

Soft Tissue Cephalometric Standards based on NHP in a Sample of Iranian Adults

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Abstract

Background and aims. This study aimed to establish soft tissue cephalometric standards in Iranian adults based on NHP, which can be used in diagnosis of orthodontic and orthognathic patients.

Materials and methods. A group of 46 individuals (24 males and 22 females) with normal occlusion and proportional facial profile were chosen from a large group of dental students. For the all of the chosen sample, lateral cephalograms were obtained with head oriented in natural position. On the basis of the true horizontal and true vertical lines, the standard values of 19 soft tissue measurements were determined using McNamara, Burstone and Viazis methods.

Results. In this study, the mean value of SN deviation to true horizontal line was 6.6°. Comparison between two genders showed that females have more obtuse nasolabial angle and thinner soft tissue chin than males ($P < 0.05$). Linear measurements showed that the overall size of males was more than females ($P < 0.05$).

Conclusion. Cephalometric norms based on NHP were found to be more reliable in orthognathic patients.

Key words: Cephalometry, NHP, soft tissue.

Introduction

Investigations of many authors show that cephalometric analysis based on sella-nasion plane (SN) and Frankfort horizontal plane (FH) has often led to poor diagnoses and misleading results, because of unreliability of these intracranial references.¹⁻⁵ It has been suggested that when the FH is used as a reference line, it is difficult to locate porion and orbital landmarks precisely. Moreover, this line is not always as horizontal and is deviated from true horizontal line in many cases.⁶⁻¹⁰

Problems also accompany the SN line when it acts as a reference plane. The inclination of SN line could be altered in different orthodontic patients due to superior or inferior location of S point. In addition, it has been shown that anterior-posterior and superior-inferior positioning of N point af-

fects the magnitude of measurements which are dependent on this reference line.^{2,3,6,10} Moreover, the standard deviation of all cephalometric norms obtained based on intracranial references is so large that it makes them not reliable enough.^{2,7,8}

Many investigations have confirmed the advantages of using extracranial reference lines and Natural Head Position (NHP) registration method in cephalometric analysis. The use of extracranial references offers a reasonable diagnosis and treatment results. These reference lines could be obtained and used by taking radiographs in NHP. Natural Head Position is defined as a characteristic position of the head when relaxed individual looks at a distant object or into his/her own eyes in a mirror at the level of the eyes.⁶ This position is established physiologically

by internal mechanisms and has a high reproducibility rate (only 1 or 2 degrees). This, as a result, makes extracranial reference lines more stable and reliable as the base for cephalometric analysis than intracranial references.¹¹⁻¹³ Two major advantages of using radiographs taken in NHP method are (1) more realistic radiographic images of the profile of the face in which the head is neither tilted forward nor backward; and (2) the fact that it makes possible to use extracranial reference lines (TH [true horizontal line] and TV [true vertical line]) for cephalometric analysis.

Houston² believed that the lack of sufficient cephalometric standards based on NHP is a reason to the problem of clinicians to refrain from using extracranial reference lines and taking cephalograms in NHP for cephalometric analysis. Many studies have started to obtain cephalometric norms using extracranial references based on NHP.¹⁴⁻²⁰ This study was carried out to obtain cephalometric norms based on NHP for Iranian adults with selected measurements which are more useful in orthognathic surgery.

Materials and Methods

This study included 46 lateral cephalograms taken in NHP of 46 subjects (24 male and 22 female) selected from dental students at Shahid Beheshti University of Medical Sciences, Tehran, Iran, in 1997. The sample size was calculated using an easy sampling method based on availability of the cases and previous studies. The following criteria were used in the selection of the subjects:

- Age 18–25 years.
- Esthetic and proportional face with no apparent disharmony and asymmetry of the face determined clinically.
- Dental Class I molar and canine relationship; minor crowding or spacing was accepted.
- No history of trauma to the face, orthodontic treatment, or maxillofacial or plastic surgery.

All subjects signed the form of ethical approval indicating their voluntary decision to participate in this study. Lateral cephalograms were taken with the teeth in centric occlusion, lips in repose and the head oriented in natural position according to Moorese.^{6,13} Then ear rods and frontal head holder were put passively without any force



Figure 1. Method of registration of cephalograms in NHP.

to maintain oriented head during registration of cephalograms (Figure 1).

Tracings of the cephalometric radiographs were made by hand on 0.003 inch matte acetate sheets. In this method, the image of the chain in front of the face was used as a guide to trace the extracranial reference lines (Figure 2a). A line was drawn from N point perpendicular to chain, namely true horizontal line (TH) and a line drawn parallel to chain from N point, namely true vertical line (TV) (Figure 2b). Then, 19 soft tissue linear and angular measurements were selected from Burstone, McNamara and Viazis measurements and evaluated. Inclination of the SN line to true horizontal line was also determined. For each measurement, in both genders, mean and standard deviations were calculated and significant differences between males and females were determined statistically using independent *t*-test. P-value < 0.05 was considered statistically significant.

