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Cephalometric Evaluation of the Craniofacial Characteristics in Chinese Children

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SUMMARY

The cranio-dento-facial pattern of Chinese children were studied in order to establish the visual norms of Ricketts' analysis for them. The 92 Chinese children, including 44 boys and 48 girls, they were aged between 9.5-10.5 years old, with harmonious facial profile, good growth pattern, were selected as the samples. The current lateral cephalograms were taken and the films were traced, the tracings can be used for any common cephalometric analysis, the findings may be drawn in the following:

1. *The Chinese children have a greater tendency toward mandibular retrognathism as compared with the Caucasian group.*
2. *Anterior teeth of the maxilla and mandible are more procumbent in the Chinese group.*
3. *The prognathism of the maxilla is apparent in the Chinese group.*
4. *Bi-labial protrusion of the soft tissue profile in Chinese children as compared with the Caucasian.*

Key words: Chinese children, Cephalometric analysis, Visual norms.

INTRODUCTION

Physical anthropologist has long been studying the skeleto-facial structures of the skull, with the advent of Cephalometric Roentgenology to the Orthodontia by the introduction of Broadbent in 1931[1], it has opened a new avenue of scientific research, and stimulated many men to explore the complexities of growth and development of human heads. For decades, several analysis[2,3] of the craniofacial characteristics have been put forward by various research workers[4,5,6] and the corresponding norms have been established for the Caucasians. Comparatively, little information is available for the non-Caucasians, expecially the Chinese. Nowadays, more and more Chinese children are accepting Orthodontic treatment, in order to demonstrate changes and abnor-

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mality, it is important to establish a range of normality for Orthodontists who treat Chinese Children.

Ricketts' analysis[7] are relatively comprehensive it has been adapted to analyze longitudinal growth, and can be used to evaluate the three kinds of relationships in the head-basal bones to cranium, teeth to basal bone, and teeth to teeth, that are of concern to the clinician. The present study was undertaken to provide more information and better understanding of the craniofacial characteristics of Chinese children and to define a current set of norms for them, according to Ricketts' analysis, and compared with the norms of Caucasian and Japanese.

REVIEW OF THE LITERATURE

Downs, in 1948[2], present his work on variations in facial relationships by studying Caucasian samples with excellent occlusion. He gave values to describe the range of the skeletal and dental patterns[3], to find the normal, and use them to appraise the various parts of the facial skeleton and teeth. In 1951, Cotton. Takano, and Wong applied Downs' analysis to three other ethnic groups; Namely; Negro by Cotton, Chinese by Wong and Japanese by Takano. Takano, in his study of the Nisei group (American born Japanese), demonstrated that there are significant differences between the Caucasian and Nisei groups, The angle of Convexity and Y-Axis were greater in the Japanese group, indicating a shorter anterior-posterior length of the face and protrusive denture patterns. Wong, by taking Chinese sample from San Francisco China twon area, concluded that Downs' analysis does not hold true for other ethnic group. The Chinese standard, as compared to Downs normals, presented a Class II facial pattern, even though each exhibited a good facial profile and normal occlusion. So he caution about using one standard to other racial groups.

Altemus, in 1960[9], studied the heads and faces of Negro children, and comparisons were made of four north American racial groups: Caucasian, Negro, Japanese, Chinese. He found that the facial plane Angles were similar for all groups except the Chinese whose chins were more retruded, and stated that there are differences in the craniofacial complex between racial groups.

Wei, in 1968[10], by investigating the Chinese adults in the University of Aldelaide, presented the findgins of craniofacial profile in relation to prognathism. He concluded that the Chinese possesses moderate maxillary alveolar prognathy and the facial profile tended to be rather retrognathic. Also, the Chinese had low facial convexity and a relatively flat facial profile, the increase in prognathism is associated with increased cranial base angulation without related so much to cranial base length.

