ORIGINAL ARTICLE

Plain Radiographic Cephalometry of the Sella Turcica: An Overview

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Abstract

Background: *The simplest of the parameters in anthropometry, including, height, weight, length, thickness and widths of various parts of the body vary from tribe to tribe and from one race to the other, and measurements of these parameters also differ amongst different age groups and between the two sexes as well.*

Method: *A review composed via Medline Internet search, literature search and contributions from our experiences as well as experiences from colleagues.*

Results: *Studies on measurements of the sella turcica have revealed variations in the size of the fossa with certain parameters such as age, sex e.t.c.*

Conclusion: *It is concluded that complete study of the sella turcica requires multidirectional tomography.*

Key words: *Sella turcica, plain radiography, cephalometry.*

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INTRODUCTION

Cephalometry is a branch of anthropometry that describes measurement of head and face in cadaveric, living, or radiological specimen. The simplest of the parameters in anthropometry, including, height, weight, length, thickness and widths of various parts of the body vary from tribe to tribe and from one race to the other. On the other hand, these measurements also differ amongst different age groups and between the two sexes as well. [1]

Plain skull X-rays were for many years the basis of the anatomical diagnosis of a pituitary region mass lesion, and these are still helpful in the demonstration of enlargement of the sella turcica or erosion of the surrounding bone if the pituitary lesion is large.[2] Careful examination of the changes within the sella is far more rewarding than measuring the dimensions of the sella.[3]

This study is aimed at reviewing the cephalometry of the sella turcica using plain radiographs.

Plain Radiography of the sella turcica

Plain roentgenograms of the skull obtained in various projections demonstrate the sella turcica. These projections include lateral view, Towne view, frontal projection, posteroanterior projection, basal view, coned and magnification views.[4]

The planum sphenoidale: - In the frontal projection the planum is identified as the jugum that joins the two lesser wings of the sphenoid. In the lateral projection the planum is identified below the orbital roofs as well-defined density extending to the limbus sphenoidale.[4]

The limbus sphenoidale: - The limbus can be identified only in lateral projection. It is found at the intersection of the orbital roofs and the planum sphenoidale.[4]

The chiasmatic sulcus: - The chiasmatic sulcus can be identified only in the lateral projection as the intervening groove between the limbus sphenoidale and the tuberculum.[4]

The tuberculum sellae: - The tuberculum sellae can be identified in the lateral and basal projections. In the lateral projection it is partly obscured by the anterior clinoid processes.[4]

The anterior clinoid processes: - The anterior clinoid processes may be identified in the frontal and lateral projections. In the frontal projection, they are situated lateral to the dorsum sellae and above the roof of the sphenoid sinus. In the true lateral projection the two anterior clinoid processes are superimposed on each other.[4]

The middle clinoid processes: - Middle clinoid processes can be identified only in the lateral view as a slight spur on the anterior margin of the pituitary fossa just below the tuberculum sellae.[4]

The floor of the sella: - In the lateral projection the floor of the pituitary fossa is well defined; the cortical bone that lines it has been termed lamina dura. The lamina dura continues posteriorly on to the dorsum sellae.[4]

The carotid sulcus: - In the lateral projection the carotid sulcus is identified as an S-shaped groove

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projected below the level of the floor of the sella.[5] In the frontal projection it appears as a shallow indentation on either side of the floor of the sella.[4]

The dorsum sellae: - In the lateral projection the dorsum sellae is seen as a vertical plate of bone with well defined anterior and posterior cortical margins.[4] In the frontal view the dorsum sellae is best identified in the Towne projection. In this projection, the dorsum sellae may be seen as a quadrilateral plate of bone, or it may have a narrow waist.[4] The dorsum sellae can usually be identified in the base view and, when so seen, is often curved with a concavity anteriorly.[4]

The posterior clinoid processes: - In the frontal view the posterior clinoid processes may be bulbous or pointed.[4 and 6]

Cephalometry of the sella turcica

Cephalometric assessment of the sella turcica is significant clinically in: (1) The determination of increased intracranial pressure. (2) The determination of direct pressure erosion of the sella from external cases in the immediate vicinity of the sella. (3) The detection of intrasellar expanding lesions.[6] Deformity of the sella turcica is often the only clue that abnormality exists within the cranium: hence a familiarity with its anatomy and radiologic appearance is essential.[6]