Results

The standards for the soft tissue cephalometric measurements obtained in this study for males and females including the mean, standard deviation and significant differences between males and females are presented in Table 1.

The following results were statistically significant:

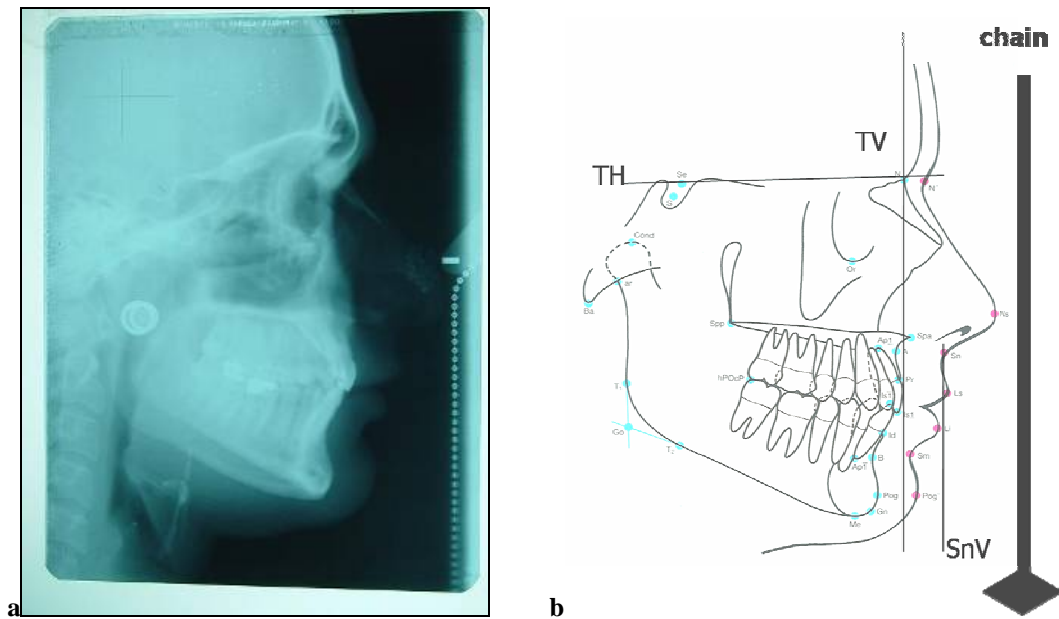


Figure 2. Cephalogram based on NHP (a); references, landmarks and cephalometric tracing for soft tissue analysis based on NHP (b).

1. For Iranian adults, the mean value of SN deviation to true horizontal line was 6.6°.
2. In males, standard deviations of SN line and FH plane to true horizontal line were found to be 3.7° and 2.7°, respectively. In females, the same was 3° for both reference planes.

Table 1. Soft tissue cephalometric norms for the studied sample of Iranian adults based on NHP

Soft tissue measurements	Description	Male		Female		P-value	Significance
		Mean	SD	Mean	SD		
Facial form							
Facial convexity angle	G-Sn-Pg' (Angle)	10.67	5.59	12.18	4.54	0.3228	NS
Midface protrusion	G-Sn (∥ TH)	4.47	4.29	5.07	3.10	0.5824	NS
Lower face protrusion	G-Pg' (∥ TH)	-6.10	6.49	-3.05	4.69	0.0768	NS
Vertical height ratio	G-Sn/Sn-Me (⊥ TH)	1.02	0.08	1.05	0.08	0.2106	NS
Lower face-throat angle	Sn-Gn'-C (Angle)	112.36	10.94	101.69	7.87	0.0005	S
Soft tissue chin thickness	Pg'-Pg' (∥ TH)	14.07	2.67	11.92	1.47	0.0017	S
Lower face relations							
Nasolabial angle	Cm-Sn-Ls (Angle)	98.00	8.04	102.57	8.26	0.0252	S
Upper incisor display	Stms-Ls (⊥ TH)	1.82	2.05	2.02	1.10	0.6881	NS
Upper lip length	Sn-Stms (⊥ TH)	23.07	3.28	21.52	1.92	0.0598	NS
Lower lip length	Stmi-Me' (⊥ TH)	51.68	2.79	47.68	3.01	0.0001	S
Superior labial sulcus	SLS- Sn (∥ TH)	-1.98	1.75	-2.21	1.36	0.6234	NS
Upper lip	Ls - Sn (∥ TH)	0.95	1.78	1.21	1.15	0.5633	NS
Lower lip	Li - Sn (∥ TH)	-2.37	2.49	-1.86	1.60	0.4178	NS
Inferior labial sulcus	ILS - Sn (∥ TH)	-13.40	2.77	-10.97	2.62	0.0039	S
Soft tissue pogonion	Pg' - Sn (∥ TH)	-10.57	3.82	-8.63	3.32	0.0739	NS
Nasal relations							
Nasal projection (soft tissue)	Pn - Sn (∥ TH)	18.5	2.43	18.02	1.79	0.4531	NS
Nasal projection (hard tissue)	Pn - N (∥ TH)	34.10	2.74	32.25	2.68	0.0255	S
Columellar inclination	Sn - Cm / TH	10.65	6.49	15.87	6.98	0.0006	S
Inclination of nose	N' - Pn / TV	28.97	3.57	29.22	3.44	0.8104	NS

