boys ($p = 0.033$) and girls ($p = 0.000$). The space between the E line and TLL averaged 1.9 ± 2.0 mm for all subjects. It did not differ by gender. However, it decreased with the CVMI in both boys ($p = 0.022$) and girls ($p = 0.006$). **Conclusions:** We have provided important results for comparing cephalometric soft-tissue values in Mongolian children in this study. These results provide a valuable guide for orthodontic diagnosis and treatment in our country.

Keywords: Cephalometry, Maxillofacial Development, Reference Standards, Orthodontics, Mongolia

Introduction

Physical appearance is an essential characteristic of the face. The perception of a pleasing face is subjective with many factors involved, like ethnic background, culture, personality, gender and age [1, 2]. The facial skeleton and its overlying soft tissue determine facial appearance, harmony and balance. However, the overlying soft-tissue structures and their relative proportions provide the visual impact of the face. It has long been established that self-esteem is strongly influenced by facial appearance [3].

The clinical examination and diagnostic exercise in orthodontic treatment planning have primarily focused on the dental and skeletal hard tissue elements involving a given patient's facial appearance. However, it was observed that not all parts of the soft tissue profile vary directly with the underlying dentoskeletal profile [4].

Many authors have suggested utilizing soft tissue analysis as a reliable guide for occlusal treatment and attendant soft tissue changes. Arnett and Bergman reported that the facial keys to orthodontic diagnosis and treatment planning as a two-dimensional clinical blueprint for soft tissue analysis and treatment planning [5-15].

Facial features are usually studied in profile. Various methods have been used to evaluate facial characteristics, such as anthropometry [16], photogrammetry [17-19], computer imaging [20], and cephalometry [10, 11]. They found that the interrelationships of these facial features must be in balance to achieve facial harmony.

Several angles have been used to evaluate facial aesthetics, including H-angle [12], Z-angle, E line and angle of convexity [13, 14]. The H-angle is formed by a line tangent to the chin and upper lip with the NB line, whereas Z-angle is formed by the Frankfort plane and profile line, formed by a line joining the extreme point of the soft tissues of the chin and the more prominent lip, usually the upper. The angle of convexity is formed by soft tissue glabella, subnasale, and soft tissue pogonion. Holdaway et al. stated that 'Systems based on hard-tissue measurements or reference lines alone may produce disappointing results' [6, 7].

An increase in dental awareness has created a great demand for orthodontic treatment in Mongolian populations. While norms have been established for Caucasian people regarding both cephalometric readings and lateral soft tissue profile parameters, to date, there is a lack of study in this area for Mongolians. There is thus, a great need to establish Mongolian population norms for use in orthodontic treatment.

Our study aimed to measure the facial variables in Mongolian children as they mature utilizing angular and linear soft tissue measurements.

Materials and Methods

Study population

The present study was conducted on lateral cephalograms of 541 subjects (228 male and 313 females) having normal occlusion between the ages of 6 and 15 years. All subjects were recruited from the 33rd and 67th Elementary and Junior high school in Ulaanbaatar, Mongolia. The other data for photometric investigation were obtained from the longitudinal population-based survey "Craniofacial Collaborative Research" conducted by a team at Tokyo Medical and Dental University and the Mongolian National University of Medical Sciences.

Inclusion criteria

Participants were included in the study if they were between 6 and 15 years of age, had normal growth and development, no facial asymmetry, no malocclusion and occlusal deformation, Angle's Class I occlusion with well-aligned maxillary and mandibular dental arches, overjet and overbite scale within 2 - 4 mm, lateral cephalograms with contrast in the normal range, no previous history of orthodontic or prosthodontic treatments and maxillofacial or plastic surgery.

Measurement methods

Cephalometric radiographs of each patient were taken on the same day. All radiographs were taken with the same x-ray equipment (Veraviewepocs, Morita, Japan) at the same distance (x-ray source-film and film-subject distances) and intensity. All assessments were performed in a darkened room with a radiographic illuminator to ensure contrast enhancement of the bone images.

