Introducing of the Novel Midsagittal Line for Diagnosis of Craniofacial Asymmetry With P.A Cephalometry Radiography

Introdução de uma Nova Linha Média Sagital para Diagnóstico de Assimetria Craniofacial com Radiografia Cefalométrica P.A.

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RESUMO

Objetivo: Determinação da linha de referência sagital mediana (LRSM), para avaliação de assimetrias craniofaciais, traçando uma linha paralela da crista galli à linha vertical verdadeira, em cefalometria PA, utilizando a técnica da posição natural da cabeça (PNC).
Metodologia: 60 indivíduos (30 homens e 30 mulheres, com idade variando de 9 a 13 anos, de uma população iraniana), com oclusão normal Classe I sem história de tratamento ortodôntico ou cirurgia mandibular, foram selecionados no Departamento de Ortodontia, Universidade de Shahid Beheshti, MC Faculdade de Odontologia, Teerã, Irã, 2009-2010. Os pacientes não portavam supranumerários ou ausência dentária, nem anormalidade esquelética. Radiografias cefalométricas PA foram obtidas para todas as amostras pela técnica da posição natural da cabeça (PNC). A linha sagital mediana também foi traçada paralelamente da corrente pendurada à referência intracraniana selecionada (crista galli). Esta linha é a linha vertical verdadeira. A linha horizontal verdadeira foi traçada perpendicularmente à corrente pendurada da crista galli (Cg). Mensurou-se a assimetria craniofacial com medições linear, angular e trigonométrica por meio de radiografias cefalométricas PA pela técnica da posição natural da cabeça (PNC), usando as verdadeiras linhas vertical e horizontal. As diferenças médias entre as medidas acima nos lados direito e esquerdo foram analisadas pelo teste t.
Resultados: Cada variável foi avaliada independentemente; os valores da média e desvio padrão foram calculados separadamente. Ademais, relações transversais foram preparadas na nossa amostra (faixa etária de 9 a 13 anos). Todos os pacientes eram descendentes iranianos. Para a validação da linha media sagital (LMS), foi medida a distância entre a espinha nasal anterior (ENA) e o Mento (Me).
Conclusão: Os achados deste estudo evidenciam que a cefalometria PA com a técnica da posição natural da cabeça (PNC) pode medir a assimetria facial com o nível de 96% de intervalo de confiança. Contudo, a introdução da linha média sagital pelo uso da técnica da posição natural da cabeça (PNC) poderia fornecer a capacidade de diagnosticar assimetrias faciais.

ABSTRACT

Objective: Determination of midsagittal reference line (MSL) for craniofacial asymmetries assessment by drawing a line from crista gali parallel to true vertical line in PA cephalometry , using NHP technique.
Method: 60 samples (30 males and 30 females, within the age range of 9-13 years old Iranian population) were selected with normal Class I occlusion without any history of orthodontic or jaw surgery treatments in Department of Orthodontics, Shahid Beheshti University, Tehran. Iran, 2009-2010. Patients had no supernumerary or missing teeth and any skeletal anomaly. PA cephalometry radiographs were taken from all samples with NHP technique. The midsagittal line was also traced parallel to the hanging chain from our selected intracranial reference point (Crista gali). This line is a true vertical line. True horizontal line traced perpendicular to the hanging chain from Crista gali (Cg). We assessed craniofacial symmetry with linear, angular and trigonometrical measurements in PA cephalometric radiographs by NHP technique, using true vertical and horizontal lines. The mean differences of above measurements in left and right sides were analyzed by T- test.
Results: Each variable was measured independently; then the mean values and S.D was calculated separately. Also, transverse ratios were prepared in our samples (age range of 9-13 years). All patients were from Iranian decent. For midsagittal line (MSL) validity, the ANS (Anterior Nasal Spine) distance in the middle third and Me (Menton) distance in lower third from MSL was measured.
Conclusion: Findings of this study showed that P.A.cephalometry with NHP technique could assess the facial symmetry with the rate 96% confidence interval. Therefore, the introduced midsagittal line by using NHP Technique, could prove the ability for diagnosis of facial asymmetries.

