The Position of Anatomical Porion in Different Skeletal Relationships

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Abstract

Previous research has shown that the position of glenoid fossa differs in different skeletal relationships. However, it is hard to identify and trace the glenoid fossa on a lateral cephalometric radiograph. The aim of the present study was to evaluate the anteroposterior and the vertical positions of the porion point (P) in different skeletal relationships as seen on lateral cephalometric radiographs. Methods: Two hundred eighty lateral cephalometric radiographs of orthodontic male patients (age range: 12 $\pm$ 0.6) having different skeletal relationships were traced and corrected for magnification distortion. They were divided into three groups according to their sagittal relationships. All selected patients had average lower face height and mesofacial type. Five vertical and horizontal linear measurements were performed; from P to CF point [Ricketts], basion (Ba) and to condylion (Co). Intra and inter-examiner reliability tests were performed. Data were statistically analyzed using ANOVA test. Results: In relation to CF, P was significantly positioned more posteriorly in Class II than in Class I ($P<0.05$) or in Class III ($P<0.05$), and no statistically significant difference in the position of P between skeletal Class I and III relationships. In relation to Ba, P was significantly positioned more posteriorly in Class II than in Class I ($P<0.05$) and no statistically significant difference in the vertical or anteroposterior positions of P between skeletal Class I and III relationships. However, skeletal Class II subjects showed more superiorly positioned P than in Class III subjects when related to Ba ($P<0.05$). There was no statistically significant difference in the vertical and the anteroposterior position of the P to Co between different skeletal relationships. Conclusion: The position of porion (P) point on a cephalometric radiograph varies among different skeletal relationships. The posteriorly positioned P point in Class II subjects could be a cause for the mandibular retrognathism in skeletal Class II malocclusion

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Introduction:

Assessment of anteroposterior position of the glenoid fossa was first reported by Wylie (1947)[1] in an assessment of anteroposterior dysplasia. However, he used the posterior surface of the head of the condyle (calling it glenoid fossa). This assumption has a shortcoming of the fact that the head of the condyle can not represent the glenoid fossa in the sense that the condyle position can vary in relation to the glenoid fossa with variation of the position of the mandible. Ricketts (1957)[2] reported that, theoretically at least, since the glenoid fossa is located in the general proximity of the middle cranial fossa, its relation to basion is presumed to remain relatively fixed. Bjork (1955) [3], on the other hand, disagreed with the importance of this relationship.

Previous studies have indicated that the condylar position during orthodontic treatment of Class II malocclusions remained the same in about 60% of the cases. However, Ricketts studies were based on laminagraphs that are not currently available in most orthodontic practices. Schudy (1965) [4] reported that the dorsal migration of the glenoid fossa is a very real factor in many cases and tends to cancel out the growth of the condyles; thus, in a sense it is arrayed on the side of vertical growth.

Previous research has shown that the position of glenoid fossa differs in different skeletal relationships. However, it is hard to identify and trace the glenoid fossa on a lateral cephalometric radiograph (Kantomaa , 1984; Pirttiniemi *et al*., 1991).[5,6] So, other investigators (Agronin and Kokich, 1987) [7] used articulare (Ar) point as a reference for the glenoid fossa. This point, however, is known to be a non-anatomical point; rather, it is a

constructed bilateral point on the posterior surface of the mandibular condyle. On the contrary, the posterior cranial base is a midline structure. Therefore, using this point is somehow questionable (Stickel and Pancherz, 1988).[8] Also, it was concluded that Articulare (Ar) systematically overestimates inferior fossa displacements, underestimates superior condylar growth, and overestimates posterior condylar growth (Buschang and Santos-Pinto, 1998).[9] They used Condylion (CO) to represent the glenoid fossa, however, it is well documented that the position of the mandible within the glenoid fossa varies among normal individuals (Ren, *et. al.* 1995).[10] Baccetti *et. al.* (1997)[11] evaluated the position of glenoid fossa in the different sagittal and vertical skeletal relationships. TMJ position was more posterior in Class II when compared to skeletal Class III. In the vertical plane, the glenoid fossa relative to basicranial structures was more caudal in low angle subjects as compared with subjects having normal or high angle vertical relationships.

Objectives: The aim of the present study was to evaluate the anteroposterior and the vertical positions of the porion point (P) in different skeletal relationships on lateral cephalometric radiographs.

Materials and Methods

Two hundred and eighty lateral cephalometric radiographs of male orthodontic patients with age range of 10 ± 0.6 years, having different skeletal relationships were traced and corrected for magnification distortion. They were divided into three groups according to their skeletal sagittal relationships into Class I (hundred radiographs), II (hundred radiographs) and III (eighty radiographs) groups. The skeletal classification was

based on the ANB angle, which was described as Class I if 2>ANB <4, Class III if ANB< 2 and Class II if ANB> 4 degrees.

