

A meta-analysis of Steiner cephalometric norms for Chinese adults

Hou Yan^{1,2}, Dong Fusheng², Ma Wensheng^{1,2}, Wu Jianling^{1,2}, Liu Yang^{1,2}

¹The Department of Orthodontics, College of Dentistry, Hebei Medical University, Shijiazhuang, China 050017

²Key Laboratory, Stomatology Hospital, Hebei Medical University, Shijiazhuang, China, 050017

Keywords: Steiner Cephalometric ; Meta-analysis; Chinese

Abstract: Objective: A meta-analysis of the studies concerned was carried out for the purpose of reaching an agreement on these studies and of establishing more precisely cephalometric standards for Chinese. **Materials and methods:** Bibliographies from Electronic database (PubMed), China National Knowledge Infrastructure (CNKI) along with master theses were referred to for papers involving Steiner cephalometric numerical data of normal Chinese adults (male and female). Together there are 825 subjects from 10 studies that have met the criteria. The overall mean values and SDs of Steiner cephalometric measurements were computed using the meta-analysis method. Parameters from the present meta-analysis were then compared with Caucasian norms, Saudi norms as well as Japanese norms. **Results:** Chinese adults present more convex profiles with significant statistical differences. **Conclusions:** Chinese with distinct cephalometric features were different significantly with other ethnic population. **Clinical relevance:** Since the data were collected from a larger sample size, the findings were expected to provide more precise reference values and they could also be widely used in more regions and races for diagnosis and treatment.

1. Introduction

Since 1931, when Broadbent^[1] introduced his cephalolometer, a new period began in orthodontics. De Coster^[2] was the pioneer to apply the principles of facial proportion used in painting to orthodontics. Under the influence of Thompson^[3], de Coster^[2] drew coordinate lines on the schema and compared it with a norm so that differences in the location of the anatomical mark points could be found. Since then, lots of similar methods have emerged in a short time. It is noticed that patients of different characteristics and races were often used in the same cephalometric norms for orthodontic diagnosis and treatment in practical application. Despite many cephalometric studies on different races have been conducted to get their cephalometric standards, such studies have also been undertaken on Chinese people. The subjects were in specific Chinese race and the cephalometric measurement were different.

A meta-analysis is a statistical analysis that integrates the results of multiple individual scientific studies^[4]. For the present research, the main purpose of meta-analysis is to reach a general agreement^[5].

2. Materials and methods

Electronic database PubMed was explored for papers in the last 20 years with key words Chinese and Steiner Cephalometric. China National Knowledge Infrastructure (CNKI) was explored for studies in the last 30 years with key words Steiner Cephalometric, while the unissued Master theses dedicated to the Department of Dentistry, Hebei Medical University was also searched with the same words. Other research sources include bibliographies, former papers and listed references.

Relevant papers were chosen as per the following criteria:

(1) Record the Steiner cephalometric measurements of Chinese adults with normal occlusion.(Both genders are required)

(2) Numerical data must be given to provide strong statistical support.

(3) Data should not be obtained from similar meta-analysis results.

Mean values and standard deviations of the Steiner cephalometric measurements for both genders were pooled. The overall mean value of the same measurements was computed through the following formula:

$$\bar{x} = \frac{n_1x_1 + n_2x_2 + \dots + n_x x_x}{n_1 + n_2 + \dots + n_x}$$

x: the mean; n: the sample amount.

And the overall SD was computed through the following formula:

$$s.d = \sqrt{\frac{n_1s_1^2 + n_2s_2^2 + \dots + n_x s_x^2}{n_1 + n_2 + \dots + n_x}}$$

Using data from studies selected a meta-analysis was performed. The statistical differences among the numerical data integrated from the relevant studies were evaluated by ANOVA. Statistical comparisons between the Chinese standards and other countries' standards were conducted by the independent t-test using the software SAS .