Cervical vertebrae stages were determined by the Hassel and Farman modification of the criteria of Lamparski, which assesses maturational changes of the second, third, and fourth cervical vertebrae to classify participants into one of five stages of the cerebral vertebral maturation index (CVMI) [15]. The cervical vertebrae maturation stages were rated by two orthodontists

(T.U. and S.I.R.) separately and without knowing chronologic ages. The average of these ratings was used as the vertebrae maturation stage [16].

All lateral cephalograms of the selected subjects were taken on a digital cephalometric machine (Veraviewepocs, Morita, Japan) by positioning the subject's head in the natural head position with teeth in centric occlusion and lips in relaxed position at a focus/object distance of 150 cm and an object/receptor distance of 20 cm [19]. The subjects were placed in a head holder and asked to look straight forward before adjusting the nasal positioner with a built-in millimeter scale.

Using cephalometric software (Winceph 11.0, Rise, Sendai, Japan), one author identified 11 landmarks on each radiograph (Figure 1, Table 1).

Table 1. Soft-tissue landmarks and E line

Landmarks	Descriptions
Soft-tissue Glabella	Gl'
Soft-tissue Nasion	N'
Top of nose	Tn
Subnasale	Sn
Columella	Col
Labialesuperius	Ls
Top upper lip	TUL
Top lower lip	TLL
Soft-tissue Pogonion	Pog'
Soft-tissue Mentalis	Me'
Neck Throat point	NTP
Top of nose – Soft-tissue Pogonion	E line

The author then obtained the desired angular and linear measurements in one reference plane (Figures 2 and 3, Table 2).

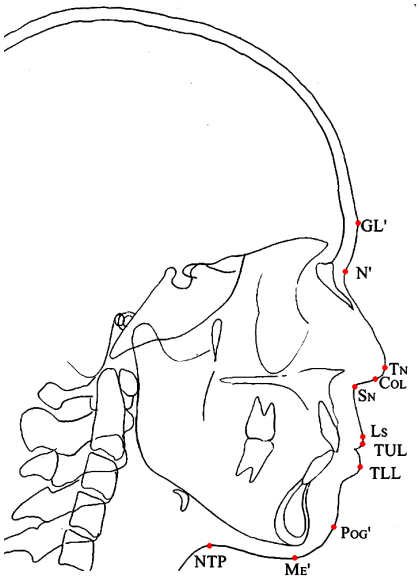

Figure 1. Soft tissue landmarks: Gl'- Soft-tissue Glabella, N'- Soft tissue Nasion, Tn- Top of nose, Sn- Subnasale, Col- Columella, Ls- Labialesuperius, TUL- Top Upper Lip, TLL- Top Lower Lip, Pog'- Soft tissue Pogonion, Me'- Soft tissue Mention, NTP- Neck Throat point.

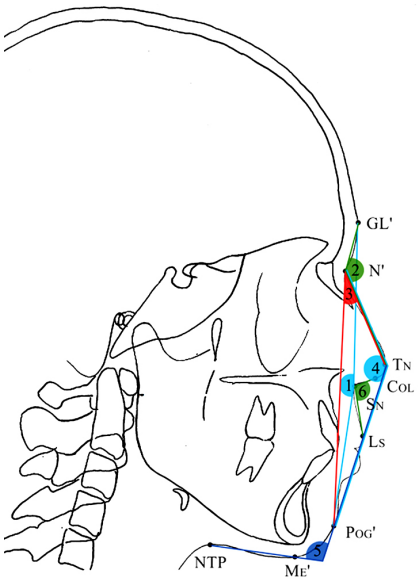

Figure 2. Angular measurements: 1. Soft-tissue facial profile angle (Gl'-Sn-Pog'), 2. Nasofrontal angle (Gl'- N'-Tn), 3. Nasofacial angle (Tn- N'- Pog'), 4. Nasomental angle (N'-Tn-Pog'), 5. Mentocervical angle (Tn-Pog'/Me-NTP), 6. Nasolabial angle (Ls-Sn-Col).