Drummond[11], in his study of forty Negro children by using Tweed triangle analysis[6], found that there are some major differences between Caucasian and Negro population. The Negro tends to have steeper mandibular plane, the maxilla was placed more anteriorly, give the appearance of bimaxillary dental protrusion. Miura[12], established reference norms for Japanese children according to Steiner's analysis, concluded that the differences between the facial patterns of Japanese and American is due principally to the protruded upper and lower incisors, and to the retroposition of the mandible in the Japanese. Garcia[13], evaluated the skeletal and dental pattern of Mexican Amercians by taking 25 grils and 34 boys as the materials. He found that the Mexican American sample were more protrusive skeletally than the Caucasian, and the incisors were more labially inclined.

Hong[14], in 1960, employed the following analysis: Downs, Wylie, Graber and Donovan, Wylie-Johnson and Bjork, to describle the main characteristics of Chinese craniofacial and denture pattern, according to his findings, the prognathism of the maxilla is more apparent in the Chinese than the Caucasian, the anterior teeth tend to be more procumbent, the maxillary length is smaller proportionally, but the nasal height and dental height were about the same. In reviewing the foregoing accounts of literatures on cephelometric studies, it is obvious that because of racial background, there are significant differences of craniodento-facial patterns between ethnic groups. The standards of one racial group could not be considered normal for other racial groups.

MATERIALS

The sample for this study comprised of 92 Chinese children, 44 boys and 48 girls. They are students of Ming-Sheng primary elementary school[15].

1. The willingness of the subject to participate in this project.
2. They all aged between 9.5-10.5 years old.
3. The selected individuals were healthy and presented a good facial harmony and pleasant appearance.
4. Their occlusal relationships were not perfect but no real malocclusions were included, those who possessed extremely severe malocclusion were excluded.
5. Non of them had any cogenital abnormality or deformity.
6. All were untreated orthodontically up to the time their x-ray films were taken.

The sample selected on these basis was because it was believed that until norms were derived the concept of normal occlusion for native Chinese children was too subjective to be used as selection critaria.

METHOD

Lateral cephalometric head films[16] of the sample were taken[17] with the PANEX-EC cephalometer (J. Morita corp.) by using the Fuji x-ray films (20.3 x 25.4 cm), J x (8 x 10), then developed with Fuji super RD-1, fixed with Fuji Hi-Renfix solution. The films were traced over[18,19,20] an illuminated viewing box on matte-acetate tracing paper, with a 3-H pencil. Linear measurements were made with a Bauley gauge, angular measurements were also recorded.

Except the usually applied anthropological landmarks, the following points, Lines and planes, were used: (Fig. 1)

Points:

1. A6-Upper Molar

   A point on the occlusal plane located by being perpendicular to the distal surface of the crown of the upper first molar.

2. B6-Lower Molar
   A point on the occlusal plane located by being perpendicular to the distal surface of the crown of the lower first molar.
3. C1-Condyle
   A point on the condyle head which contacts the ramus plane.
4. DT-Chin
   The point on the anterior curve of the soft tissue chin, tangent to the esthetic plane.
5. CC-Pterygoid
   The intersection of the Basion-Nasion plane and facial axis.
6. CF-Pterygoid
   Intersection of Pterygoid root vertical with Frankfort horizontal plane.
7. DC-Condyle
   A point selected in the center of the condyle neck on the Ba-Na plane.
8. En-Nose
   A point on the soft tissue nose tangent to the esthetic plane.
9. Gn-Gnathion
   A point at the intersection of the facial and mandibular planes (Cephalometric Gn).
10. GO-Mandible
    Gonion intersection of the ramus and mandibular planes. (Cephalometric Go).
11. PO-Pogonion
    Most anterior point on the midsagittal symphysis tangent to the facial plane.
12. Xi-Point
    It is the crossing point of the diagonals drawn from the corners of a rectangle, it represents the centroid of the ramus.

