







Soft Tissue Cephalometric Measurements Among Malaysian Malays and Chinese

Nor Farid Mohd Noor¹, Rehana Basri², Mohammad Khursheed Alam³, Sanjida Haque¹, Melvin Saw Jian Hao¹, Maisarah Abu Talib¹

¹School of Dental Science, Universiti Sains Malaysia, Kota Bharu, Kelantan, Malaysia.

²College of Dentistry, Jouf University, Sakaka, Saudi Arabia.

³College of Medicine, Jouf University, Sakaka, Saudi Arabia.

Author to whom correspondence should be addressed: Dr. Mohammad Khursheed Alam, Associate Professor, Orthodontic Unit, College of Dentistry, Jouf University, Sakakah, Saudi Arabia. Phone: +966 5352339. E-mail: dralam@gmail.com.

Academic Editors: Alessandro Leite Cavalcanti and Wilton Wilney Nascimento Padilha

Received: 23 June 2019 / Accepted: 28 February 2020 / Published: 30 March 2020

How to cite this article: Noor NFM, Basri R, Alam MK, Haque S, Hao MSJ, Talib MA. Soft tissue cephalometric measurements among Malaysian Malays and Chinese. *Pesqui Bras Odontopediatria Clín Integr.* 2020; 20:e4978. <https://doi.org/10.1590/pboci.2020.057>

Abstract

Objective: To obtain the standardized values of individuals of Malaysian Malay and Chinese for further relevant research, such as treatment planning and aesthetical considerations. **Material and Methods:** In this retrospective study, 440 (305 were Malays and 135 were Chinese) standardized lateral cephalometric radiographs of orthodontic patients selected through simple random sampling are profiled using Holdaway's analysis. The independent t-test was used to assess the disparities in race and gender. The significant level was $p < 0.05$. **Results:** Significant differences were found between the Malays and Chinese in their skeletal profile convexity, superior sulcus depth, inferior sulcus to the H line and nose prominence. Between Malay females and males, there are significant differences in superior sulcus depth, soft tissue subnasale to H line, basic upper lip thickness, upper lip thickness and nose prominence. Between Chinese males and females, there were differences in their skeletal profile convexity, upper lip to H line, basic upper lip thickness and upper lip thickness. **Conclusion:** The findings demonstrated the difference between standardized norms and the unique profiles of Malaysian Malays and Chinese. There are significant gender disparities in the soft tissue cephalometric measurements among Malaysian Malay and Chinese subjects.

Keywords: Orthodontics; Cephalometry; Radiographic Image Interpretation, Computer-Assisted.

Introduction

A lateral cephalometric radiograph (LCR) is a standardized, reproducible radiograph used primarily for orthodontic diagnosis and treatment planning. Lateral cephalometry analysis is well known and accepted throughout the dental profession as it is a reliable and reproducible diagnostic method that has allowed orthodontists to formulate treatment plans, measure changes in jaw positions and teeth due to treatment and growth [1].

The objective of modern orthodontics is a maximal comprehensive diagnosis; in which soft tissue analysis is included, because orthodontic treatment give a significant effect on the soft tissue profile [2]. We can thus see the importance of soft tissue analysis towards orthodontic treatment and this fact has been acknowledged by the vast influx of research in this area by several authors who compared the soft tissue cephalometric values of subjects of Korean descent to European American norms [3]. They noted that “orthodontic diagnosis typically includes comparing a patient's cephalometric measurements to standard values. Lateral cephalometric norms, however, may be specific to an ethnic group and cannot always be applied to other ethnic types”. This has been verified by other researchers who have sought to compare the soft tissue values of different ethnic groups with the established “norms” which are based on profiles of individuals of European American descent evaluating adults of Saudi Arabian descent based on Holdaways analysis [4], Japanese [5], and the Anatolian Turkish ethnic group [6]. All researchers concur that many of the norms are significantly different from ethnic group to ethnic group, and that these differences play a major role in orthodontic treatment planning.