All of these subjects had average face height, with mesocephalic facial type. Five vertical and horizontal linear measurements were performed; from P to CF point [Ricketts], basion (Ba) and to condylion (Co) [Figure1]. The description of these points and measurements are as follows:

Cephalometric Points:

Porion (Po): The most superior point of the outline of the external auditory meatus ("anatomic Porion") (bilateral).

CF: (Frankfort center): Crossing of Frankfort plane with vertical dropped from the posterior margin of the pterygopalatine fossa at Pr (The most posterior point on the outlines of the pterygopalatine fossa). (Ricketts)

Pterygomaxillare (PM): The tangent of the posterior margin of the outline of the pterygomaxillary fissure (A bilateral, inverted teardrop-shaped radiolucency, whose anterior border represents the posterior surfaces of the tuberosities of the maxilla). (bilateral)

Sella (S): The geometric center of the pituitary fossa (sella turcica), determined by inspection - a constructed point in the midsagittal plane. (midsagittal)

Nasion (N): The intersection of the internasal and frontonasal sutures, in the midsagittal plane. (midsagittal)

A-point (Point A): The deepest (most posterior) midline point on the curvature between the ANS and Prosthion. Its vertical coordinate is unreliable and therefore this point is used mainly for anteroposterior measurements. The location of A-point may change somewhat with root movement of the maxillary incisor teeth. (midsagittal)

B-point (Point B): The deepest (most posterior) midline point on the bony curvature of the anterior mandible, between Infradentale and Pogonion. (midsagittal)

Condylion (Co): The most superior posterior point on the head of the mandibular condyle. (bilateral).

Basion (Ba): The lowest point on the anterior margin of foramen magnum, in the midsagittal plane. It can be located by following the image of the slope of the inferior border of the basilar part of the occipital bone to its posterior limit, superior to the dens of the axis. (midsagittal).

Linear measurements:

P-Cf: Linear distance between Porion (P) and Cf along Frankfurt Horizontal plane (FH).

P-Co (H): Horizontal linear distance between Porion (P) and a perpendicular from Co to (FH).

P-Co (V): The vertical linear distance of the perpendicular from Co to (FH).

P-Ba (H): Horizontal linear distance between Porion (P) and a perpendicular from Ba to (FH).

P-Ba (V): The vertical linear distance of the perpendicular from Ba to (FH).

Data were statistically analyzed using ANOVA tests. To assess tracing errors, a second tracing was prepared for each of ten tracings. The mean error in linear measurements was ±0.4 mm. The mean error in angular measurements was ± 0.91°.

Results: Table 1 shows the results of this study. In relation to CF, P was significantly positioned more posteriorly in Class II than in Class I ($P<0.05$) or in Class III ($P<0.05$),

and there was no statistically significant difference in the position of P between skeletal class I and III relationships. In relation to Ba, P was significantly positioned more posteriorly in Class II than in Class I relationship ($P<0.05$) and there was no statistically significant difference in the vertical or anteroposterior positions of P between skeletal Class I and III relationships. However, skeletal Class II showed more superiorly positioned P than in Class III cases when related to Ba ($P<0.05$). There was no statistically significant difference in the vertical or in the anteroposterior position of the P to Co between different skeletal relationships.

Discussion

In cephalometric analysis, identification of some structures from regular cephalometric tracings, especially the TMJ and glenoid fossa is always hard to achieve. Many authors used Condylion (Wylie, 1947) and others used Articulare (Agronin and Kokich, 1987) to represent glenoid fossa on lateral cephalometric radiographs. Using either landmark has its own shortcoming in this regard. The close position of porion to the glenoid fossa, and considering it as a part of the temporal bone, at a small distance from the TMJ makes it unique in representing the temporal bone on lateral cephalometric radiographs. Having such a special reference point for the temporal bone may be beneficial to clearly evaluate any positional changes of the temporal bone with growth or as a treatment effect of certain orthopedic appliances. The anatomical Porion, was traced on the lateral cephalomteric radiographs of 280 male patients with different skeletal malrelationships. All selected patients had average growth pattern of the mandible (not backward or forward) with mesocephalic facial types. Identification of the Porion was tested by selecting a sub-sample of ten cephalomteric radiographs and traced twice by two examiners. The difference

between the two measurements was evaluated using student *t*-test. There was no statistical significant difference at significance level of $p<0.05$. The mean error of identification of the Porion was 0.8 mm.

To evaluate the position of porion, relatively stable structures were used to relate Porion to them, which were Basion (a midsagittal landmark) and CF, representing the ptrerygomaxillary fissure. Also, Condylion was used to see if there is a change in the measurements between the Porion and Condylion, as both are related to the temporal bone itself. The posteriorly positioned Porion in Class II relative to Class I and Class III is in agreement with (Baccetti *et. al*., 1997) who showed that the glenoid fossa is more posterior in Class II than in Class I or Class III skeletal relationships. The variation in the position of porion in the different sagittal relationships confirms the importance of the sagittal position of temporal bone and glenoid fossa in the etiology of Class II malocclusion, in which it is positioned more posteriorly causing a posterior position of the mandible.

