بسم الله الرحمن الرحيم

Sudan University of Science and Technology
Collage of graduate studies

Study of anatomical variations of the sphenoid sinus among Sudanese using Computed Tomography

دراسة الإختلافات التشريحية لجيب العظم الوتدي لدى السودانين بإستخدام الأشعة المقطعية المحوسبة

A Thesis Submitted, as a partial fulfillment of award of Master Degree in Diagnostic Radiology

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2018

الآية

بسم الله الرحمن الرحيم

قال الله تعالى:

{وَفِي أَنْفُسِكُمْ أَفَلا تُبْصِرُونَ}

صَدَقَ اللَّه الْعَظِيْم

سورة الذاريات الاية 21

Dedication

With all love I dedicate this work

To my husband and my children Eyad, Mohamed and Abdalrahman for all the time I wasn’t there.

To my parents, brothers and sisters for their support and encouragement and especially to my sister Sara who I couldn’t do this without her.

Acknowledgement

I wish to express my honest and sincere gratitude to my supervisor **Dr. Afraa Siddig Hassan Omer**, Her motivation and encouragement were of a great value for this work to see light, for enlightening my mind with her valuable knowledge and guidance, and for her time.

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Abstract

With the expanding use of the functional endoscopic sinus surgery (FESS), proper understanding of the sphenoid sinus anatomy has become increasingly important. Knowledge of the size and extent of pneumatization of sphenoid sinus is an important to avoid any complications during surgery.

This descriptive study was conducted in Sudan - Khartoum to study the anatomical variations of sphenoid sinus among Sudanese using ct scan. 70 images of ct for para nasal sinus (35males and 35females) were evaluated in both axial and coronal plane; their ages were ranged from 18 to 58 years old. Data were compared statistically using spss programe with relation to age and gender of the patients.

The result of the study showed that the type for most of participants was sellar (73.58%) in both right and left sinuses, (36.42%) of them were presellar, while (0%) of them were conchal for both sinuses. It also showed that the pneumatization in sinus is independent on age and gender.

المستخلص

مع توسع استخدام جراحة الجيب الأنفي بالمنظار أصبح من المهم فهم تشريح الجيب الوتدي ومعرفة الاختلافات الهوائية وذلك لتقليل المخاطر أثناء الجراحة.

أجريت هذه الدراسة الوصفية في السودان_الخرطوم لدراسة الاختلافات التشريحية لجيب العظم الوتدي لدى السودانيين باستخدام الأشعة المقطعية المحوسبة. تم تقييم 70 صورة من التصوير المقطعي للجيوب الأنفية(35 ذكور و35 من الإناث) في كل من المستوى المحوري والاكليلي، وكانت أعمارهم تتراوح بين 18 و58 عاما. تم تحليل البيانات ودراستها احصائيا مع مقارنتها بالعمر والجنس باستخدام برنامج التحليل الإحصائي.

أظهرت نتائج الدراسة أن نوع الجيوب الأنفية لمعظم المشاركين كان من النوع السرجي (73.58%) (36.42%) من النوع امام السرج بينما (0%)من النوع المحاري . كما أظهرت أن الاختلافات الهوائية لاتعتمد على العمر أو الجنس.

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List of Abbreviations

AC	anterior clinoid
AE	anterior ethmoid
CC	carotid canal
CT	computed tomography
FO	foramen ovale
FR	foramen rotundum
CS	foramen spinosum
OC	optic nerve
PE	posterior ethmoid
PTP	pterygoid plate
SPS	sphenoid sinuses
VC	vidian canal

CHAPTER ONE

INTRODUCTION

1.1 Introduction:

Sphenoid sinus is the most inaccessible Para nasal sinuses; it is located deeply and enclosed within the sphenoid bone. It is intimately related to numerous vital neural and vascular structures, such as the internal carotid artery, optic nerve and vidian canals. The anatomical relationships of the sphenoid sinus are of considerable importance, the sella turcica bearing the pituitary gland with the optic chiasm anteriorly, the cavernous sinus and contents run along its lateral walls. The floor of the sphenoid sinus forms the roof of the nasopharynx. (Vidya etal., 2015).

The sphenoid sinuses are present at birth but continue to grow until 10 to 12 years of age. They are two large, irregular cavities hollowed out of the interior of the body of the bone, and separated from one another by a bony septum, which is commonly bent to one or the other side. They vary considerably in form and size, are seldom symmetrical, and are often partially subdivided by irregular bony lamina (Standring S.2008). Each sphenoid sinus opens into the sphenoethmoidal recess directly above the superior concha and drains into the superior nasal meatus. (Kelley l.2013)

Computed tomography is currently is the modality in the evaluation of diseases affecting Para nasal sinuses. Axial and coronal views may be useful for delineating the anatomical landmarks, but coronal CT gives more information which is necessary for sphenoidal surgeries. The sphenoid septum is an important landmark during transphenoid approach to important structures such as the internal carotid artery, optic canal and skull base. (Vidya et al., 2015)

In order to minimize risks during surgery; a careful analysis should be coupled with knowledge about the anatomical variations on CT scans before surgical intervention. CT scan can help the surgeon to enhance identification of the limits of dissection during surgery. Besides, being aware of the exact knowledge of anatomic morphology and probable anomalies are of particular importance to the surgeon (Bolger et al., 1991).

1.2 Problem of the study:

The sphenoid sinus is neglected by the physician because of its subtle symptoms when diseased, and by the surgeon because of its inaccessibility. An accurate knowledge and understanding of the anatomy of sphenoid sinus help the physician diagnose and mange problem in this area.

1.3 Objective of the study:

1.3.1 General objectives:

The aim of this study is to evaluate the anatomical variations of sphenoid sinus as detected by CT scan.