In this study, we assess the soft tissue cephalometric measurements among the ethnic groups of Malaysian Malays and Chinese using Holdaway's analysis. Related research in this area has been done such as the changes of lip morphology related to different skeletal indices for the same ethnic groups. However, no research in Malaysia has been done for Holdaway's analysis for Malaysian Malays and Chinese. This study will compare their satisfaction of patients who received posterior dental implants in relation to their muscle activity done by electromyography and also clinical findings. Besides academic curiosity, this research will help shed light on the deviations of soft tissue parameter values, which may aid further relevant research in this area, such as orthodontic treatment planning and aesthetical considerations for Malaysian Malays and Chinese.

Based on these, the aim of our study was to formulate cephalometric soft tissue norms of Malaysian Malays and Chinese using Holdaway's linear and angular measurements and also to compare and investigate the differences between the soft tissue profile of Malaysian Malays and Chinese.

Material and Methods

Study Design and Sample

This was a retrospective study involving the collection and analysis of lateral cephalometric radiographs of volunteers. The samples were from students of Universiti Sains Malaysia Kampus Kesihatan (USMKK) who were of Malaysian Malay or Chinese descent who fulfilled the inclusion criteria. The samples collection was based on the following criteria: 1) Subjects of whom both parents are of either fully Malaysian Chinese descent / fully Malaysian Malay descent; 2) Those with normal occlusion as based on the British Standards Institute; i.e., an occlusion satisfying the requirements of function and aesthetics with a Class I incisor relationship (lower incisor edges occludes with or lie immediately below the cingulum plateau of the upper central incisors) [7]; 3) Subjects that had no previous orthodontic treatment; 4) Full dentition from

second molar to second molar; 5) No skeletal abnormality; 6) Little or no incisor crowding, and 7) Balanced facial skeletal profile.

The radiographs were traced by one investigator. Each group was profiled using Holdaway's analysis, both linear and angular measurements. Figure 1 showed the reference lines being used in Holdaway's analysis and Figure 2 showed a cephalometric tracing close-up illustrating the linear and angular measurements being used.

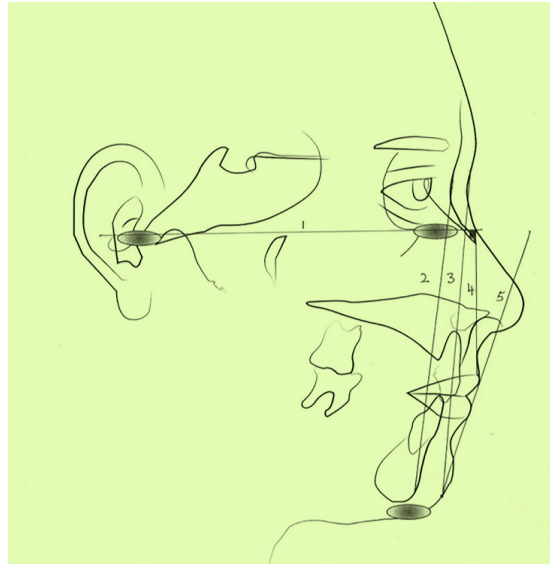


Figure 1. Cephalometric tracing showing the reference lines being used. 1) Frankfort horizontal plane; 2) The hard tissue facial plane from nasion to pogonion; 3) A soft tissue facial line from soft tissue nasion to the point of the soft tissue chin overlaying Ricketts' suprapogonion; 4) A line running at a right angle to the Frankfort plane down tangent to the vermilion border of the upper lip; 5) The H line drawn tangent to the soft tissue chin and the upper lip.