DESCRITORES

Posição Natural da Cabeça (PNC); Linha sagital mediana; Assimetria facial; Linha vertical verdadeira; Linha horizontal verdadeira.

KEY-WORDS

Natural Head Position (NHP); Midsagittal line; Facial asymmetry; True vertical line; True horizontal line.

INTRODUCTION

Different methods with versatile features are proposed for diagnosis of facial asymmetries. By using these methods clinician can identify location and the amount of skeletal deformities causative of asymmetries[1-5].

Conventional methods for asymmetry assessment are based on intracranial landmarks. Researchers[5,6] used two intracranial landmarks for introducing conventional midsagittal line as reference for diagnosing facial symmetry. However, determination of this reference line depends upon landmarks which themselves can be affected by asymmetries[7]. As such, validity of this reference line is questionable. Controversies and statistical differences in previous studies for diagnosis of facial symmetry, necessitates proposing a new technique with a more credible reference line for P.A. cephalometric analysis.

The aim of this study was evaluation of midsagittal reference line for maxillofacial asymmetry assessment. This is accomplished by using one intracranial landmark (Crista Gali) with the true vertical line (a hanging chain near the patient`s face), while patient look into mirror to his/her own eyes[8]. The benefit of using this new reference line (MSL) is its independency from intracranial structures[9,10].

MATERIAL AND METHODS

Sixty samples (30 males and 30 females) were selected with normal occlusion. Patients had no skeletal discrepancy, supernumerary, missing, or any past history of orthodontic treatment or jaw surgery. PA cephalometry radiographs were taken with NHP technique (in standing position, while patients looked at front mirror to his/her eyes, while hanging a chain near the face) from all samples.(Fig 1:A and B) Then, midsagittal line was traced parallel to the hanging chain, from the Crista gali (one intracranial reference) - Figure 2.

This midsagittal line is the true vertical line. Then, the true horizontal line was traced perpendicular to the midsagittal line from Crista gali (Cg). By these two lines, we can assess craniofacial symmetry with linear, angular measurements and triangular ratios. Finally, using this technique, we determined standard transverse dimension values for 9-13 years old Iranian children.

P.A cephalometry with NHP technique has specific value for assessment of landmarks position and points symmetry at right and left sides (Figure 2). Then, the mean differences of above measurements in left and right sides were analyzed by T- test.

For assessing symmetric points in this research, we initially considered three parts in face:
A: reference points in upper third of face.
B: reference points in middle third of face.
C: reference points in lower third of face.