Complete study of the sella turcica requires multidirectional tomography. Studies on measurements of the sella turcica have revealed variations in the size of the fossa with certain parameters such as age,[7] sex, height[8] and race.[1]

The methods for measurement have involved the following principles: (1) anteroposterior and depth measurements (Camp), [9] (2) area measurement in the lateral projection (Silverman), [7] (3) volume measurements (DiChiro and Nelson, [10]; Fisher and DiChiro[11]). Silverman's[7] data are based on measurement of the pituitary fossa of boys and girls 1 month to 18 years of age from the Fels Research Institute growth study. Camp's[9] method has found greatest favour, although greater accuracy in doubtful cases are obtained by the volume measurement established by DiChiro and Nelson[10] and by Fisher and DiChiro[11].

The anteroposterior dimension may be defined as the greatest distance between the anterior and posterior walls of the sella. A line is usually drawn between a point below the tuberculum sellae and the anterior margin of the dorsum sellae. The depth is the greatest distance between the floor of the hypophyseal fossa and the line drawn between the tuberculum sellae and the top of the dorsum sellae.[11] In adults, the anteroposterior diameter of the sella turcica is said to vary from 5 to 16mm and from 4 to 16mm in vertical depth.[12] The accepted normal maximum dimensions of the sella turcica are 16mm for anteroposterior dimension and 12mm for depth.[13] The normal range for length obtained by Camp[9] in a study of 500 cases of Caucasians was 4 to 16mm with an average of 10.6mm. The depth measurements were: minimal, 4mm. maximal, 12mm. and average 8.1mm. He however suggested that a distance exceeding 16mm between the tuberculum sellae and the dorsum sellae probably indicates an enlarged sella. Taveras and Wood (1964)[14] in Baltimore measured the greatest anteroposterior diameter and regarded 17mm as the upper limit of normal. If the distance along the second line measures 14mm or more, the sella is considered to be abnormally deep.[15] Paul and Juhl,[16] similarly, found the maximum normal measurement of the anteroposterior diameter of the fossa, to be 16.00mm and depth as 12.00mm in Caucasians. Jones *et al* [17] reported that the mean sella turcica length (anteroposterior diameter) in Caucasian subjects treated by combined surgical-orthodontic means was 10.20mm compared with 10.00mm in those treated by orthodontics only. The mean sella turcica depth for both groups was 8.60mm whereas the mean interclinoid distance in the orthodontics only group was 4.1mm compared with 3.5mm for the surgical orthodontic group. On the other hand, Egbe *et al*[18] in 1998, reported on Nigerian subjects that the lengths of the fossa measured from radiographs obtained using the skull unit were greater than those obtained with the conventional unit. This difference was however not statistically significant. The length of the fossa from the skull unit radiographs varied from 6.00mm to 17.00mm with a mean of 11.03mm $\pm$ 1.55mm, while measurement from those radiographs obtained with the conventional unit had a range from 6.00mm to 17.00mm with a mean of 10.91mm $\pm$ 2.98mm. The mean values of the fossa lengths obtained by the skull unit were thus greater than those from radiographs obtained with conventional unit. The range of the fossa depths from radiographs obtained by the skull unit was 4.00mm to 12.00mm with a mean of 9.11 2.13mm. The range of fossa depths from radiographs obtained by the conventional unit was 4.00mm 12.00mm with a mean of 8.83mm $\pm$ 3.14mm. Again the difference here was not statistically significant. These show a remarkable agreement with

Paul and Juhl.[16] More pronounced differences occurred in the average values for the results obtained with the skull unit.[18] From Sokoto, northwestern Nigeria, Zagga A. D,[19] reported that the actual range of sella turcica dimensions were 4.00mm to 17.00mm for anteroposterior diameter (length), 3.00mm to 12.00mm for depth and 0.00mm (bridging) to 11.00mm for interclinoid distance. The mean anteroposterior diameter for all the subjects involved in the study was 11.9mm (±2.9), the mean depth was 7.0mm (±1.9) and the mean interclinoid distance was 2.9mm (±2.0).