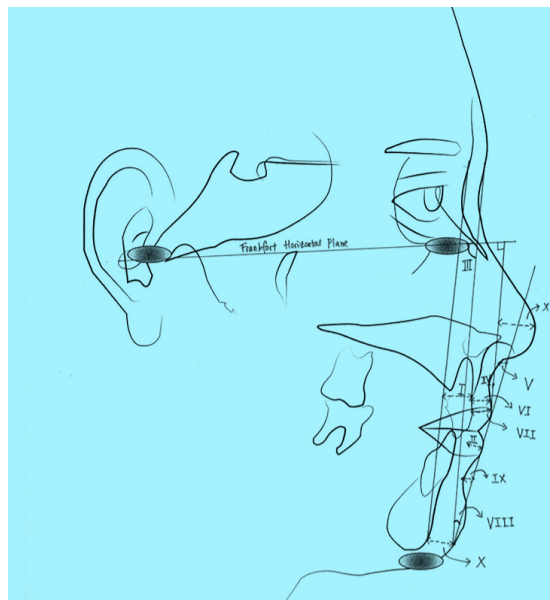


Figure 2. Cephalometric tracing close-up illustrating the linear and angular measurements being used. I) Skeletal profile convexity (Face Con); II) Lower lip to H line (LL-H Line); III) Soft tissue facial angle (Face Angle), IV) Superior sulcus depth (SS depth); V) Soft tissue subnasale to H-line (sub-H line); VI) Basic upper lip thickness (UL-A point); VII) Upper lip thickness (UL-vermillion), VIII) H-angle (H angle); IX) Inferior sulcus to H line (IS-H line); X) Soft tissue chin thickness (chin thick); XI) Nose prominence (nose prom).

The parameters measured were: 1) Skeletal profile convexity (convexity): the distance from point A to the hard tissue line Nasion-Pogonion (Na-Pog); 2) Lower lip to H line (LL-H line): the distance from the lower lip to H line (a tangent drawn from the tip of the chin to the vermilion); 3) Soft tissue facial angle (face angle): the inner angle formed by the intersection of soft tissue nasion-soft tissue suprapogonion line with the Frankfort horizontal plane; 4) Superior sulcus depth (SS depth): the distance between the upper lip sulcus and a perpendicular line drawn from the vermilion to Frankfort plane; 5) Soft tissue subnasale to H line (sub-H line): the distance from subnasale to H line; 6) Basic upper lip thickness (UL-A point): the distance from a point about 3 mm below point A to the drape of the upper lip; 7) Upper lip thickness (UL-vermilion): the distance from the labial surface of upper incisors to the vermilion border of the upper lip; 8) H angle (H angle): the angular measurement of the H line to the soft tissue facial plane; 9) Inferior sulcus to the H line (IS-H line): the distance at the point of maximum curvature on the lower lip and the H line; 10) Soft tissue chin thickness (chin thick): the distance between the two vertical lines representing the hard tissue and soft tissue facial planes at the level of Ricketts' suprapogonion; and 11) Nose prominence (nose prom): the distance from a line perpendicular to Frankfort horizontal and running tangent to the vermilion border of the upper lip to the tip of the nose.

Control of Error

The reliability was analyzed by calculating the Dahlberg's formula: $ME = \sqrt{\sum(x_1-x_2)^2/2n}$. To determine the difference between 2 measurements made at least a month apart. In which x_1 was the first measurement, x_2 was the second measurement and n the number of repeated records [8]. Twenty randomly selected lateral cephalometric radiographs will be retraced and re-measured to calculate the method error [8].

Statistical Analysis

Descriptive statistics of the measured parameters (two angular and nine linear) were obtained for all lateral cephalometric radiographs. For each variable, calculations were made to obtain the mean, mean difference and standard deviation. The data were verified and analyzed statistically using IBM SPSS, Statistics Version 20.0, with confidence level set at 5% ($p < 0.05$) to test for significance among the sexes and race. Sexual and racial dimorphisms were evaluated by the t-test.

To assess whether there was a significant level of error during data collection, 44 lateral cephalometric radiographs (10 percent of the entire body of data) were selected at random and repeated one month apart. The combined error was considered to be within the acceptable limit, which was less than 0.42 mm for linear measurements and 0.63 degrees for angular measurements [8].

Results

Table 1 shows the difference of linear and angular measurements for Holdaway's analysis between Malaysian Malays and Chinese, as well as a comparison to Holdaway's norms.

Table 1. Holdaway's analysis between Malaysian Malays and Chinese.