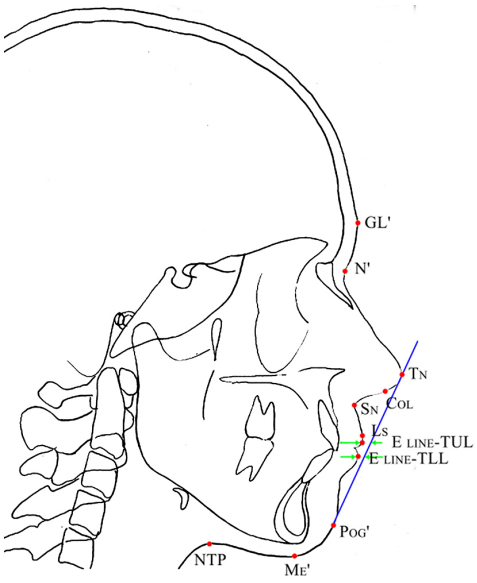

Figure 2. Linear measurements: E line-TUL, E line-TLL.

Table 2. Description of measurements.

Parameters	Descriptions	Unit
Soft-tissue facial profile angle	Gl'-Sn'- Pog'	degree°
Nasofrontal angle	Gl'- N'-Tn	degree°
Nasofacial angle	Tn- N'- Pog'	degree°
Nasomental angle	N'- Tn-Pog'	degree°
Mentocervical angle	Tn-Pog'/Me-NTP	degree°
Nasolabial angle	Ls-Sn'-Col'	degree°
Upper lip distance	E line-TUL	mm
Lower lip distance	E line-TLL	mm

Statistical analyses

The effects of age and gender on our cephalometric measurements of Mongolian children were determined using independent t-tests. One-way ANOVA, followed by Tukey's post hoc tests were used to compare the arithmetic mean in more than two groups. Statistical significance was set at a p-value of $p < 0.05$. All statistical analyses were done using Statistical Package for Social Sciences (SPSS) version 25.0 statistical analysis software.

Ethical statement

Ethical approval for this study was obtained from the Mongolian National University of Medical Sciences Research Ethics Committee on June 08, 2018 (№2018/3-10). Before data collection, the parents of all children provided written, informed consent.

Results

The study was conducted on lateral cephalograms of 541 subjects (228 male and 313 females) having normal occlusion between 6 to 15 years of age. The demographic and CVMI characteristics of the research participants are shown in Table 3. The facial profiles of the entire study population are compared by gender in Table 4. The facial profile patterns are summarized according to their CVMI stage for boys in Table 5, girls in Table 6, and for all study participants in Table 7.

Effect of age and gender on CVMI stage

Gender had no significant effect on the age at which participants reached each CVMI stage (Table 3). Thus, the CVMI stage was used as a surrogate marker for age in our study.

Table 3. Comparison of study participants by gender according to CVMI stage.

Cervical stage	Developmental stage	Age Male (n = 225)		Age Female (n = 316)		*p-value
		N	Mean ± SD	N	Mean ± SD	
CVMI 1	Prepubertal	107	6.0 - 9.5	125	6.0 - 8.9	0.423
CVMI 2	Prepubertal	45	12.6 ± 0.7	67	10.3 ± 1.1	0.534
CVMI 3	Circumpubertal	36	13.3 ± 0.6	56	11.8 ± 0.4	0.615
CVMI 4	Circumpubertal	22	14.0 ± 0.0	38	12.0 ± 0.0	0.518
CVMI 5	Postpubertal	15	14.0 ± 0.0	30	14.0 ± 0.9	0.939

CVMI - Cerebral Vertebral Maturation Index, *independent t-test comparing the age of males and females at each stage

Soft-tissue facial profile angle Gl'-Sn-Pg'

This profile angle is used to assess the convexity or concavity of the facial profile, excluding the nose. The Gl'-Sn-Pg' angle for all participants was 170.2 ± 5.4° (Table 4) and did not vary by CVMI stage for boys or girls (Tables 5 and 6).