Lines and planes:

1. Incisal Axis–
   Long Axis of the incisors.
2. Apo plans
   Point A to pogonion.
3. Functional occlusal plane
   Through 1st molars and bicuspids.
4. Esthetic plane
   Tip of nose to tip of chin.
5. Frankfort Horizontal plane
   Superior edge of the anatomic porion to the inferior border of the Orbit.
6. Pterygoid vertical PTV
   Perpendicular to Frankfort through distal of Pterygopalatine fossa.
7. Facial Axis–
   Point Pt to Gnathion
8. Basion-Na Plane
   A dividing line between face and the cranium form a reference for mandibular rotation and growth.
9. Facial Plane
   NA-Po. line from which to evaluate facial contour, convex or concave.
10. Condylar Axis (Xi-DC)
    Describe morphology of the mandible.
11. Corpus Axis (Xi-Pm)
    Evaluate denture change, and morphology of the mandible.
12. Mandibular Plane (Go-Me)
    Skeletal morphology of the mandible.

RESULTS

The results obtained were divided into two main parts. First, the mean, standard deviation[22] between male, female and all

Table 1. The Mean Values, S.D. and t Test between Male and Female and All Sexes by Using Ricketts' Analysis

Sexes / Measurements	male		female		t Values		
	Mean	S.D.	Mean	S.D.		Mean	S.D.
1 Facial Axis	86.9	2.8	85.5	3.0	0.096	86.2	2.9
2 Facial Depth	86.2	2.4	85.7	3.1	0.038	85.9	2.8
3 Mand. Plane	28.5	4.6	29	4.6	-0.023	28.7	4.6
4 Lower Facial Height	46.8	3.4	47.2	3.0	-0.025	47	3.2
5 Mandibular Arc	30	4.2	28	4.6	0.08	29	4.4
6 Convexity*	3.3	1.5	3.1	2.1	0.03	3.2	1.8
7 1 1 to APO*	4	2.4	3.4	2.2	0.06	3.7	2.3
8 1 1 to APO	25.4	4.9	23.4	5.2	0.07	24	5.1
9 6 6 to PTV*	12	3.2	12.3	2.5	-0.02	12.1	2.8
10 Lower Lip to EP*	3.7	2.4	82.7	2.4	0.08	3.2	2.4
Internal Structure							
Cranial Deflection	28.3	1.9	28.7	1.7	-0.05	28.5	1.8
Cranial Length Ant.*	56.2	3.3	55.8	4.1	0.02	56	3.7
Ramus Position	74	3.1	74.9	2.4	-0.08	74.4	2.8
Porion Location*	39.7	2.6	37.9	2.5	0.15	38.8	2.6
Corpus Length*	64.7	4.2	63.5	4.2	0.06	64.1	4.2
Supplementary							
Post. Facial Height*	59.6	4.0	58.4	5.0	0.05	59	4.5
1 1 Protrusion*	7.5	1.9	6.7	2.4	0.08	7.1	2.2
Interincisal Angle	122	9.0	125.9	9.1	-0.09	124	9.1

*Recroded in millimeters, others in degrees.

Table 2. Comparison of the Cranio-Dento-Facial Values between the Caucasian, Japanese and Chinese, According to Ricketts' Analysis