PA cephalogram tracings were done by one person on the Canson tracing paper with 224×210 dimension with a black pencil (diameter 0.5mm).
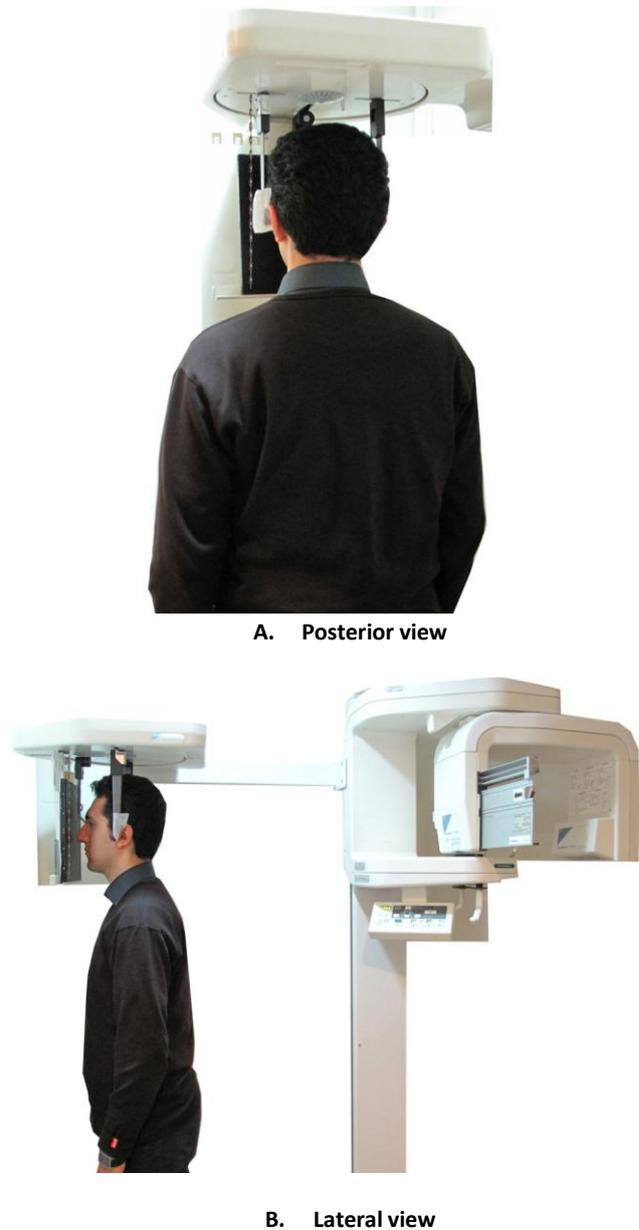

A.   Posterior view

B.   Lateral view

Figure 1. The film, chain and patient's position for taking PA cephalograms with NHP technique. (A. posterior view, B. lateral view).

Figure 2. Postero anterior cephalogram in NHP technique

RESULTS

As we mentioned linear variables, transverse, angular and triangular ratios were used for symmetric assessment. According to these linear variables, we assessed transverse ratios based upon the defined left and right of craniofacial landmarks (Table 1 and 2).

Table 1: Mean and S.D of dentofacial linear variables in 9-13 years Iranian children

Linear variable	X	S.D
Lo-Lo	92.2	3.2
Pt-Pt	51.3	6.2
Es-Es	93.8	4
J-J	63.6	3.4
Zg-Zg	123.5	5.2
Ma-Ma	108.8	5.8
Um-Um	59.6	3.7
Ag-Ag	82	3.8
Lm-Lm	59.6	4
Co-Co	98	2.5

Lo = Latero-Orbital, Pt = Petrous, Es = Sphenoid, J = Jugale, Zg = Zygoma, Ma = Mastoid, Um = Maxillary molar, Ag = Antegonion, Lm =Mandibular, Co = Condylion

Table 2: Mean and S.D of dentofacial transverse ratio in 9-13 years Iranian children.

Transverse ratio variables	X	S.D
J-J / Lo-Lo	0.69	0.04
Ag-Ag / Lo-Lo	0.89	0.04
J-J / Ag-Ag	0.78	0.04
Um-Um / J-J	0.92	0.03
Lm-Lm / Ag-Ag	0.72	0.06
Um-Um / Lm-Lm	1.01	0.04
Zg-Zg / Cg-Me	1.20	0.07
Cg-ANS / Cg-Me	0.47	0.03
ANS-Me / Cg-Me	0.53	0.03

Cg = Crista Gali; Me = Menton; ANS = Anterior Nasal Spine

Furthermore, according to the distance ratio from the reference midsagittal line in left and right sides of PA cephalometry radiograph, we assessed symmetry of face by true vertical and also horizontal line. Each variable was measured independently. Then, their mean and S.D was calculated separately. Also, transverse ratios were prepared in our samples (9-13 years old Iranian children).

For midsagittal line (MSL) validity assessment, in middle third, the ANS distance and in lower third, the Me (Meton) distance from symmetry line was measured. The Mean and S.D. of these distances from MSL was calculated for all images. Obviously, if ANS and Me adapted on MSL, their distances considered as Zero. Then the differences of mean values were analyzed by T-test.