Nasofrontal Gl'- N'-Tn'

This angle was 147.2 ± 7.6° for all participants (Table 4). It did not vary by CVMI stage for boys (p = 0.072, Table 5). It did vary within by CVMI stage for girls (p = 0.000, Table 6), where the angle decreased with the CVMI stage. Because of this, the angle also decreased with the CVMI stage for the entire study population (p = 0.000, Table 7).

Nasofacial angle Tn- N'- Pog'

The angle averaged 20.4 ± 7.7° for all participants (Table 4). It did not vary by CVMI stage or by gender.

Nasomental angle N'- Tn-Pog'

The angle of the subjects averaged 144.9 ± 4.3° for all participants and did not differ by gender (p = 0.742, Table 4). It decreased with the CVMI stage for girls (p = 0.000, Table 6) and with the numbers available in our study, fell just short of significantly decreasing with the CVMI stage in boys (p = 0.064, Table 5). However, combining the genders, the angle decreased with the CVMI stage for the entire study population (p = 0.000, Table 7).

Mentocervical angle Tn-Pog'/Me-NTP

The Tn-Pog Me-NTP angle was significantly larger in boys than girls for the study cohort (107.8 ± 8.6° vs. 105.3 ± 7.8°, p = 0.001, Table 4). It did not change with the CVMI stage for either boys or girls.

Nasolabial angle Ls-Sn-Col

The Ls-Sn-Col angle averaged 100.8 ± 10.6° and did not differ by gender when examining our entire cohort (Table 4). However, the angle decreased with the CVMI stage for both boys (p = 0.043, Table 5) and girls (p = 0.021, Table 6).

Space between E line-TUL

The distance between the E line and TUL was significantly larger in boys than girls (1.7 ± 2.1 mm vs. 1.2 ± 2.0 mm, p = 0.004, Table 4). It also significantly decreased with the CVMI stage for both boys (p = 0.033, Table 5) and girls (p = 0.000, Table 6).

Space between E line-TLL

The space between the E line and TLL averaged 1.9 ± 2.0 mm for the entire study cohort (Table 4). This distance did not differ by gender. However, it did decrease with the CVMI in both boys (p = 0.022, Table 5) and girls (p = 0.006, Table 6).

Table 4. Comparison of the facial profile parameters of Mongolian children by gender.

Parameters	Male	Female	All	*p-value
	Mean ± SD	Mean ± SD	Mean ± SD	
Gl'-Sn-Pog'	170.2 ± 4.5	170.2 ± 6.1	170.2 ± 5.4	0.355
Gl'-N'-Tn	146.9 ± 5.5	147.5 ± 9.1	147.2 ± 7.6	0.145
Tn-N'-Pog'	20 ± 2.7	20.8 ± 10.2	20.4 ± 7.7	0.938
N'-Tn-Pog'	144.9 ± 4.4	144.9 ± 4.3	144.9 ± 4.3	0.742
Tn-Pog' / Me'-NTP	107.8 ± 8.6	105.3 ± 7.8	106.3 ± 8.3	0.001
Ls-Sn-Col	101.5 ± 9.8	100.2 ± 11.3	100.8 ± 10.6	0.545
E line - TUL	1.7 ± 2.1	1.2 ± 2.0	1.4 ± 2.0	0.004
E line - TLL	2.0 ± 2.0	1.9 ± 2.1	1.9 ± 2.0	0.109

*Independent t-test comparing genders

Table 5. Comparison of the facial profile parameters in Mongolian boys according to CVMI stage.