10 Factor Analysis	Caucasian	Japanese	Chinese
1 Facial Axis	90 ± 3°	86 ± 3°	86.2 ± 2.9°
2 Facial Depth	87 ± 3°	± 3°	85.9 ± 2.8°
3 Mand. Plane	26 ± 4°	30 ± 4°	28.7 ± 4.6°
4 Lower Facial Height	47 ± 4°	49 ± 4°	47 ± 3.2°
5 Manidbular Arc	26 ± 4°	25 ± 4°	29 ± 4.4°
6 Convexity	2 ± 2mm	3 ± 1.5mm	3.2 ± 1.8mm
7 1 1 to APO	1 ± 2mm	3 ± 1mm	3.7 ± 2.3mm
8 1 1 to APO	22 ± 4°	25 ± 5°	24 ± 5.1°
9 6 6 to PTV	12 ± 3mm	11 ± 3mm	12.1 ± 2.8mm
10 Lower Lip to EP	-2 ± 2mm	2 ± 21.5mm	3.2 ± 2.4mm
Internal Structure			
Cranial Deflection	27 ± 3°	28 ± 2°	28.5 ± 1.8°
Cranial Length Ant.	55 ± 3mm	55 ± 3mm	56 ± 3.7mm
Ramus Position	75 ± 3°	74 ± 3°	74.4 ± 2.8°
Porion Location	39 ± 2mm	39 ± 2mm	38.8 ± 2.6mm
Corpus Length	65 ± 3mm	63 ± 3mm	64.1 ± 4.2mm
Supplementary			
Post. Facial Height	55 ± 3.3mm	57 ± 4mm	59 ± 4.5mm
1 1 Protrusion	3.5 ± 2.3mm	6.2 ± 1.5mm	7.2 ± 2.2mm
Insterincisal Angle	130 ± 6°	124 ± 7.5°	124 ± 9.1°

sexes, the t test, were tabulated in table 1, the t test shows there were no significant differences between sexes. Second, table 2 shows the comparisons of Ricketts' norms between Caucasian, Japanese and Chinese.

The polygon of Chinese norms were portrayed (Fig. 2) by using the mean and one S.D. of this study, the Caucasian and Japanese norms were superimposed upon them respectively to appraised the cranio-dento-facial pattern of these different ethnic groups.

DISCUSSION

In 1937, Holly Broadbent[23] studied the face of the normal child and gave the concept of men average facial pattern. Downs, in 1948[24], presented analysis consisted a harmonious balance face, he believed there was a facial pattern representative of the average facial form and variation from it can be found. Steiner, in his serial studies, (1953[25], 1959[26], 1962[27] borrowed some points from Riedel, and popularized the use of the cranial base line, demonstrated the significance of the anterior posterior reltionships of the maxilla and mandible in Orthodontic treatment, and assessed the dentofacial complex, giving definite values for what he considered a normal, harmonious face.

Ricketts[7,28,29,30], in his longitudinal cephalometric studies with modern computer technology, has developed his own theory to describe the cranio-facial growth, which is fairly convenient and reliable. In essence, the principles can be described as in the following: First, he emphasized the importance of mandibular growth. Fundamentally, his view of mandibular growth is somehow associated with a curve - the arcial growth pattern. The "Xi" point was located in the mandible to identify a "central core" cephalometrically in the lateral headfilm, this point represents the geometric center of the ramus, it is formed by the intersection of the diagonals of the rectangle that represents the narrowest width and height of the ramus at its dimensions. Then, the Pm. (Protuberance menti) point, it is selected where the curvature of the anterior border of the symphysis changes from concave to convex, which is an identifiable and stable landmark. The third point "Dc", represents the center of the neck of the condyle on the Ba-Na line. From these three points, two axis may be drawn-a line from Dc to Xi constitutes the condylar axis, and the line from Xi to pm is the corpus axis. These two lines form the core of the mandible, then, three curves were developed to describe the true arc of growth of the mandible. It is dependent on superioranterior growth of the ramus, rather than the conventional posterior growth. In addition, by the body-section laminagraphy, Ricketts further described the bending of the mandible, in his observation, the mandible on an average bends one-half degree per year along the Dc-Xi-Pm axis from infancy to maturity. His view of mandibular growth adds new dimensions to dental craniofacial biology. Second, a number of relative stable reference points and lines have been proposed since the inception of cephalometric roentgenology to assay the cranial growth from the facial growth, because there are two main portions in the head; the cranium and the face, with the cranial base as a natural line of demarcation. Some of its components are faster or longer growing areas, while other static areas may cease growth early relative to those dynamic areas. Ricketts pointed out a practical center of least growth that can be used as the orientation point for serial studies. It is constructed by drawing a basic vertical line from the pterygoid vertical to perpendicular to the Frankfort Horizontal plane at the posterior margin of the pterygo-maxillary fissure[31], through pt point, it represents the lower lip of the foramen rotundum. The intersection of FHP and PTV has been shown to be remarkably stable, the change in the location of this point as a result of patient growth is minimal. As demonstrated in cephalometric research by Brodie and Broadbent[32], they found that the pteryo-maxillary fissure is a fairly constant landmark in the facial area, it does not appear to very anteriposterionly. When used as a registration point, depicts maximum growth in every direction, and the pattern of overall facial growth is gnomonic. Therefore, when serial cephalometric tracings of a patient superimposed at this point, it provides a unique way that most reflects the overall growth of the head in space. Third, conventionally, the occlusal plane was determined by connecting a line bisecting the overbite of first permanent molar to the central incisor. Now the occlusal plane is constructed by drawing a line bisecting the overbite of the first molar and passing through the overbite of the first premolar to represent the functional occlusal plane, which usually locates slightly inferior to Xi point. Because the vertical dimension is maintained by the lateral segment of the dentition, as the Orthodontists try to flatten the curve of Spee in the early stage of Orthodontic treatment, the occlusal plane may alter, depending on the type of treatment. In Ricketts' theory, the utility arch[33] depresses anterior teeth, upper of lower, but leveling of arch does not change occlusal plane, due to the occlusal plane is calculated from the buccal section, and it can be adjusted as desired with respect to Xi point and the lip embrassure, so the treatment results is firmly assured. Fourth, in many situation, the FHP is a line tangent to the superior edge of the mechanical porion and the inferior border of the orbit. Since the mechanical porion is quite variable, Ricketts adopted the anatomic porion instead of the mechanical one to determine the FHP. which is repeatable and much reliable for cephalometric serical studies.