1.3.2 Specific objectives:

- To assess the normal sphenoid sinuses.
- To correlate and determine the sphenoid sinuses variations related with age, side and gender in Sudanese population.

1.4 Overview of the study

This study consisted of five chapters, Chapter one an introduction which, Includes; problem of study also contain general and specific objectives. Chapter two includes back ground and literature review about role of CT images in study of sps. Chapter three describes the methodology. Chapter four includes result of the study. Chapter five includes discussions, conclusion and recommendation

CHAPTER TWO
LITERATURE REVIEW

2.1. The anatomy of Para nasal Sinuses

The par nasal sinuses are air-filled spaces located within the bones of the skull and facial bones. They are centered on the nasal cavity and have various functions, including lightening the weight of the head, humidifying and heating inhaled air, increasing the resonance of speech, and serving as a crumple zone to protect vital structures in the event of facial trauma. Four sets of paired sinuses are recognized: maxillary, frontal, ethmoid, and sphenoid. Each of these sinuses is named according to the skull bones. (Ameet Singh et al; 2017).

2.1.1. Maxillary Sinus

The maxillary sinus is pyramidal in shape and located within the body of the maxilla behind the skin of the cheek (Fig. 2-1). The roof is formed by the floor of the orbit, and the floor is related to the roots of the premolars and molar teeth. The maxillary sinus opens into the middle meatus of the nose through the hiatus semilunaris (Fig. 2-1). (Snell 1995).

2.1.2Frontal Sinuses

The two frontal sinuses are contained within the frontal bone (Fig. 2-1). They are separated from each other by a bony septum. Each sinus is roughly triangular, extending upward above the medial end of the eyebrow and backward into the medial part of the roof of the orbit. Each frontal sinus opens into the middle meatus of the nose through the infundibulum (Fig. 2-1). (Snell 1995).

2.1.3Ethmoid Sinuses

The ethmoidal sinuses are anterior, middle, and posterior and they are contained within the ethmoid bone, between the nose and the orbit (Fig. 2-1). They are separated from the latter by a thin plate of bone so that infection can readily spread from the sinuses into the orbit. The anterior sinuses open into the infundibulum; the middle sinuses open into the middle meatus, on or above the bulla ethmoidalis; and the posterior sinuses open into the superior meatus. (Snell 1995)

2.1.4SphenoidSinuses

The sphenoid sinus is a paired structure that is located predominantly in the sphenoid bone. The two sinus cavities are separated by a complete bony septum, approximately 0.6 mm thick, located in the mid sagittal plane. Some asymmetry in size and shape is nearly always present, but marked septal deviations are relatively rare (Kevin et al., 2000). The sphenoid sinus reflects its anatomic relations in its walls. Adjacent structures, present before the development of the sinus, produce irregularities in the walls of the sinus as the cavity grows to contact and pass beyond them. Often the extension is such as to form recesses on either side of an elevation, and in the well pneumatized cavities the walls commonly present a continuous sequence of depressions and elevations. In such cases only a thin bony plate separates the sinus from the adjacent structures, and the intimate relationship thus established contributes much to the clinical importance of the sphenoid sinus.

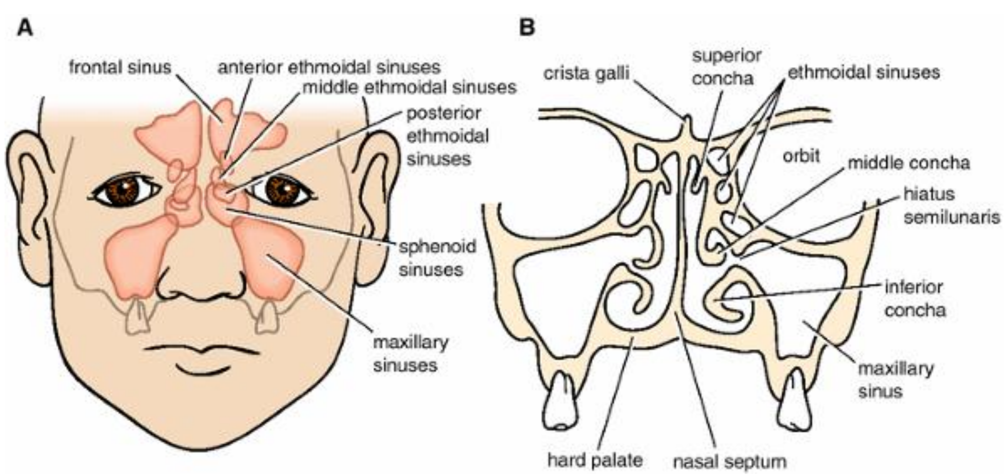

Figure 2-1 A. The position of the paranasal sinuses in relation to the face. **B**. Coronal section through the nasal cavity showing the ethmoidal and the maxillary sinuses. (Snell 1995).

2.1.4.1 Vascular supply of sphenoid sinus

The posterior ethmoid artery supplies the roof of the sphenoid sinus. The rest of the sinus is supplied by the spheno palatine artery. Venous drainage is via the maxillary veins to the jugular and pterygoid plexus systems.

2.1.4.1 Innervations of sphenoid

The sphenoid sinus is supplied by branches from both V1 and V2. Then asociliary nerve (from V1) runs into the posterior ethmoid nerve and supplies the roof. The branches of the sphenopalatine nerve (V2) supply the floor (Francis et al., 2002).

2.2 Sphenoid bone

The sphenoid is a butterfly-shaped bone that is divided into 4 main parts: the body of the sphenoid centrally, 2 set of greater and lesser wings laterally, and 2 sets of pterygoid processes inferiorly. Medial and lateral pterygoid plates arise from each pterygoid process; the space contained is called the pterygopalatine fossa.