Parameters	CVMI-1	CVMI-2	CVMI-3	CVMI-4	CVMI-5	*p-value
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Gl'-Sn-Pog'	169.9 ± 4.7	170.7 ± 4.0	170.7 ± 3.2	169.3 ± 5.9	168.5 ± 6.2	0.674
Gl'-N'-Tn	148 ± 4.9	146 ± 6.2	147.5 ± 5.8	145.4 ± 4.7	143.3 ± 3.9	0.072
Tn-N'-Pog'	19.9 ± 2.7	19.6 ± 2.8	20.6 ± 2.3	21.6 ± 2.6	21 ± 2.1	0.370
N'-Tn-Pog'	145.2 ± 4.3	145.5 ± 4.4	144.5 ± 3.4	142.6 ± 4.9	142.4 ± 4.2	0.064
Tn-Pog' / Me'-NTP	108.4 ± 8.1	106.8 ± 8.8	108.1 ± 6.2	108.2 ± 9.9	108 ± 18.1	0.653
Ls-Sn-Col	103 ± 10.1[a]	100.6 ± 9.6	98.2 ± 9.6	99.8 ± 8.9	99 ± 3.5[a]	0.043
E line - TUL	2.1 ± 2.0[bc]	1.4 ± 2.3[d]	1.1 ± 1.2[e]	1 ± 1.7[b]	0.9 ± 0.6[cde]	0.033
E line - TLL	1.9 ± 2.0[f]	2.5 ± 2.2[g]	2.0 ± 1.6[h]	1.5 ± 1.9	1.0 ± 2.0[fgh]	0.022

*One-way ANOVA result; Tukey multiple post-hoc comparison result comparing CVMI stages: [a]1 vs. 2, p = 0.05; [b]1 vs. 4, p = 0.01; [c]1 vs. 5, p = 0.004; [d]2 vs. 5, p = 0.004, [e]3 vs. 5, p = 0.060; [f]1 vs. 5, p = 0.009; [g]2 vs. 5, p = 0.002, and [h]3 vs. 5, p = 0.004. All others were not significant. CVMI - Cerebral Vertebral Maturation Index.

Table 6. Comparison of the facial profile parameters in Mongolian girls according to CVMI stage.

Parameters	CVMI-1	CVMI-2	CVMI-3	CVMI-4	CVMI-5	*p-value
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Gl'-Sn-Pog'	170.6 ± 4	170.8 ± 5	168 ± 11	168.9 ± 5.8	170 ± 4.9	0.674
Gl'-N'-Tn	149.2 ± 10.9[ab]	149.3 ± 4.9[c]	145.3 ± 6.8	144.6 ± 4.4[a]	143.2 ± 8.8[abc]	0.000
Tn-N'-Pog'	20.9 ± 12.7	18.9 ± 3.4	22.6 ± 12.5	20.8 ± 2.5	21 ± 2.1	0.361
N'-Tn-Pog'	145.3 ± 3.6[d]	146.6 ± 5[efg]	143.4 ± 4.2[e]	143.7 ± 5.4[df]	143.3 ± 4.2[ag]	0.000
Tn-Pog' / Me'-NTP	104.6 ± 7.5	106.7 ± 7.9	104.2 ± 8.7	105.3 ± 6.5	107.8 ± 8.1	0.653
Ls-Sn-Col	100.8 ± 13[h]	99.7 ± 8.7	100.2 ± 8.7	102.3 ± 12.3	96.5 ± 8[h]	0.021
E line - TUL	1.6 ± 1.9[ij]	1.2 ± 1.7[k]	1.2 ± 1.8	0.7 ± 2.2[i]	-0.1 ± 2.3[jk]	0.000
E line - TLL	2.0 ± 2l	2.0 ± 1.8[m]	2.4 ± 2[n]	1.9 ± 2.9	0.7 ± 2.2[lmn]	0.006

*One-way ANOVA result; Tukey multiple post-hoc comparison result comparing CVMI stages: [a]1 vs. 4, 5, p = 0.017; [b]1 vs. 5, p = 0.000; [c]1 vs. 5, p = 0.051; [d]1 vs. 4, p = 0.019; [e]2 vs. 3, p = 0.015; [f]2 vs. 4, p = 0.002; [g]2 vs. 5, p = 0.011; [h]1 vs. 5, p = 0.081; [i]1 vs. 4, p = 0.010; [j]1 vs. 5, p = 0.000; [k]2 vs. 5, p = 0.004, [l]1 vs. 5, p = 0.009, [m]2 vs. 5, p = 0.002, and [n]3 vs. 5, p = 0.004. All others were not significant. CVMI - Cerebral Vertebral Maturation Index.