Ricketts' analysis were adopted for comparison between 3 racial groups:

namely: Chinese, Japanese[34] and Caucasian.

The lateral Visual Norms for Chinese children according to this study were portrayed. (Fig. 3.)

Skeletally

The facial axis angle is formed by the intersection of the Ba-Na line and the facial axis, which expresses the direction of growth of the chin and the ratio of facial height to depth, it changes little with age if the patient is growing normally.

The angle being largest in Caucasian group, with the Chinese and Japanese almost similar. Since the mandible is more labile than the maxilla, and manifests a large component of growth, therefore, the majority of the linear and angular measurements relate to the position and growth tendencies of the lower jaw. When this angle is studied, other contributing factors must be taken into consideration, such as the mandibular arc, the mandibular plane angle, the posterior facial height etc.

The facial depth is the angle formed by the intersection of the facial plane and the Frankfort Horizontal Plane. It locates the chin horizontally, from this measurement, the anterior posterior position of the pogonion can be determined.

The Chinese and Japanese have smaller angle than Caucasian, indicating the retrognathic tendency in these two Oriental groups. (Fig. 4.)

The mandibular plane angle is formed by the mandibular plane and the FHP. It gives the clinician an indication of the cant of the mandibular corpus, is a result of growth and adaptive changes that occur to the mandible during normal development. The value being largest for the Japanese. Smallest for the Caucasian, with the Chinese in between.

The lower facial height is an angle formed by a line from anterior nasal spine to Xi point and corpus axis. (ANS-Xi-Pm), it describes the divergence of the oral cavity with growth, like the facial axis angle. Usually it does not change significantly with age, unless treatment mechanics open or close the bite. This measurement is similar for Caucasian and Chinese.

The convexity of point A is the distance in millimeters from A point to the facial plane measured perpendicular to the plane. High covexity indicates a class II skeletal pattern, negative convexity a class III pattern. The linear measurement were similar for Chinese and Japanese, with Caucasian being the shortest, denoting the former two groups have a tendency toward maxillary protrusion as compared with the Caucasian.