Variables	Malays		Chinese		Holdaway Established Values	
	Mean	SD	Mean	SD	Mean	SD/Range
Face Con (mm)	-0.509	2.374	0.068	2.065	0	-
LLH (mm)	-1.885	1.416	-1.996	1.537	0-0.5	-1 to 2
Face Angle (°)	89.739	2.671	89.539	2.937	91	7

SS Depth (mm)	4.049	1.793	3.700	0.982	3	1-4
Sub-H line (mm)	9.125	2.059	8.983	1.954	5	2
UL-A (mm)	13.389	2.127	13.690	1.852	15	-
UL-V (mm)	11.283	1.338	11.170	1.404	13-14	-
H-Angle (°)	15.782	3.657	15.600	3.282	10	7-14
IS-H Line (mm)	3.136	1.540	2.757	1.476	-	-
Chin Thick (mm)	11.124	1.749	10.856	1.467	10-12	-
Nose Prom (mm)	7.756	2.334	8.486	2.005	14-24	-

Tables 2 and Table 3 respectively shows the differences of linear and angular measurements for Holdaway's analysis between the genders for both the Malay and Chinese ethnic groups, respectively.

Table 2. Holdaway's analysis between the genders of Malay.

Variables	Malay Males		Malay Females		Holdaway Established Values	
	Mean	SD	Mean	SD	Mean	SD/range
Face Con (mm)	-0.363	2.423	-0.612	2.341	0	-
LLH (mm)	-1.948	1.215	-1.840	1.544	0-0.5	-1 to 2
Face Angle (°)	89.680	2.35	89.777	2.881	91	7
SS Depth (mm)	4.049	1.810	3.797	1.742	3	1-4
Sub-H line(mm)	9.499	1.754	8.862	2.216	5	2
UL-A (mm)	13.718	1.992	13.157	2.194	15	-
UL-V (mm)	11.888	1.442	10.858	1.074	13-14	-
H-Angle (°)	16.005	3.460	15.626	3.791	10	7-14
IS-H Line (mm)	3.156	1.251	3.121	1.717	-	-
Chin Thick (mm)	11.014	1.515	11.201	1.897	10-12	-
Nose Prom (mm)	7.387	2.443	8.015	2.225	14-24	-

Table 3. Holdaway's analysis between the genders of Chinese.

Variables	Chinese Males		Chinese Females		Holdaway Established Values	
	Mean	SD	Mean	SD	Mean	SD/range
Face Con (mm)	0.603	2.746	-0.278	1.381	0	-
LLH (mm)	-2.415	1.329	-1.725	1.607	0-0.5	-1 to 2
Face Angle (°)	89.379	2.437	89.640	3.229	91	7
SS Depth (mm)	3.728	0.935	3.682	1.016	3	1-4
Sub-H line (mm)	9.345	2.275	8.750	1.690	5	2
UL-A (mm)	14.389	2.265	13.240	1.363	15	-
UL-V (mm)	11.863	1.418	10.723	1.205	13-14	-
H-Angle (°)	15.119	3.866	15.911	2.824	10	7-14
IS-H Line (mm)	2.909	1.760	2.658	1.262	+3 - +7	-
Chin Thick (mm)	11.076	1.317	10.714	1.548	10-12	-
Nose Prom (mm)	8.804	1.898	8.280	2.056	14-24	-

Table 4 shows a simple summary of significant differences for all comparisons done in this study.

Table 4. Significant differences for all comparisons.

Variables	Malays and Chinese	Malay Males and Females	Chinese Males and Females
	p-value	p-value	p-value
Face Con	0.015*	0.368	0.034*
LLH	0.460	0.493	0.010*
Face Angle	0.485	0.749	0.616
SS Depth	0.009	0.003*	0.788

Sub-H line	0.499	0.008*	0.084
UL-A	0.155	0.023*	0.001*
UL-V	0.421	0.000*	0.600*
H-Angle	0.619	0.374	0.172
IS-H Line	0.016*	0.835	0.335
Chin Thick	0.121	0.341	0.163
Nose Prom	0.002*	0.021*	0.139

*Statistically significant.

Discussion

The data that we retrieved from the 440 traced lateral cephalometric radiographs were analyzed in 3 ways: First, we compared the general means of Malaysian Malays and Chinese to each other, and then we compared the inter-gender disparities for each ethnic group.