The lesser wing and the planum sphenoidale (the roof of the sphenoid sinus) form the medial portion of the anterior cranial fossa. The medial portion of the middle cranial base is formed by the body of the sphenoid bone, the tuberculum sella, the pituitary fossa, the middle and posterior clinoid processes, and the dorsum sellae. The lateral portion of the middle cranial base is formed by the lesser and greater wings of the sphenoid bone. Various foramina contained within the sphenoid transmit numerous important neurovascular structures. The supraorbital fissure is located at the junction of the greater and lesser wings of the sphenoid and carries cranial nerves III, IV, V1, and VI, as well as sympathetic fibers from the cavernous sinus to the orbit. The foramen rotundum transmits the maxillary branch (V2) of cranial nerve V, which exits into the pterygopalatine fossa. Running through the median pterygoid plate, the pterygoid (Vidian) canal carries the Vidian nerve into the pterygopalatine fossa. The foramen ovale is located posteriorly to the lateral pterygoid plate and allows passage of cranial nerve V3.Sitting in the infratemporal surface of the greater wing of the sphenoid; the foramen spinosum transmits the middle meningeal artery. (Ameet Sing et al; 2017).

2.3 Physiology of sphenoid Sinus

The function of the paranasal sinuses is not yet completely understood. It has been suggested that the sinuses assist with the warming and humidification of inspired air, and contribute to mucous production. It has also been noted that the paranasal sinuses are important for contributing to increased vocal resonance, and are instrumental for buffering increased pressure in the upper aero digestive tract. On a more theoretical level, Pneumatization of the bones of the face and skull base may have evolved as a way of decreasing the weight of these bones. Physiologically, there appears to be nothing that separates the sphenoid sinus from the rest of the paranasal sinuses. (Jonathan et al., 2003)

2.4 Pneumatization of the sphenoid sinus

Pneumatization of the sphenoid sinus is highly variable and can extend as far as the clivus inferiorly, the sphenoid wings laterally, and the foramen magnum inferiorly. Pneumatization of the vast majority of sinuses reaches the sella turcica by age 7. Three major pneumatization patterns for sphenoid sinus have been noted: sellar, presellar and conchal. (Ameet Singh et al; 2017)

There are various ways to classify the types of sphenoid sinus. Cope (1917) used the planes of fusion between ossification centers as the boundary line and classified the sinus into presphenoidal, postsphenoidal, and intermediate types according to variations in its posterior limits. The widely adopted classification of the sphenoid sinus proposed by Hammer and Radberg classified the sinus into three general types that occur at different frequencies and reflect the degree of pneumatization of the sphenoid bone: sellar, presellar, and conchal (Fig 2.2). The sellar type of sphenoid sinus occurs in approximately (86%) of individuals, and represents well pneumatized sphenoid body with full indentation of the sella into the sinus (sinus pneumatization extends beyond a vertical line drawn through the tuberculum sellae). The presellar type (11%) has a moderate amount of sphenoid Pneumatization with no sellar indentation (the sinus cavity remains anterior to a vertical line drawn through the tuberculum sellae), while in the conchal type (3%), there is minimal pneumatization of the sphenoid bone. The various patterns of pneumatization are illustrated in (Fig. 2.2a–c), respectively. This classification was widely adopted because trans-sphenoidal surgery focused mainly on the sellar region during that area (Hammer and Radberg, 1961).

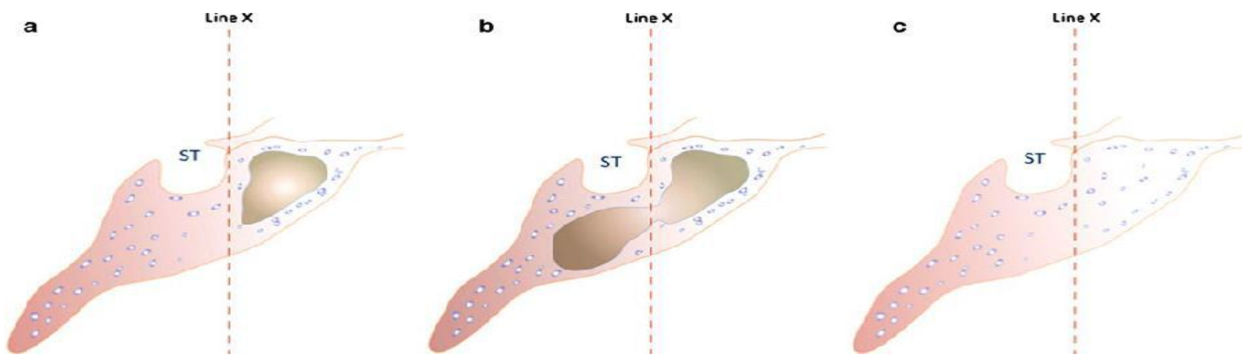

Figure 2.2: a Presellar type of pneumatization, b sellar type ofpneumatization, c conchal pneumatization(ST sella turcica) line X vertical line drawn through tuberculum sellae, presellar type: pneumatizationremains anterior to line X, sellar type: pneumatization extends beyond line X, conchal type: filled with bone. Figures a–c illustrating the types of pneumatization pattern (Anusha et al., 2013)

There are some modifications to this classification system. For example, Lang adds a fourth classification that he refers to as postsellar (Lang, 1989).This designation indicates the extension of Pneumatization posterior to the hyperphysical indentation. In a small number of people, there is no pneumatization of the sphenoid bone. There is, of course, additional variability in younger people who have not undergone complete Pneumatization of the sphenoid bone. Cho et al. (2010) subdivide the sellar type into the complete and in complete sellar types, and Li et al. (2010) divide the SS into six types: no development, conchal, presellar, half sellar, full sellar, and postsellar. Although these modifications provide more details regarding the morphological features of the SS, all of the above classification systems are based on the traditional trans-sphenoidal approach while focusing on the sellar floor area. During recent decades, with a better understanding of the anatomy of the sellar and para sellar regions as well as the tremendous development of endoscopy, the traditional trans-sphenoidal approach has expanded beyond the area of the sellar floor.