Dentally

The lower incisor protrusion and inclination relate the position of the lower central incisor to the maxillo-mandibular relationship (the A-Po plane). Since the position of the lower incisors play an important role in Orthodontic diagnosis, any anterior or posterior movement of the lower incisor will have great influence on arch length and affect the esthetic and stability of the dentition. The linear measurement being smallest in the Caucasian and significantly larger in the Chinese and Japanese. The angular measurement also shows significant difference between the Caucasian and the Oriental groups. The interincisal angle, which is formed by the long axis of the maxillary incisor and the mandibular incisor, is more acute in the Chinese and Japanese than in the Caucasian.

The former two factors combined with the interincisal angle, highly indicated that more procumbency of the anterior teeth is found in the Oriental groups than in the Caucasian group. The upper molar position is the distance from the most distal point of maxillary first permanent molar to the PTV. measured parallel to the occlusal plane, it determines if the malocclusion is due to the position of the upper or lower molar. The value being similar for all three groups.

Esthetically

The use of the Esthetic plane, as described by Ricketts, is a line tangent to the tip of the nose to the tip of the chin (nose-chin plane). Lip protrusion is the distance from lower lip to the Esthetic plane, which indicates soft tissue balance between lips and profile. The value was significantly different between racial groups, it being negative (-2.0 mm) in the Caucasian and being positive (+3.2 mm) beyond the Esthetic plane for the Chinese and Japanese. Ricketts finds the lip contours most pleasing when the upper lip falls approximately 4 mm behind the line and the lower lip about 2 mm behind it. The finding obviously is not suitable for the Orientals.

The esthetic viewpoint is somehow subjective, as the idea applied to the Orientals, it seems that the Orientals[35,36,37] possess bi-labial soft tissue protrusive profile, (Fig. 5.) although they are in the physiologic and harmonious status.

Internal structures

There were no significant differences in the internal structure between three racial groups. The foundation of any study must rest on a firm knowledge of what is normal. As stated by Downs in 1956[24]:

"Dentofacial patterns differ racially sufficiently to be significant". Clinically, cephalometric roentgenology is of great value in evaluating the relationship of the maxilla and mandible to the cranial base; an invaluable aid in diagnosis, treatment planning and growth prediction; in facial typing, since from the Orthodontic viewpoint, a person's facial type is best described by the relative anterior-posterior relationship of the forehead, middle face (maxilla) and lower face (mandible), most of the problem met by the Orthodontist are anterior-posterior malrelationships. It also shows in advance the limitation of treatment, and serves as a scientific method for the assessment of treatment results.

Cephalometric studies on non-Caucasian indicated that there are measurable skeletal and dental differences when compared to Caucasian because of racial background. The mean values of one racial group could not be considered normal for others[38]. In a normal range of a particular racial group, an infinite variety of facial patterns existed, and they occur to a greater extent between ethnic groups. The norm, if applied properly, serves a useful purpose as a basis of comparison and reference, it is not to be applied indiscriminately to any racial group or individual. Malocclusion can not be corrected according to a rigid standard or to the norm establish for that particular group. It has been pointed out that prognathism was the average facil pattern of the Chinese, Japanese, Negro, Australian aborigine etc.[39] such faces represent a physiologically normal balance and harmony supporting the conclusions[35,36] of many research workers in their studies.

Attempts to reduce the prognathism in these prognathous facial type to the average pattern as in the mesiognathic type of Caucasian is not recommended. Also, it is known that changes do occur in the growing individual, especially after the onset of puberty. Then, it's necessary to establish a series of progressive normals[40,41], accom-

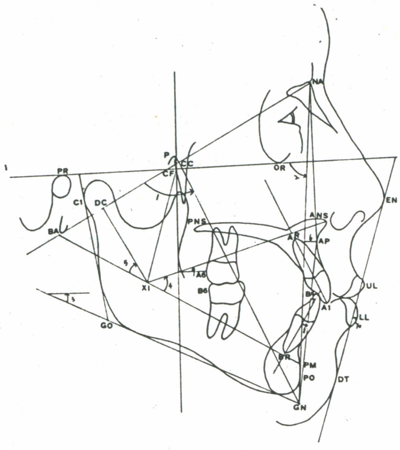

Fig. 1. Lateral cephalometric landmarks and 10 factors analysis used in Ricketts' analysis.