Out of 11 parameters measured according to Holdaway's analysis, we found that the soft tissue profile of Malaysian Malays and Chinese had significant differences in four parameters, with the other seven showing the differences to be insignificant. Therefore, we can conclude that the facial soft tissue profiles of Malaysian Malays and Chinese are mildly similar. Malays had a slightly concave facial profile compared to Chinese, whose facial profile was slightly convex. Malays also generally had a comparatively deeper upper lip sulcus depth, falling just outside of Holdaway's normal range for Caucasian adults. Malays also had more prominent noses compared to Chinese and exhibited a greater distance from the inferior sulcus to H-line. The rest of the values, however, showed insignificance in differences.

For the gender disparities, the finding that the H angle is greater in men agrees with the results of many researchers. However, it has been suggested that there were no sex differences in H angle measurements [9]. Our findings were similar to their results, in that we found no statistically significant differences between men and women for both Malaysian Malays and Chinese. This finding was also reported by previous authors in a study involving the Anatolian Turkish population [6]. When we compare the data across both ethnic groups, there are certain similarities that we can observe, namely that the UL-A and UL-V measurements are greater for males compared to females, indicating that for Malaysian Malays and Chinese, generally males have a thicker upper lip compared to their female counterparts. Once again, our findings concur with some authors [4,6] who reported greater upper lip thickness and basic upper lip thickness for males compared to females for the Anatolian Turkish and Saudi Arabian ethnic groups.

Apart from the UL-A and UL-V parameters, the other inter-gender disparities for both Malaysian Malays and Chinese were found to be rather minute. It can thus be concluded that the facial profiles for both ethnic groups when compared with the opposite gender, are largely similar with few disparities. Malays only showed differences in SS Depth, Subnasale to H-Line and nasal prominence, while the Chinese showed further intergender disparities in the facial convexity and LL-H line measurements. Other than that, the rest of the differences were statistically insignificant.

Locally, various studies have also been done which assessed the cephalometric norms of Malaysian Malays and Chinese, although most if not all of the studies were not focused on soft tissue profile, yet it is interesting to note their findings comparatively with this study. Previous authors evaluating Malaysian Chinese noted that while the amount of lip separation was similar in both sexes, the lips were more protrusive in the females compared to males [10] and these findings coincide with those described by other authors [11,12]. It has been reported that the protrusion could appear to be exaggerated due to the reduced prominence of the nose and chin in Chinese females compared to males [12]. On the other hand, some authors

emphasize that this apparent protrusion was due to the thickness of the soft tissue profile and alveolar prognathism [11]. However, in this study, we found no significant difference in nose prominence between Chinese males and females, results that are different from those found in other studies [10,12]. This study also found the length of the nose of the males and females to be largely similar.







Studies done to detail the cephalometric norms for Malaysian Malays are few and far between. Pioneering research comparing the norms for Malaysian Malays to Glasgow Caucasian adults, with a focus largely on hard tissue parameters, has been developed [13]. Subsequent research profiled Malaysian Malays according to Steiner's analysis [14]. Although the research was mainly focused on hard tissue profiling, it is interesting to note that they found that when compared to Caucasians, Malaysian Malays had more protrusive upper and lower lips, with a less prominent chin and this concurred with previous findings [13]. According to the findings of this research, the upper lip thickness and chin thick of Malaysian Malays falls within the normal range of Holdaway's normal values. It may be possible then the protrusion of lips could be due to hard tissue variations [14], such as alveolar prognathism as the soft tissue parameters show similar values to their Caucasian counterparts with the exception of the Upper lip to vermilion measurement, of which the Malay mean is 1 mm below the normal range.

We hope that more research can be done in this area of profiling the soft tissue cephalometric norms of the local ethnic groups of Malaysia as it is just as important as hard tissue profiling for orthodontic diagnosis and treatment planning. As of now, the amount of research into soft tissue cephalometric norms for Malaysian ethnic groups is lacking, a fact we hope can be rectified in the future as soft tissue profiling becomes more and more recognized.

Conclusion

There are significant differences in the soft tissue cephalometric measurements between Malaysian Malays and Chinese and between Malay males and females. There are significant differences in the soft tissue cephalometric measurements and between Chinese males and females.