Table 7. Comparison of the facial profile parameters in Mongolian children by CVMI stage.

Parameters	CVMI-1	CVMI-2	CVMI-3	CVMI-4	CVMI-5	*p-value
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Gl'-Sn-Pog'	170.3 ± 4.3	170.7 ± 4.3	168.6 ± 9.8	169.1 ± 5.8	171.6 ± 5.1	0.674
Gl'-N'-Tn	148.7 ± 8.7[a]	147.1 ± 6[bc]	145.8 ± 6.6	145 ± 4.5[a]	143.2 ± 8.3[bc]	0.000
Tn-N'-Pog'	20.4 ± 9.5	19.4 ± 3	22.1 ± 11	21.1 ± 2.5	20.8 ± 2.2	0.576
N'-Tn-Pog'	145.3 ± 3.9[d]	145.9 ± 4.6[efg]	143.7 ± 4[e]	143.2 ± 5.1[df]	143.2 ± 4.1[ag]	0.000
Tn-Pog' / Me'-NTP	106.4 ± 8.0	106.8 ± 8.5	105.1 ± 8.3	106.6 ± 8.2	107.8 ± 9.3	0.486
Ls-Sn-Col	101.8 ± 11.8[h]	100.3 ± 9.3	99.8 ± 8.8	101.2 ± 10.9	96.8 ± 7.6[h]	0.035
E line - TUL	1.9 ± 2[ij]	1.3 ± 2.1[k]	1.2 ± 1.6	0.8 ± 2.0[i]	0.6 ± 2.2[jk]	0.000
E line - TLL	2.0 ± 2.0[l]	2.2 ± 1.9[m]	2.3 ± 1.9[n]	1.7 ± 2.5	0.7 ± 2.1[lmn]	0.000

*One-way ANOVA result; Tukey multiple post-hoc comparisons comparing CVMI stages: [a]1 vs. 4, 5, p = 0.017; [b]1 vs. 5, p = 0.000; [c]1 vs. 5, p = 0.051; [d]1 vs. 4, p = 0.019; [e]2 vs. 3, p = 0.015; [f]2 vs. 4, p = 0.002; [g]2 vs. 5, p = 0.011; [h]1 vs. 5, p = 0.081; [i]1 vs. 4, p = 0.010; [j]1 vs. 5, p = 0.000; [k]2 vs. 5, p = 0.004, [l]1 vs. 5, p = 0.009, [m]2 vs. 5, p = 0.002, and [n]3 vs. 5, p = 0.004. All others were not significant. CVMI - Cerebral Vertebral Maturation Index.

Discussion

The investigation aimed to determine the average angular and linear measurements that define the soft tissue facial profile of Mongolian children. We analyzed standardized cephalometric x-rays taken in the natural head position, as have several other authors in their studies [19]. It should be noted, however, that the purpose of the present study was to gather data to use to establish aesthetically pleasing and balanced soft-tissue profiles during orthodontic treatment. The selected cohort was between 6 and 15 years of age. The mean value of nasolabial angle (Ls-Sn-Col) in Mongolian children is 101.5 ± 9.8° in males and 100.2 ± 11.3° in females, which are similar to the values in Kim et al. in the Mongolian population [17] and Reddy et al. in North Indian population (102.32 ± 4.69° in males and 101.50 ± 4.39° in females) [20].

The mean soft tissue convexity angle (Gl'-Sn-Pog') in Mongolian children is 170.2 ± 4.5° degrees in males and 170.2 ± 6.1° in females, which are more than the values given by Bergman et al. [18] in the Caucasian population (139.9 ± 5.38° in males and 139.2 ± 4.48° in females) and Malkoç et al. [21] in the Turkish population (142.35 ± 6.15° in males and 142.57 ± 5.29° in females). The mean profile angle for all participants was 170.2 ± 5.4° and did not vary by CVMI stage for boys or girls. This result is consistent with the findings of the previous study by Saba et al. [22] in the Arabic population. Moreover, the angular photogrammetric analysis in 12-year-old Chinese children showed that both males and females exhibited slightly smaller facial convexity angle (168.1 ± 5.1° for males and 169.85 ± 4.83°) compared with Mongolian children [23].