2.5 Absence of sphenoidal sinuses

To treat the disease effectively and avoid complications, otorhinolaryngologist must possess a detailed understanding of paranasal sinus anatomy and its variations (Anik et al., 2005). Furthermore, the surgeon must pay attention to the other anatomical risk factors even after the opening has been identified. These factors, include the skull base, which comes into contact with the superior wall of the sphenoidal sinuses (SS), the cavernous sinus touching its lateral border, and the branches of the sphenopalatine artery running along the inferior to the ostium (Aydinliogluand Erdem, 2004; Wong, 2004). Despite all these difficulties, not much anatomical research has been dedicated to the location of the opening in the sphenoidal sinuses.

The sphenoid sinus cavities are variable in size, and are often asymmetrical (Peres-Pinas et al., 2000; Tasar et al., 2003). In the fourth fetal month, the sphenoid sinus emerge as evaginations from the posterior nasal capsule into the sphenoid bone and at birth; they become visible as minute (0.5 x 2 x 2mm) cavities (Anik et al., 2005). By the age of 7, they extend posteriorly to the level of the sella turcica, and by the age of 12, sphenoid pneumatization reaches its adult size and the sinuses measure on average 14 x 14 x 12mm(Anderhuber et al., 1992; Peres-Pinas et al., 2000;Tasar et al., 2003).

The lack of any sinus pneumatization by the age of 10 should suggest the possibility of sphenoid pathology (Digre et al., 1989; Lang, 1988). The absence of paranasal sinuses is an uncommon clinical sign and it refers primarily to the frontal sinuses (12%) and secondarily to the maxillary sinuses (5–6%) (Anderhuber et al., 1992; Digre et al., 1989). The incidence of absence of the sphenoid sinus is reported as 1–1.5% in previous studies (Anik et al., 2005; Antoniades et al., 1996; Degirmenci et al., 2005; Digre et al., 1989; Keskin et al., 2002). The absence of the sphenoid sinus usually occurs with syndromes, such as craniosynostosis, osteodysplasia and Down's syndrome and has also been reported as Hand–Schuller–Christian Disease (Anderhuber et al., 1992; Antoniades et al., 1996). Pneumatization can extend into the greater wing, pterygoid process, and rostrum and the basilar part of the occipital bone (Hajek, 1926; Lang, 1988).The pathogenesis of absence of the sphenoid sinus has been regarded as the cause of deficient resorption from the body of the sphenoid bone (Hajek, 1926). (Keskin et al., 2002) pointed out that sphenoidal absence can also be categorized as the fourth type of pneumatization. Making differentiation between the types of the sphenoid sinus is important clinically in planning pituitary surgery. Trans-nasal surgery would be difficult and dangerous in conchal or absence of the SS. In such cases, employing other operative techniques might be useful (Keskin et al., 2002).Surgeons should also consider the possibility of sphenoidal absence or arudimentally SS before trans-sphenoidal hypophysectomy. As a supplement to the traditional classification, absence of the SS can be described as the fourth type of pneumatization.

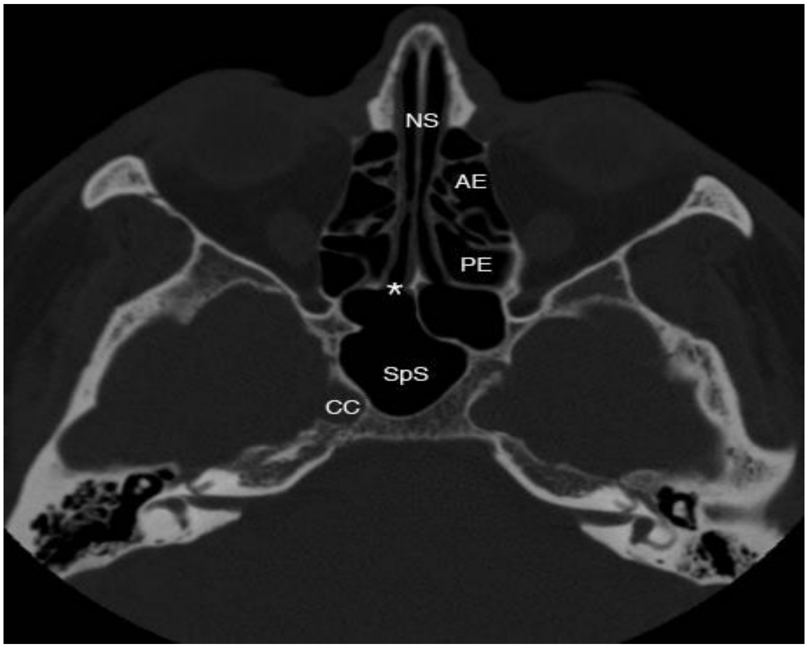

Figure 2-3 Axial image shows sphenoid sinus (SpS) and the sphenoethmoidal recess marked by the (*). (AE: anterior ethmoid, PE: posterior ethmoid, CC: carotid canal, NS: nasal septum) (http://uwmsk.org/sinusanatomy2/Sphenoid-Normal.html)