DISCUSSION

All previous studies for asymmetries assessment was done by conventional P.A cephalometry[1,5,11], but in this study P.A cephalometry was used NHP method. As such, many shortcomings of previous studies were resolved.

With this method, an extracranial reference line was used and each variable was measured independently. Then, their mean and S.D was calculated. In addition to high reproducibility , we did not have problems with intracranial anatomic differences among our samples[7].Transverse ratios in our samples were prepared. Also, personal errors and difficulties in symmetry assessment due to head movements and rotations, during preparing P.A cephalogram, was eliminated[12].

As we mentioned, reference line for dentofacial landmarks assessment was traced according to extracranial line (T.H.L and T.V.L) and by a fixed point (Crista Gali). Thus, difficulties and errors in conventional methods due to determining different intracranial landmarks by different operators was reduced significantly[8-10].

Reported methods by other researchers can assess only dental and skeletal landmarks according to median axis of face, except computer based method of Mongini which needs many software components[6].

Using transverse ratio analysis in this study eliminated errors due to magnification.
As the age range of samples was between 9-13 years old Iranian children, the results of transverse ratio can observe as a valuable reference for transverse dentofacial measurements.

In NHP method, in addition to reproducibility of X-ray procedures and using extracranial landmarks, symmetry assessment is true and predictable up to 96%, which was similar to previous study[7].

CONCLUSION

In posteroanterior cephalometry radiographs with NHP method:

- We can assess symmetry by using extracranial landmarks, with minimum errors and maximum validity.
- It is highly reproducible. Up to 96% of symmetries or asymmetries are detectible.

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REFERENCES

1. Fong JH, Wu HT, Huang MC, Chou YW, Chi LY, Fong Y, Kao SY. Analysis of facial skeletal characteristics in patients with chin deviation. J Chin Med Assoc 2010; 73(1):29-34.

2. Grummons DC, Dappsyne MAG. A frontal asymmetry analysis. J Clin Orthod 1987; 21(7):448-63.

3. Betts N, Vanarsdall L, Dexter H, Barber K, Fonseca J. Diagnosis and treatment of transverse maxillary deficiency. Int J Adult Orthog Surg 1995; 10(2):75-96.

4. Aoshia O. Investigation of the facial symmetry of cases with cross bites needing surgical orthodontic treatment using posteroanterior roentgenographic cephalometric. Nippon Kyosei 1990; 49(3):256-62.

5. Grayson BH, Mccarthy G. Analyses of craniofacial asymmetry by multiplan cephalometry. Am J Orthod 1983; 84(3):217-24.

6. Mongini F, Schmid W, Felliso A. Acomputer based assessment of structural and displacement asymmetry of the mandibule. Am J Orthod 1991; 100(1):19-34.

7. Madsen DP, Sampson WJ, Townsend GC. Craniofacial reference plane variation and natural head position. Eur J Orthod 2008; 30(5):532-40.

8. Chen CM, Lai S, Tseng YC, Lee KT. Simple technique to achieve a natural head position for cephalography. Br J Oral Maxillofac Surg 2008; 46(8):677-8.

9. Cuccia AM,Caradonna C. The natural head position. Different techniques of head positioning in the study of craniocervical posture. Minerva Stomatol 2009; 58(11-12):601-12.

10. Cuccia AM, Carola C. The measurement of craniocervical posture: a simple method to evaluate head position. Int J Pediatr Otorhinolaryngol 2009; 73(12):1732-6.

11. Athanasiou E, Drosche H l, Bosch C. Data and patterns of transverse dentofacial structure of 6 to 15 years old children: A posteroanterior cephalometric study. Am J Orthod 1992; 101(4):65-71.

12. Araujo P, Wilhelm SA. Skeletal and dental arch asymmetrics in individuals with normal dental occlusion. Int J Adult Orthog Surgery 1994; 9(2):111-8.