Some investigators have reported that nasofrontal angles of males and females differ, while others report minimal or no difference [24]. In our study, the nasofrontal angle was invariant with the CVMI stage for boys, but it significantly varied for girls, where the angle decreased with the CVMI stage. Due to this, the angle also decreased with the CVMI stage for the entire study population.

In our study, the nasomental angle significantly decreased with the CVMI stage for girls. However, there was no significant difference by gender in our results, consistent with that found in a previous study. As for mentocervical angle, Leung et al. reported that larger mentocervical angle was found in males compared to the females in Chinese adolescents (97.05 ± 7.76° vs. 92.58 ± 6.64°) [23]. On the other hand, Fernández-Riveiro et al. found that the mentocervical angle of females was larger than males in European caucasian adolescents (84.18 ± 6.65° vs. 79.85 ± 7.19°) [25]. In our study, males exhibited larger mentocervical angle compared with females (107.8 ± 8.6° vs. 105.3 ± 7.8°, p = 0.001).

Numerous studies have indicated that the nasolabial and labiomental angles vary in different populations. For example, the nasolabial angle, as a reflection of the relationship between the base of the nose and the upper lip in CVMI stage 1 Croatian adolescents aged between 12-15 years old is 106.39 ± 10.36°. In stage 1 Turkish adults, this value varied to 75.40-126.90° for males and 81.71-129.90° for females. For southern Chinese adolescents, the nasolabial angle for males is 102.7 ± 11.1° and 101.6 ± 11.3° for females [26]. However, in our study, the nasolabial angle was 101.5 ± 9.8° for males and 100.2 ± 11.3° for females, which are smaller compared to these studies. As for the distance between the E line and TUL, we observed significant differences between genders (p = 0.004), while E line TLL values did not differ in our study [27].

Our study has a few limitations. Our sample size was small and limited to children from the urban area of Ulaanbaatar. So our results may not be fully representative of Mongolian children. Furthermore, we conducted this study in only two elementary and one junior high school in Ulaanbaatar. Therefore, future research should pursue a generalized survey in multiple schools in various regions.

Conclusions

A cephalometric study of 541 subjects (228 male and 313 females) between 6 to 15 years of age Mongolian children was conducted. Our results showed that there is a significant gender difference in mentocervical angle Tn-Pog'/Me-NTP (p = 0.004). Due to the significant decrease of the nasofrontal Gl'-N'-Tn' angle in girls with CVMI stage (p = 0.000), the angle also decreased with the CVMI stage for the entire study population (p = 0.000). We have provided important results for comparing cephalometric soft-tissue values in Mongolian children in this study. These results provide a valuable guide for orthodontic diagnosis and treatment in our country.

Conflict of Interest

The authors declare no conflict of interest.

Acknowledgments

The authors sincerely appreciate Associate professor Oyuntsetseg Bazar DDS, PhD, and the members of the Department of Orthodontics, School of Dentistry, Mongolian National University of Medical Sciences, who conducted orthodontic treatments.