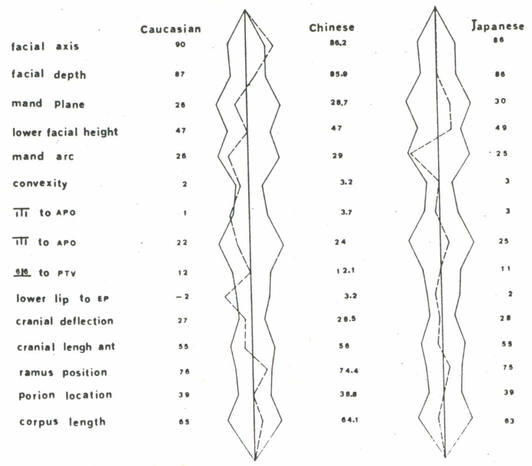

Fig. 2. The polygons of ten factors analysis and internal structure between Chinese and Caucasian (left), and between Chinese and Japanese (right). Solid lines indicate Chinese group.

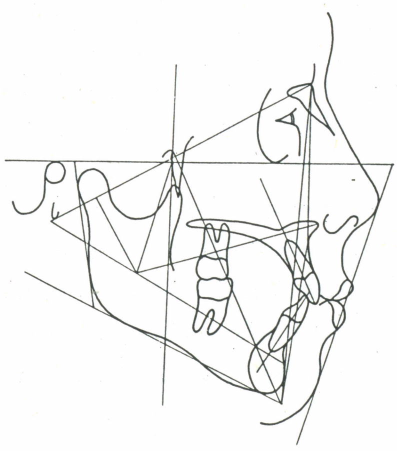

Fig. 3. Lateral Visual norms for Chinese children, according to Ricketts' analysis.

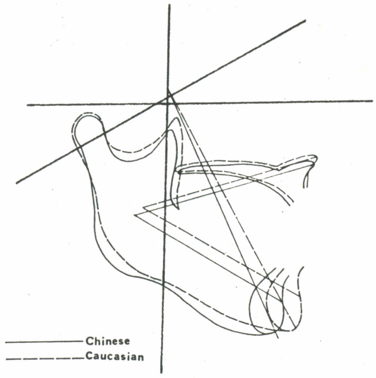

Fig. 4. The mandibular retrusiveness in the Chinese as compared with the Caucasian.

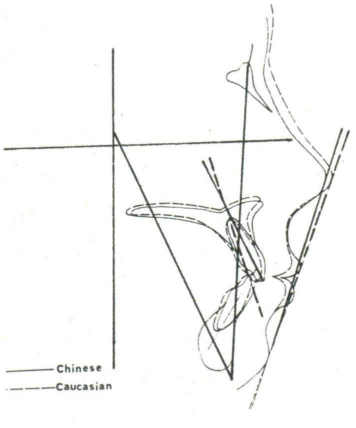

Fig. 5. Facial protrusiveness between Chinese and Caucasian.

panied by the craniofacial growth rates, one for each age group, since growth is not constant during the maturation process, and more research will be done even throughout the entire lifespan of the individual, for better improvement in Orthodontic biological field.

SUMMARY AND CONCLUSIONS

A cephalometric evaluation of the cranio-facial pattern in Chinese 10 years old children was undertaken in this project. The current set of clinical visual norms according to Ricketts' analysis were obtained. Comparisons was made between the Chinese, Japanese and Caucasian groups.