3. Results

Gathered from online papers and relevant theses selected, together there are 825 subjects from 10 studies ^[6-11,16-19] that have met the criteria .For studies that failed to meet the criteria ,the main reasons were about age . There were statistically significant differences among the selected studies in all listed cephalometric measurements. Among all the studies, U1-NB measured by Zhou pingping was the highest, and Pog-NB measured by Zhou pingping the lowest .U1-L1 reported by Che fengzhe was the lowest.

Independent t-test showed that statistically significant differences existed compared the meta-analysis results with Caucasian, Saudis and Japanese.

4. Discussion

Chinese have many kinds of skeletal and facial pattern considering the difference among a variety of race. Those published Chinese cephalometric norms were derived from specific population of certain race with inequable cephalometric method. If we want to find a kind of comprehensive Chinese cephalometric norms regardless of race to compare with those of other ethnic in different country, the reference was a little. Meta-analysis was applied in this study to establish the Steiner cephalometric standards for Chinese adults combined several sorts of typical

race and region. Meta-analysis significantly increases the combined sample amount by integrating data from separated studies, making the statistical support stronger and values estimated more accurate. To guarantee the consistency in inclusion criteria, all of the papers^[6-11,16-19] selected in the present study chose samples with normal occlusion and well-balanced faces without record of orthodontic treatment or facial trauma.

Compared with Caucasian^[12,13], Chinese had more convex faces. The overall mean value of angle ANB for Chinese subjects was about 1.34-4.84°, as for Caucasians the number was 1.2-3.8°. The measurements related to incisor(U1-NA(°), U1-NA(mm) ,L1-NB(°) ,L1-NB(mm) ,U1-L1) all showed more convex angles than those of Caucasian. The measurements of SE, SL indicated Chinese are shorter than those of Caucasian. But Chen fengzhe^[7] believed the distance measurement in Steiner analysis represent the skeletal position instead of skeletal length. In that opinion, the forehead and the mental points of Caucasian are more anterior than those of Chinese. The angle of SN-GoGn and OP-SN explained the tendency of mandibular plane. And Chinese showed a tendency clockwise to class II facial pattern compared with Caucasian. Comparisons of Pog-NB length for Chinese and Caucasian were not made since the value was not accessible in the former published Caucasian norms.

Compared to Saudis^[14], Chinese also had some obvious difference. The overall mean value of angle ANB for Chinese subjects was about 1.34-4.84°, as for Saudis the number was 0.5-4.5°. Although there was no significantly difference in SNA, U1-NA, U1-NA(°) and U1-L1 between Saudis and Chinese, the lower incisors inclination in Chinese demonstrate more protrusion with a tendency to Class II facial pattern. So the reason that Chinese showed more convex face than Saudis due greatly to the mandible. Pog-NB length indicated no significantly difference, the mental of mandible seemed to impact the profile little as to the difference between Saudis and Chinese. SE, Comparisons of SL for Chinese and Saudis were not made since the value was not accessible in the former published Saudis norms.

Compared to Japanese^[15], significant statistical differences existed in all the Steiner cephalometric measurements except ANB. However, The measurements related to incisor (U1-NA(°), U1-NA(mm) ,L1-NB(°) ,L1-NB(mm) ,U1-L1) all showed more convex angle than those of Japanese. The measurements of SE indicated Japanese had more anterior forehead than those of Chinese while Chinese had more anterior mental points than those of Japanese. The angle of SN-GoGn and OP-SN showed Japanese had a higher mandibular plane angle than Chinese. That could explain in some extent why Chinese had more anterior mental points though Japanese indicated significantly larger than Chinese in Pog-NB.

5. Conclusions

The meta-analysis of the individual cephalometric studies by means of Steiner norms appears to provide a helpful method of applying the cephalometric analysis to Chinese adults regardless of the difference of region and race when the native cephalometric norms was unavailable or compared with other countries clinically. It also represents an additional diagnosis tool in orthodontic treatment planning. In view of the findings, the following conclusions could be extracted in this investigation:

(1) Statistically significant differences existed among the selected papers concerning Steiner cephalometric analysis of Chinese adults with normal occlusion.