Normal variants of the anatomical features of the sella turcica

The anatomy of the sella turcica is variable in size and shape. It has been classified into three types: round, oval and flat.[17] It can also be deep or shallow in both children and adults. In children, 70% of sella turcica are round.[6] In adults only 24.4% are round, whereas 58% are oval and 17.2% are flat.[6] In Sokoto northwestern Nigeria, Zagga A. D,[19] reported oval types of sella turcica in 83%of subjects studied, round in 11% and flat in 6%. In profile, the sella at times has a somewhat high concave appearance caused by what appears to be an excavation beneath the anterior clinoids. This is frequently described in children and has no pathological significance. Bruneton *et al* (1979)[20] studied 200 radiographs of normal adults from North America and noted the percentage of variants of each anatomical feature on both standard radiographs and tomograms. In his series the floor was concave in 58% of subjects, flat in 32. 5% and convex in 9.5%.[20] From Sokoto, northwestern Nigeria, Zagga A. D,[19] reported that 75% of the subjects studied had concave type of sella turcica floor, 16% had flat type and 9% had convex type.

Michael and Peter (2000),[21] reported from Australia on the anatomical basis of the primary empty sella turcica and stated that it is illustrated to emphasize that it represents a normal variant and not pathology. Dietemann *et al*. (1981),[22] reported on Caucasians, five anatomical and radiological observations of a spine protruding into the pituitary fossa. This osseous spine, about 4mm long, arises in the midline from the inferior part of the anterior aspect of the dorsum sellae and extends upward and forward.

Bridging of the sella turcica

The clinoids are blunt protruding processes which are poorly developed in the newborn, and middle clinoid processes are absent in some individuals.[23] Fusion of the posterior and anterior clinoid processes is known as a sella turcica bridge.[17] Sella turcica bridging has been classified into two types depending on the type of the fusion of the anterior and posterior clinoid processes. Type A features ribbon-like fusion, and type B is represented by bony extension of the anterior or posterior clinoid processes such that they meet or superimpose across the sella turcica.[24] Incidence of bridging has been reported in anatomical and radiographic studies.[24] Direct measurement of the skull[11] and inspection at autopsy,[15] found an incidence of bridging of 5.5% and 6% respectively, whereas a 4.6% incidence was reported based on radiographic examination.[5] The incidence of sella turcica bridging in European subjects with severe craniofacial deviations who required combined surgical-orthodontic treatment has been assessed from lateral cephalometric radiographs.[24] A sella turcica bridge occurred in 18.6% of 177 subjects, which is more than the incidence of bridging reported previously in the literature.[24] On the other hand Jones *et al*. (2004),[17] from United Kingdom reported that the incidence of bridging in the combined surgical-orthodontic group compared with orthodontics-only group was 16.7% and 7.3% respectively. In the former group, 40% of bridges were type A and 60% were type B, whereas in the orthodontics-only group, 63.6% were type A and 36.4% were type B.[17] In Sokoto, northwestern Nigeria, Zagga *et al* (2006)[25] reported 11.4% prevalence of sella turcica bridging. Of this figure, 65.4% belonged to type B, while 34.6% had type A bridge. Snyder and Blank (1944)[26] from Ohio, reported that the incidence of bridging is about 5% in the general population and noted a hereditary tendency. In contrast, Ronald *et al* (1992-2005),[27] from the University of Iowa, in another study of 157 skulls, reported that the frequency of bridging was 0.64%. In United States of America, Cederberg *et al*. (2003),[28] reviewed the lateral cephalometric radiographs of 255 subjects for the prevalence of calcifications of the sella turcica, in particular calcification of the interclinoid and petroclinoid ligaments. Of all subjects, calcification of the interclinoid ligament ranged from 39% rated as more than half calcified to 8% completely calcified. Petroclinoid analysis revealed 67% with no calcification, 23% with partial calcification and 9% completely calcified.[28]

Conclusion

It is concluded that complete study of the sella turcica requires multidirectional tomography.

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