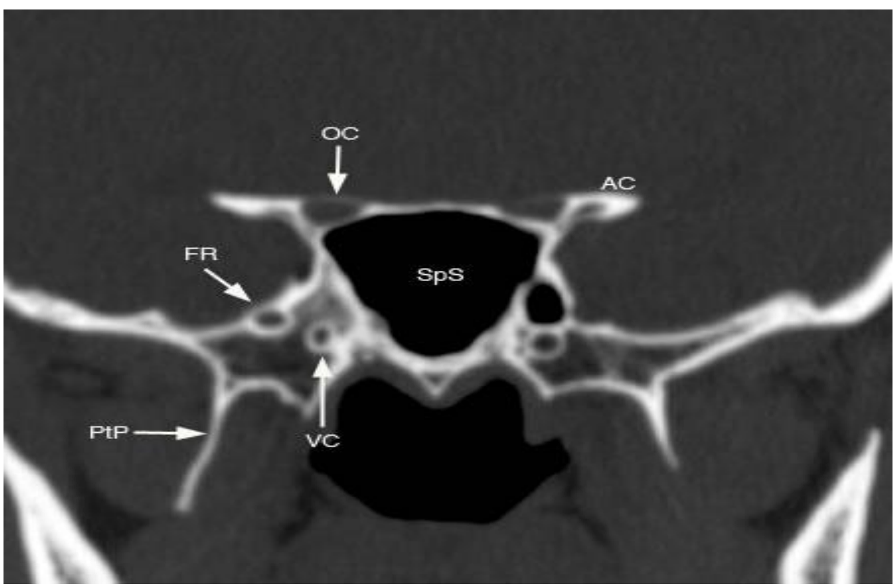

Figure 2-4 Coronal image of the sphenoid sinus (SpS) and neighboring structures. (FR: foramen rotundum, VC: vidian canal, OC: optic canal, AC: anteriorclinoid, PtP:pterygoidplate)(http://uwmsk.org/sinusanatomy2/Sphenoid-Normal.html)

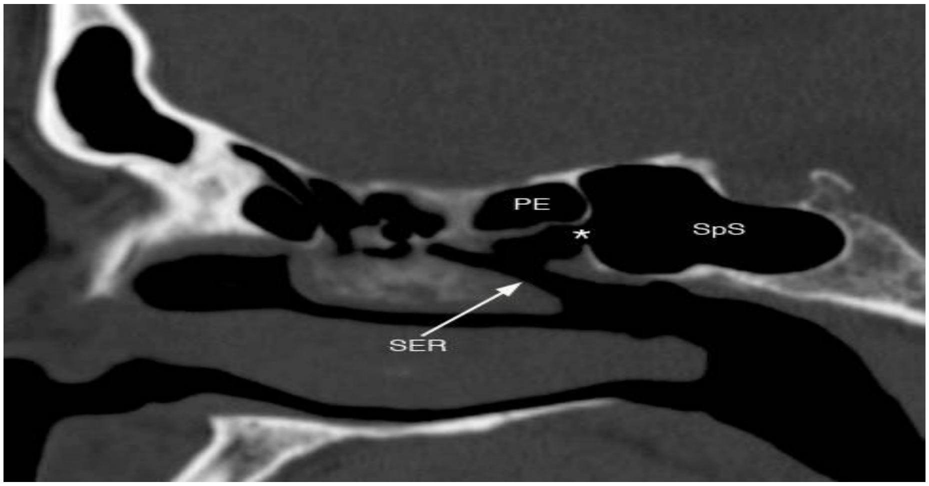

Figure 2-5 Sagittal image showing the sphenoid sinus (SpS) with sinus ostium (*) and arrow demonstrating the sphenoethmoidal recess (SER). (PE: posterior ethmois sinus) (http://uwmsk.org/sinusanatomy2/Sphenoid-Normal.html)

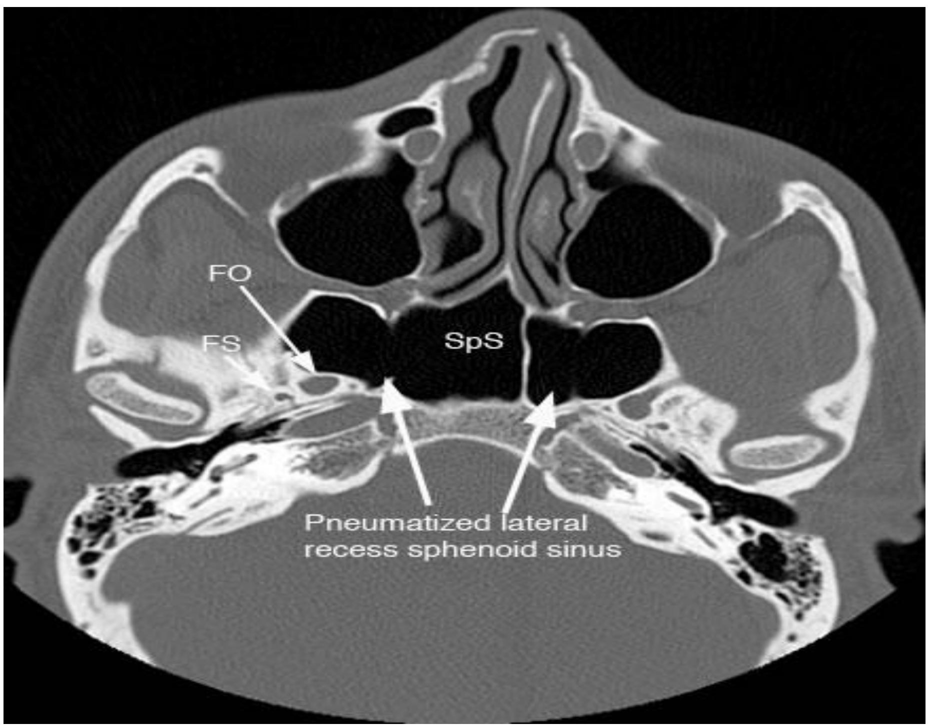

Figure 2-6 axial image with large arrows pointing to pneumatized lateral recesses of the sphenoid sinus (SpS). (FO: foramen ovale, FS: foramen spinosum) (http://uwmsk.org/sinusanatomy2/Sphenoid-Normal.html)