SD: standard deviation; TH: true horizontal line; TV: true vertical line; ∥TH: parallel to true horizontal; ⊥TH: perpendicular to true horizontal; S: significant (P < 0.05); NS: non-significant (P > 0.05).

The angular measurements are in degrees and linear measurements are in millimeters.

3. Nasal projection (Pn-N \parallel TH) was higher in males than in females ($P = 0.0255$).
4. Lower lip length (Stmi-Me \perp TH) was higher in males than in females ($P = 0.0001$).
5. Inferior labial sulcus (ILS-Sn \parallel TH) was deeper in males compared with females ($P = 0.0039$).
6. Nasolabial angle in females was more obtuse than males ($P = 0.0252$). This result is due to more upward position of nose tip in females than in males ($P = 0.0006$).
7. The soft tissue chin was thicker in males than in female ($P = 0.0017$).

Discussion

The aim of the present study was to obtain cephalometric norms from Iranian adults in NHP method. Measurements which are more essential and effective in orthognathic surgery were selected with the assumption that measurements of Burstone and McNamara analysis combined with NHP concepts would lead to better orthodontic and orthognathic treatment results. Houston² believed that lack of standards based on NHP is the reason why orthodontists do not have much interest in using extracranial references. Advantages of extracranial versus intracranial references and lack of standards based on NHP in different populations provoked several researches in this respect.¹⁴⁻¹⁹

In the present study, similar to some of the previously published data,^{2,7} a relatively high standard deviation for the angels formed by FH plane and SN line to true horizontal plane in natural head position was noted, which indicate different orientation of these planes to true horizontal plane. Table 2 presents the standard deviation obtained in the current and previous studies. The registration method of NHP (standing or sitting) might have been contributed to the different results between different studies.²¹

On the other hand, geometrically cephalometric errors in ANB angle, for which the rotational effect of the jaws demonstrated by Jacobson is a good example, and other angular or linear measurements as well as effects of anatomic variations of landmarks and difficulties in their determination have been mentioned. It is important to note that in some of the orthognathic surgery candidates,

the position of the landmarks, even the reference lines, are abnormal because of the severity of the dentofacial deformity.^{2,3,6,10}

Several studies tried to use horizontal plane directly or indirectly in their analysis to achieve better clinical results.^{22,23} McNamara²⁴ used the N-vertical to FH plane for analyzing antero-posterior discrepancy of the jaws to minimize errors dependent on ANB angle. Burstone et al¹⁸ drew a line 7° angulated to SN and used it as horizontal reference plane, believing that SN is usually tilted 7° to FH plane.

With respect to the differences between genders, linear measurements indicate larger size of all facial components in males than in females ($P < 0.05$) as was previously revealed by other studies.^{15,16} The male subjects showed more retrusive lower face than females in relation to true vertical line through subnasal (Sn) ($P < 0.05$). This finding is in accordance with the results of Spradley et al for American Whites.¹⁹

In this study, the soft tissue chin thickness was shown to be more prominent in males than in females ($P < 0.05$), a finding that was not reported by previous studies. Females have more obtuse nasolabial angle compared to males ($P < 0.05$) which is a similar finding to that of other studies.¹⁶⁻¹⁸

The selection of samples with normal occlusion and esthetic profile as well as ethical issues considering the risk of radiation associated with taking radiographs were limiting factors for the sample size of this study.

Facial harmony and esthetics are predominantly linked to racial preferences.²⁵ Normative data of normal samples of different eth-

Table 2. Standard deviation of SN and FH to true horizontal line (TH) in different studies

Study	FH/TH	SN/TH
Bjerin (1957)		
Boy and girls	4.6	4.0
Cooks (1988)		
Boys	5.2	5.6
Girls	4.0	4.9
Lundström & Lundström (1992)		
Boys	5.3	5.6
Girls	4.7	5.0
Lundström & Lundström (1995)		
Boys	5.2	5.4
Girls	4.0	4.9
Current study (1997)		
Boys	2.7	3.7
Girls	3.0	3.0

nic groups are a useful guide along with the clinical examination and patient records.²⁶ For realistic post treatment results, almost all cephalometric norms achieved by conventional method specially those for orthognathic surgery candidates could be reevaluated and refined due to advantages of NHP concepts.

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