(2) Chinese adults present more convex faces and more anterior incisors than Caucasians; Chinese adults demonstrate more difference in mandible to class II facial pattern than Saudis; Chinese profiles have as convex as Japanese who have a higher mandibular plane angle.

(3) Considering the large sample size, the meta-analysis results obtained in this study should

serve widely in more regions and races for clinical diagnosis as well as treatment planning of Chinese orthodontic patients.

References

- [1] Broadbent, B.H. A new technique and its application to orthodontia[J].*Angle Orthod*,1931:1-45.
- [2] de Coster L. The network method of orthodontic diagnosis. *Angle Orthod* 1939, 9:3-14.
- [3] Thompson DW. *On Growth and Form*, vol 2, ed 2. Cambridge, MA: Cambridge University Press, 1952:1054, 1082, 1083.
- [4] Glass, 1976 G.V. Glass, Primary, secondary and meta-analysis of research, *Educ. Res.* 5 .1976: 3–8.
- [5] L'abbe et al., 1987 K.A. L'abbe, A.S. Detsky and K.O'rourke, Meta-analysis in clinical research, *Ann. Intern. Med.* 1987; 107: 224–233.
- [6] Hu xingyu, Lan shunqing. Cephalometric analysis of normal adults in Sichuan province. *Journal of Luzhou Medical College* 2001,24(6):491-493
- [7] Che FZ, Xuan YZ, Jin ZH. Cephalometric study with Steiner analysis on normal occlusion of Korean adults in Yanbian China. *West China Journal of Stomatology.* 2008 ;26(2):156-158.
- [8] Zhou yan, Xu kongli, Peng lihui. Analysis and research on normal craniofacial structure and profile in Guangxi Zhuang race. *Journal of Modern Stomatology.*1999;13(4):287-288
- [9] Zhong pingping,Zhang duanqiang. Cephalometric Study on the Dentomaxillofacial Characteristics of Adults with Normal Occlusion in Fujian Province [J]. *Fujian Med Univ.*2009;43(5):387-388
- [10] Man yi. A Roentgenography Cephalometric Study on Lateral Craniofacial Structure of the Han Nationality Adults with Normal Occlusion in Xinjiang Autonomous Region of China.Xi jiang Medical University Master's Theses:19-26
- [11] Zhao zhenjin, Deng yan. Steiner cephalometric norms from 100 adults with normal occlusion in Dongbei [J]. *Orthodontics.*2001;8(3):138
- [12] Steiner C. Cephalometric for you and me[J].*Am. J. Orthod.*1953;39:729-755
- [13] Steiner CC.The use of cephalometrics as an aid to planning and assessing orthodontic treatment. Report of a case. *Am J Orthod* .1960; 46:721-35.
- [14] Nasser M, Al-Jasser, BDS, MSc. Cephalometric Evaluation for Saudi Population Using the Downs and Steiner Analysis [J]. *Journal of Contemporary Dental Practice*, 2005; 6(2):1-9
- [15] N. Inoue,etc. Latest orthodontics[M]. Dental Medicine Press, Tokyo, 1971:328-341
- [16] Xu yun, Den yi . On the Cephalometric Means of the Normal Dente Permanente Occlusion in Yunnan. *Academic Journal of Kunming Medical College.* 2001; (3):24- 26
- [17] Zhang jun, Wang xuxia,Shi hongtao et al. Craniofacial characteristics in persons with normal occlusion from Shandong province[J].*Orthodontics*,2003;10(3):133-135
- [18] Wen xingtao, Li xiao zhi, Ding jianfeng, Lin hua-rong. Cephalometric study of craniofacial morphology by computer on adult with normal occlusion in chongqing. *J Clin Stomatol*,Jan20008;24(1):38-41
- [19] Dai ning, Sun hui, Li rong, Feng xue. Cephalometric study of adults with normal occlusion in Xian using Steiner method. *Chinese. Journal of Aesthetic Medicine.* 2010;19(10):1522-1524