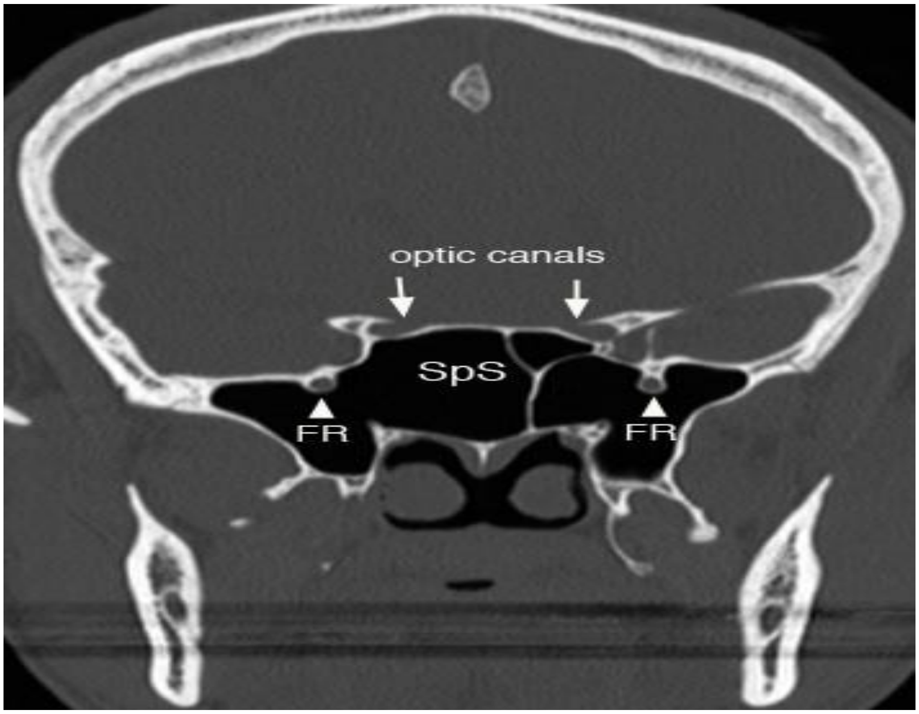

Figure 2-7 Coronal image showing pneumatized lateral recesses of sphenoid sinus (SpS) and foramen rotundum (FR) is bulging into the sinus. Arrows point to optic canals superior to sphenoid sinus and medial to anterior clinoid processes. (**http://uwmsk.org/sinusanatomy2/Sphenoid-Normal.html)**

Figure2-8 axial image with arrows pointing to pneumatized pterygoid plates (PP).(**http://uwmsk.org/sinusanatomy2/Sphenoid-Normal.html)**

2.6 Pathology of paranasal sinuses

2.6.1 Sinusitis:

Any condition (Inflammation, neoplasm, foreign body) that interferes with drainage of a sinus renders it liable to infection. If the ostium of a sinus is blocked, the secretion or exudates accumulates behind the obstruction. There are two types of sinusitis: Acute sinusitis**,** generally a complication of acute infection of the nose (rhinitis) and rarely secondary to dental sepsis.Chronic sinusitis, acute sinusitis may become chronic due to incomplete resolution of acute inflammation and from damage to the mucous membrane, inadequate drainage of the sinuses, nasal obstruction due to polyps, or enlargement of the nasopharyngeal lymphoid tissue (adenoids). (Stamm, 2000), (Pankey, 2000).

2.6.2Polyps

Are focal inflammatory swellings of the mucosa of the nose and paranasal sinuses. Allergic polyps of the nose are usually multiple and appear as smooth, pale, movable, rounded tumors, which protrude in to the airway and cause symptoms of nasal obstruction. (Kumar et al., 1997)

2.6.3 Mucocele:

Accumulation of mucous secretions in a nasal sinus, infection of mucocele results in empyema. Mucocele occur most often in anterior ethmoid sinus, frontal sinus and maxillary antra. Mucocele of the sphenoid sinus is rare, and may be large enough to displace the contents of the orbit. (Kumar et al., 1997)

2.6.4Tumors:

The tumors of nasal cavity and paranasal sinuses are uncommon. However benign and malignant tumors of epithelial as well can occur .CT plays important roles in the staging of these tumors, the location and extent of disease.

Carcinoma appears as aggressive soft-tissue that occludes sinus Ostia, exhibit local soft-tissue invasion, and cause bone destruction. (Vartaian,,2005)

2.7. Computed Tomography (CT):

CT utilizes a conventional X-Ray tube a bank of detectors, which rotate around the patient to produce a finely focused series of projections, which are reconstructed by computers to produce across-sectional image, usually transaxial image.(figure 2.7) CT image has low spatial resolution but it has high contrast resolution in comparison with the conventional x-ray. CT scan can now be obtained in about 1 second and new spiral scanners which combine continuous table movement and continuous X-Ray tube emission allow volumes of tissue up to 60 cm in length to be scanned, with slice obtain anywhere with this volumes. This allows better multiplaner reconstruction. Finally the image can be stored on magnetic tapes or optical disk and recorded permanently on C-Ray film.

The advantages of CT are as follow:

-Excellent contrast resolution.

-Transaxial image with no tissue superimposition.

-Excellent anatomical display can be used to guide biopsies.

CT exams are generally painless, fast and easy. With helical CT, the amount of time that the patient needs to lie still is reduced. Though the scanning itself causes no pain, there may be some discomfort from having to remain still for several minutes. If you have a hard time staying still, are claustrophobic or have chronic pain, you may find a CT exam to be stressful. The technologist or nurse, under the direction of a physician, may offer you a mild sedative to help you tolerate the CT scanning procedure.