References

1. Mandall NA, McCord JF, Blinkhorn AS, Worthington HV, O'Brien KD. Perceived aesthetic impact of malocclusion and oral self-perceptions in 14 to 15-year-old Asian and Caucasian children in greater Manchester. Eur J Orthod 2000; 21: 175-83.
2. Sahin AM, Gazilerli Ü. Analysis of Holdaway soft tissue measurement in children between 9 and 12 years of age. Eur J Orthod 2001; 23: 287-94.
3. Hershon LE, Giddon DB. Determinants of facial profile and self- perception. Am J Orthod 1980; 78: 279–95.
4. Subtelny JD. A longitudinal study of soft tissue facial structures and their profile characteristics defined in relation to underlying skeletal structures. Am J Orthod 1959; 45: 481-507.
5. Arnett GW, Bergman RT. Facial keys to orthodontic diagnosis and treatment planning. Part II. Am J Orthod 1993; 103: 395-411.
6. Bergman RT. Longitudinal study of cephalometric soft tissue profile traits between the ages of 6 and 18 years. Angle Orthod 2014; 84: 48-55.
7. Holdaway RA. A soft tissue cephalometric analysis and its use in orthodontic treatment planning. Part II. Am J Orthod 1984; 85: 279-93.
8. Burstone CJ. Lip posture and its significance in treatment planning. Am J Orthod 1967; 53: 262-84.
9. Legan HL, Burstone CJ. Soft tissue cephalometric analysis for orthognathic surgery. J Oral Surg 1980; 38: 744-51.
10. Darkwah WD, Kadri A. Cephalometric study of the relationship between soft facial morphology and ethnicity: Review article. Trans Res Anat 2018; 12: 20-4.
11. Bronfman CN, Janson G. Cephalometric norms and esthetic profile preference for the Japanese: a systematic review. Dental Press J Orthod 2015; 20: 6.
12. Holdaway RA. A soft-tissue cephalometric analysis and its use in orthodontic treatment planning. Am J Orthod 1983; 84: 1–28.
13. Merrifield LL. The profile line as an aid in critically evaluating facial esthetics. Am J Orthod 1966; 52: 804–22.
14. Ricketts RM. Esthetics, environment, and the law of lip relation. Am J Orthod 1968; 54: 272-89.
15. Hassel B, Farman A. Skeletal maturation evaluation using cervical vertebrae. Am J Orthod Dentofacial Orthop 1995; 107: 58-66.
16. McNamara JA, Franchi L. The cervical vertebral maturation method: A User's guide. The Angle Orthod 2018; 88: 172-5.
17. Kim JH, Odontuya G. Comparison of cephalometric norms between Mongolian and Korean adults with normal occlusions and well-balanced profiles. The Korean J Orthod 2011; 41: 42.
18. Bergman RT, Waschak J. Longitudinal study of cephalometric soft tissue profile traits between the ages of 6 and 18 years. The Angle Orthod 2013; 84: 48-55.
19. Lundstrom A, Lundstrom F. Natural head position and natural head orientation: basic considerations in cephalometric analysis and research. Eur J Orthod 1995; 17: 111-20.
20. Munish P, Ahuja NK. A computer-assisted angular photogrammetric analysis of the soft tissue facial profile of north indian adults. J Ind Orthod 2011; 45: 119-23.
21. Malkoç S, Demir A. Angular photogrammetric analysis of the soft tissue facial profile of the Turkish adults. Eur J Orthod 2009; 31: 174-9.
22. Saba HAZ. The Skeletal and Soft Tissue Facial Profile in Adolescent and Adult. AI-Rafidain Dent J 2009; 9: 149-55.
23. Leung CSY, Yang Y, Wong RWK, Hagg EUO, Lo J, McGrath CPJ. Angular photogrammetric analysis of the soft tissue profile in 12-year-old southern Chinese. Head Face Med 2014; 10: 56-60.
24. Oghenemavwe LE, Orupabo CD, Augustina P. Gender characterization of Nasofacial Relationship of Ibos of Imo State using discriminant function analysis. J Dent Sci 2018; 17: 71-4.
25. Fernández-Riveiro P, Smyth-Chamosa E. Angular photogrammetric analysis of the soft tissue facial profile. Eur J Orthod 2003; 25: 393-9.
26. Yuen SW, Hiranaka DK. A photographic study of the facial profiles of southern Chinese adolescents. Quintessence Int 1989; 20: 665–76.
27. Erdenebulgan P, Ganjargal G. Arnett facial soft tissue cephalometric analysis norms for Mongolian children. Cent Asian J Med Sci 2020; 6: 55-65. https://doi.org/10.24079/CAJMS.2020.06.002.