Conclusion: Porion point could be used as a reference point to evaluate the position of temporal bone on a cephalometric radiograph. The position of Porion on a cephalometric radiograph varies among different sagittal skeletal relationships.

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Table 1. Comparison (using ANOVA test) of the five linear variables between the three skeletal malrelationship.

	Class I		Class II		Class III		
Variable	Mean	SD	Mean	SD	Mean	SD	Sig.
P-Cf	40.6	2.9	42.5	2.9			0.036*
			42.5	2.9	39.4	3.9	0.007**
	40.6	2.9			39.4	3.9	0.305
P-Co-H	11.2	4.3	12.4	3.6			0.317
			12.4	3.6	11.7	2.3	0.481
	11.2	4.3			11.7	2.3	0.695
P-Co-V	1.7	4.0	1.4	3.5			0.852
			1.4	3.5	0.78	1.9	0.497
	1.7	4.0			0.78	1.9	0.430
P-BA-H	-0.25	2.7	1.9	2.9			0.019*
			1.9	2.9	0.65	1.9	0.160
	-0.25	2.7			0.65	1.9	0.273
P-BA-V	20.6	3.8	21.9	4.3			0.274
			21.9	4.3	18.6	3.7	0.014**
	20.6	3.8			18.6	3.7	0.122

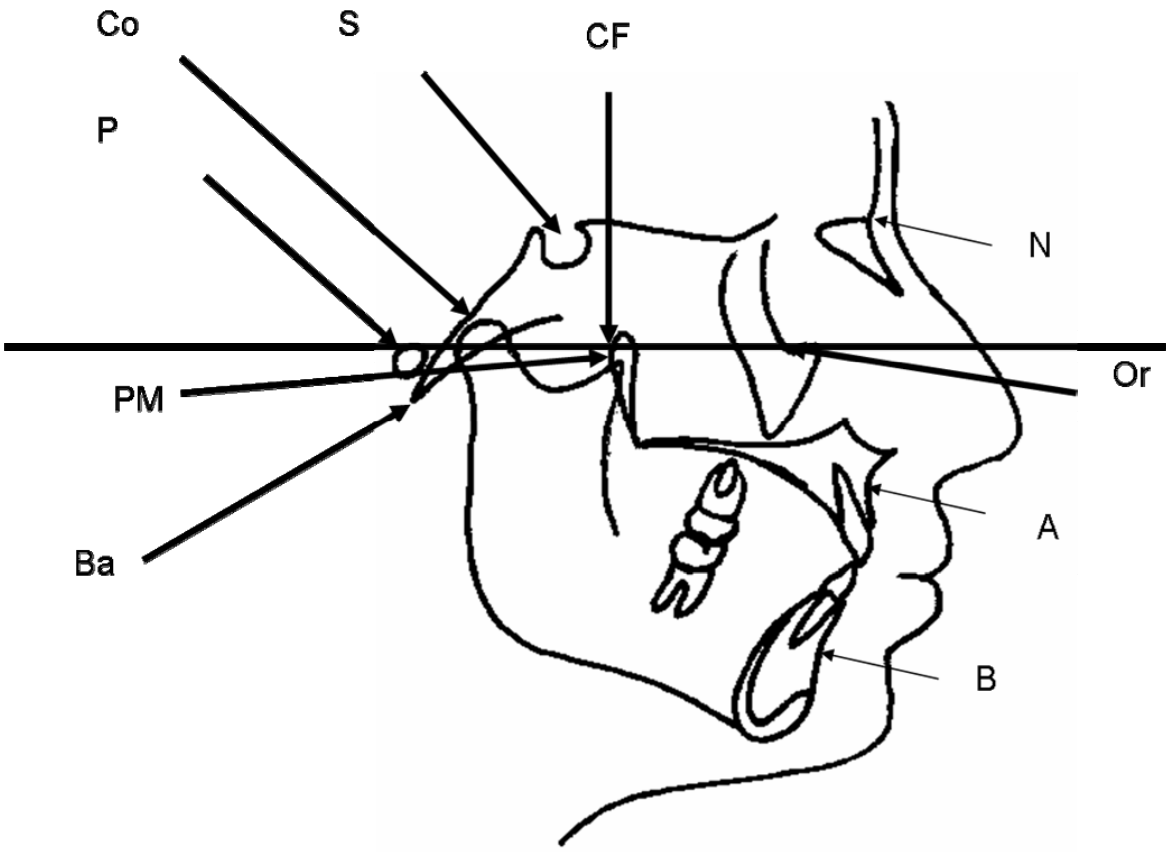

Figure 1 Cephalomteric landmarks used to relate porion to different skeletal structures.