2.7.1. Limitations of CT of the Sinuses:

While CT is occasionally used to detect the presence of tumors, magnetic resonance imaging (MRI) is the primary choice for this purpose. A person who is very large may not fit into the opening of a conventional CT scanner or may be over the weight limit for the moving table which is usually about 450 pounds. (Radiology info-2014)

Figure(2.9) ct machine http://www3.gehealthcare.in

2.8 Previous Studies:

Study done by Banna and Olutola in (1983) .The aim of study was to study the degree of pneumatization, number of inter sphenoidal septa and the relationship of the septa to the lowest portion of the sellar floor. The study done for 70 patients .They found, in 85.7%, pneumatization was of the sellar type, in 11.4% of the pre-sellar type and in 2.8% of the conchal type.

Study done by Mustafa Kazkayasi1, Yasemin Karadeniz2, Osman K. Arikan (2005) in under the title of Anatomic variations of the sphenoid sinus on computed tomography. The study was performed on 267 patients with a complaint of chronic or recurrent sinusitis. The evaluations of the sphenoid sinuses were regarded separately, so as 534 sides were examined. Especially bony anatomic variations as well as mucosal abnormalities of the sphenoid sinuses were examined. Pneumatization of the pterygoid process and anterior clinoid process were found in 39.7% and 17.2% of the patients respectively. Vidian canal protrusion was found in a total of 158 sides of which 60 were bilateral. These entities were encountered usually when pneumatization of the pterygoid process occurred. Carotid canal and optic canal protrusions were found in 5.2% and 4.1% of the patients respectively. Mucosal thickening, and polyps or cysts of sphenoid sinuses were detected in 20.6% and 4.5% of the patients respectively.

Study done by Ossama Hamid and Lobna El Fiky(2008) in under the title of Anatomic Variations of the Sphenoid Sinus and Their Impact on Trans-sphenoid Pituitary Surgery. they have evaluated retrospectively, the CT and MRI scans of 296 patients, who have operated for pituitary adenomasvia a trans-sphenoid approach, regarding the different anatomical variations of the sphenoid sinus: degree of pneumatization, sellar configuration, septation pattern, and the inter carotid distance. They found that there were 6 cases with conchal pneumatization, 62 patients with presellar, 162 patients with sellar, and 66 patients with postsellar pneumatization. They have concluded that a highly pneumatized sphenoid sinus may distort the anatomic configuration and cautioned about the importance of the midline when operating the sella to avoid the accidental injury to the carotid arteries and optic nerves

Study done by Vidya CS Keshav Raichurkar(2015) under the title of anatomic variation of sphenoid sinus in mysore based population ct scan study , 80 macerated skulls (Males=48, Females=32) subjected to 3D axial multislider CT scan. Axial and coronal images of slice thickness of 4mm were obtained. Sphenoid sinus symmetry and pneumatization was observed and classified. The present study showed symmetry in 56 skulls (70%), asymmetry in 18 skulls (22.5%) and presence of transverse septa in 6 skulls (7.5%). The sellar type of pneumatization in 68 skulls (85%), presellar type in 8(10%) and post sellar type in 4 skulls (5%).

CHAPTER THREE

MATERIALS AND METHODS

3.1 Materials

3.1.1 Place and time of the study:

The study was carried out in Sudan, Khartoum state, Modern Medical Center From January to February 2018.

3.1.2 Patient's population:

The sample comprised of 70 Sudanese subjects attended for CT scanning for sinuses 35were males and 35 were females and with ages ranging between (18-58) years. Subjects were diagnosed as normal sinus.

3.1.3 Exclusion criteria:

Patients having pathological changes as neurological deficit, stroke, epilepsy, vertigo, sinusitis, any congenital abnormalities in sphenoid sinuses and subjects younger than 16 years were excluded.

3.1.4 Machine used:

All patients were examined on a multi-slice CT scanner (Optima CT520 Series\GE) according to the following parameters: slice thickness 0.625mm, 120kV, 10-45 mA, Collimator width 1.25MM-250 MM, Scan type-Helical full 1.0 sec, FOV: 25.0, Bone window (WL350,WW2000 HU).

3.2Method:

3.2.1Technique used:

Taking the hard palate as reference axis, in the coronal study the plane of section was perpendicular to this structure. Axial sections were performed in a plane parallel to the hard palate from the upper dental arch to the roof of the frontal sinuses. Data acquired on the axial plane, coronal and sagittal plane were created by secondary reconstruction method in the workstation. The thickness of reconstructed image slice was of −1 MM. The patients were prepared for the procedure by giving them full information about the procedure.

The following variants were studied; as well as the type of sphenoid sinus (Sellar – pre-sellar – Conchal) and this was according to the classification of (Hammer & Radberg, 1961). Age, gender had been evaluated. The measurements were obtained with both left and right sides for comparisons.

3.2.2 Method of data collection:

All subjects were examined by multislice CT scanner of adult Sudanese population and data collected on data collecting sheets.

3.2.3 Image interpretation:

Interpretation by Radiological technologist: and radiologist

3.2.4 Data analysis:

Data was analyzing using statistics package for social sciences (SPSS).

3.2.4 Ethical issues:

All the data was collected by complete agreement of patients.