The following findings and conclusions were observed:

1. The cranio-facial characteristics were very similar between the Chinese and the Japanese groups, while there are significant differences between the Chinese and the Caucasian groups.
2. The Chinese group has the tendency toward manibular retrognathism as compare with Caucasian group.
3. The maxilla is placed more anteriorly in Chinese children.
4. Lower incisor protrusion and inclination combined with the more acute interincisal angle, indicating the more procumbent anterior teeth in Chinese group.
5. The above characters give the Chinese children a full, prominent soft tissue profile, resembling that of Caucasian bilabial protrusion.
6. The prognathic profile represents the harmonious normal balanced face for the Chinese children.
7. From these results, an analysis chart and lateral visual norms of Ricketts' analysis for Chinese children was designed.
8. Treatment goal is not just based on the racial norm established for that group. Consideration must be given to the ethnic differences and the particular dento-facial pattern of each individual, since individuality is also of prime importance.
9. It is hoped that this chart will be useful and will bring about further information to those who treat Chinese children.

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以放射線測顱攝影術分析
國人學童顱顏結構之特性

黃 麗 珠

臨床上以手術或矯正方式治療上、下顎顏面及咬合不正關係時，常需藉重顱顏結構之分析。自Broadbent 於1931 年引介放射線測顱攝影術（ Cephalometric roentgenology ）應用於矯正學以來，即有各學者提出多種分析法，其中以最近發展出之Ricketts分析法最具獨創性，且簡明易解。其理論之特點如下：

1. 以解剖形態之內耳道上緣爲耳點（ Porion ），代替傳統之機械性耳點，其可信度提高。
2. 以眼耳平面與翼腭窩（ Petrygo-palatine fossa ）後緣垂線交點爲顱顏之中心點（ＣＦ）此點亦是生長預測之定位點（ Orientation point ）。
3. 注重下顎之生長，以弧形理論及等角螺線解釋其發育方向，足以提供臨床醫師顱骨、顏面、齒槽骨之生長情形及判斷不正關係問題所在。
4. 機能咬合平面之建立，以確定矯正治療之後果。

因種族、年齡、個別性差異均足以影響治療之方向，文獻上可資參考者多爲針對白種人之研究，對於東方人，尤其是中國人之研究則明顯缺乏。有鑑於此，於1983年３月至６月選取北市民生國小四年級學童，其臉型輪廓，生長發育情形良好，無先天疾患或遺傳疾病之學童９２位，其中男４４位，女４８位其平均年齡爲１０歲。此年齡層之兒童正值第二大臼齒將要萌出，爲矯正治療之適當時期。爲其攝取側面顱顏Ｘ光片，經複描後，將資料輸入電腦，分析求得其值。於繪出側面之Visual norm 後，與日本人、白種人相較，其值顯示：國人與日本學童顏面深度值較白種人爲小，上顎前突度則明顯較大。下顎門齒對ＡＰＯ平面（Ａ點爲肥骨前鼻棘下緣線上之最凹點，ＰＯ點爲骨性頤部最突出點）之距離及斜度均較白種人爲大。而下顎骨之生長度變異甚大，顏面軸角、下顎弓、下顎顏面角，後顏面高度等，均爲影響其垂直或橫向發展之因素。上、下顎門齒交角顯然較白種人傾向於鋭角；下唇對鼻尖，頤部連線之美學平面，國人及日本學童爲正值（＋３.２mm）、（＋３.０mm）即突出此平面，白種人爲負值（－２.０mm）。

所得結論如下：

1. 國人學童之顱顏生長發育情形與日本學童相似處甚多，與白種人相較，則有明顯差異。
2. 顏面深度值顯示國人學童下顎發育偏小，而稍後縮。
3. 上頜骨前突度較白種人明顯，顯示上頜前突。
4. 上、下顎門齒斜度及下顎門齒突度顯示前齒咬合關係不似白種人垂直，而趨向於前傾。
5. 以美學觀點看軟組織外形，顯示國人學童雙唇突出於美學平面，白種人則位於此平面內側，此爲輪廓之明顯差異。
6. 種族之不同，各有其顱顏發育之自然，調合狀態，治療不僅應視其環境之差異，個別性變異亦爲重要之因素。

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