Authors' Contributions

NFMN	 0000-0001-6432-781X	Conceptualization, Methodology, Investigation, Formal Analysis, Writing – Original Draft Preparation and Writing – Review and Editing.
RB	 0000-0002-7025-0414	Conceptualization, Writing – Original Draft Preparation and Writing – Review and Editing.
MKA	 0000-0001-7131-1752	Conceptualization, Methodology, Investigation, Formal Analysis, Writing – Original Draft Preparation and Writing – Review and Editing.
SH	 0000-0002-7445-1416	Conceptualization, Writing – Original Draft Preparation and Writing – Review and Editing.
MSJH	 0000-0001-6333-6466	Conceptualization, Investigation, Writing – Original Draft Preparation and Writing – Review and Editing.
MAT	 0000-0002-9478-9465	Conceptualization, Methodology, Investigation, Writing – Original Draft Preparation and Writing – Review and Editing.

All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

Financial Support

None.

Conflict of Interest

The authors declare no conflicts of interest.

References

- [1] Khan OH, Nawaz A, Kamran MA, Khan AG, Nadeem M, Qamaruddin I, Alam MK. A cephalometric evaluation for Pakistani adult using Steiner analysis. *Int Med J* 2015; 22(6):534-6.
- [2] Alam MK, AbTalib M, Aziz NS, Basri R, Purmal K, Rahman SA. Comparison of linear and angular cephalometric lip morphology among Malaysian Malay and Malaysian Chinese population. *Int Med J* 2014; 21(2):177-80.
- [3] Hwang HS, Kim WS, McNamara Jr JA. Ethnic differences in the soft tissue profile of Korean and European-American adults with normal occlusions and well-balanced faces. *Angle Orthod* 2002; 72(1):72-80.
- [4] ALBarakati SF, Bindayel NA. Holdaway soft tissue cephalometric standards for Saudi adults. *King Saud Unive J Dent Sci* 2012; 3(1):27-32. <https://doi.org/10.1016/j.ksujds.2011.10.004>
- [5] Alcalde RE, Jinno T, Orsini MG, Sasaki A, Sugiyama RM, Matsumura T. Soft tissue cephalometric norms in Japanese adults. *Am J Orthod Dentofacial Orthop* 2000; 118(1):84-9. <https://doi.org/10.1067/mod.2000.104411>
- [6] Basciftci FA, Uysal T, Buyukerkmen A. Determination of Holdaway soft tissue norms in Anatolian Turkish adults. *Am J Orthod Dentofacial Orthop* 2003; 123(4):395-400. <https://doi.org/10.1067/mod.2003.139>
- [7] Williams AC, Stephens CD. A modification to the incisor classification of malocclusion. *Br J Orthod* 1992; 19(2):127-30. <https://doi.org/10.1179/bjo.19.2.127>
- [8] Houston WJ. The analysis of errors in orthodontic measurements. *Am J Orthod* 1983; 83(5):382-90. [https://doi.org/10.1016/0002-9416\(83\)90322-6](https://doi.org/10.1016/0002-9416(83)90322-6)
- [9] Hasund A, Wisth PJ, Bøe OE. Der H-Winkel in der kieferorthopädischen Diagnostik. *Fortschritte der Kieferorthopädie* 1980; 41:40-6.
- [10] Purmal K, Alam MK, Zam Zam NM. Cephalometric norms of Malaysian adult Chinese. *Int Med J* 2013; 20(1):87-91.
- [11] Cheng FG. A cephalometric study of the Chinese in profile. *Aust Orthod J* 1986; 9(3):285-8.
- [12] Lew KK, Ho KK, Keng SB, Ho KH. Soft-tissue cephalometric norms in Chinese adults with esthetic facial profiles. *J Oral Maxillofac Surg* 1992; 50(11):1184-9. [https://doi.org/10.1016/0278-2391\(92\)90151-O](https://doi.org/10.1016/0278-2391(92)90151-O)
- [13] Hasan MS. Cephalometric norms of Malaysian Malays compared with Glasgow Caucasians. University of Glasgow; 1998. 219pp.
- [14] Mohammad HA, Abu Hasan MI, Hussain SF. Cephalometric evaluation for Malaysian Malay by Steiner analysis. *Sci Res Ess* 2011; 6(3):627-34.