CHAPTER FOUR

RESULTS

Table 4.1: distribution of participants according to gender:

Gender	Frequency	Percent
Male	35	50.0
Female	35	50.0
Total	**70**	**100.0**

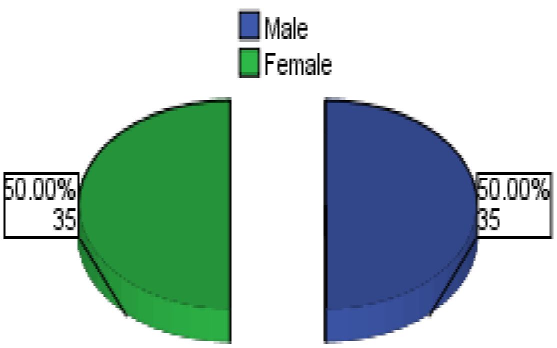

Figure 4.1: distribution of participants according to gender

Table 4.2: distribution of participants according to age:

Age	Frequency	Percent
20 years or less	6	8.6
21-30 years	22	31.4
31-40 years	24	34.3
41-50 years	16	22.9
More than 50 years	2	2.9
Total	**70**	**100.0**

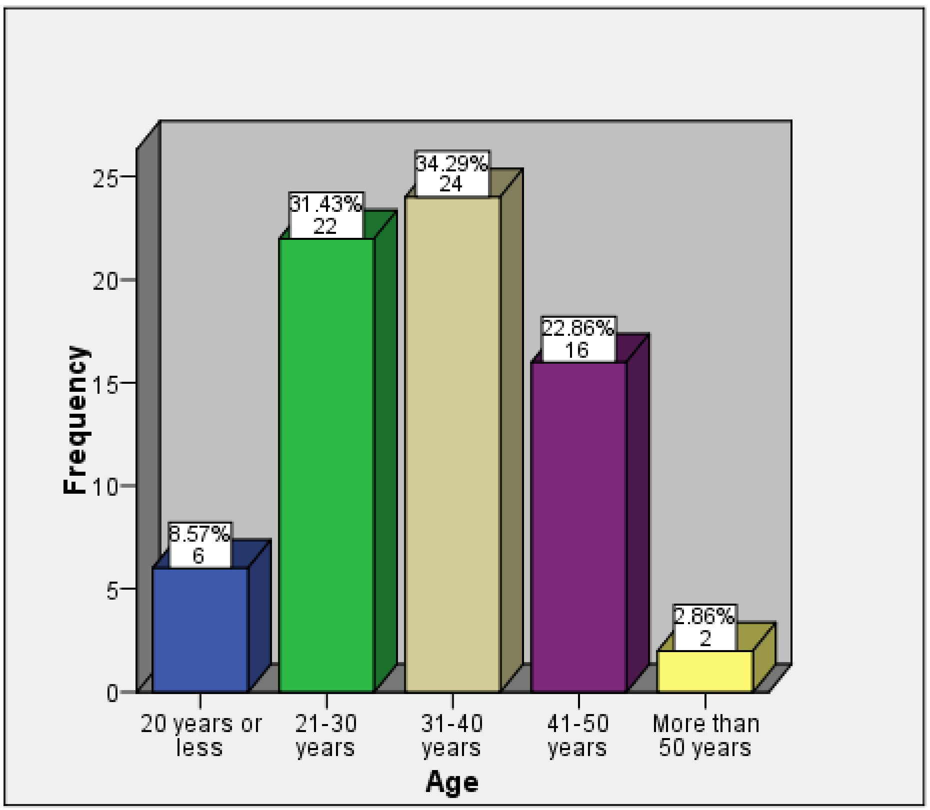

Figure 4.2: distribution of participants according to age

Table 4.3: Showing the degree of Pneumatization.

types	male		female		percentage
	right	**left**	**right**	**left**	
Sellar	27	29	21	26	73.58%
Pre-sellar	8	6	14	9	36.42%
Conchal	0	0	0	0	0.0%

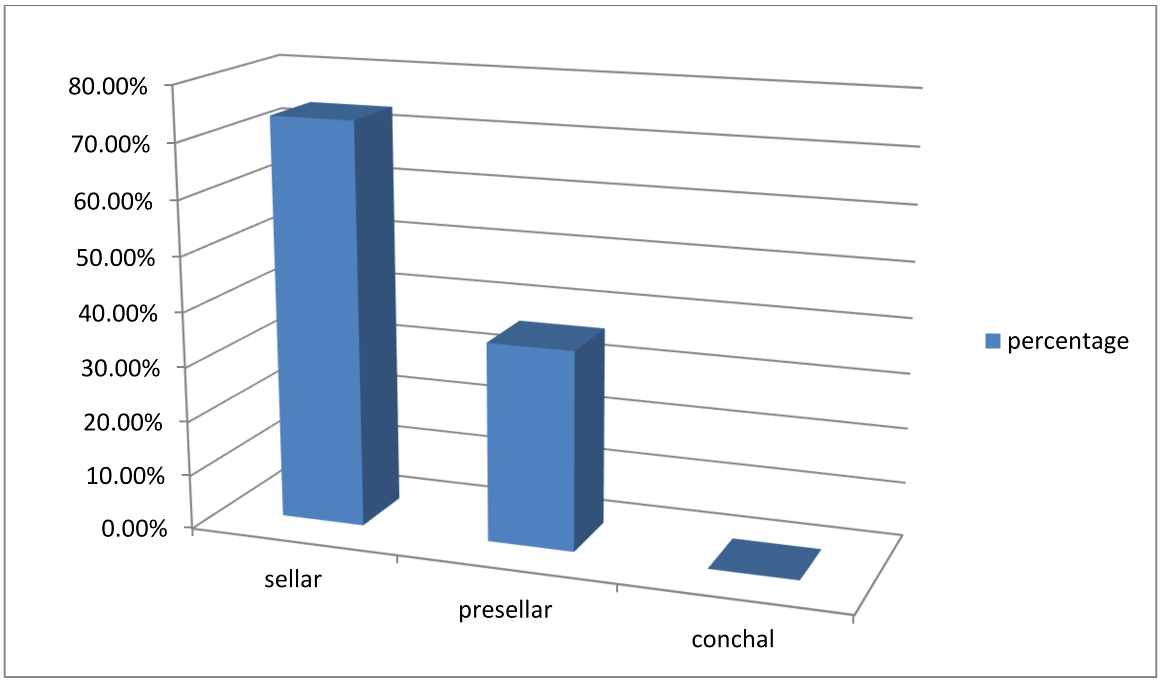

Figure 4.3: Showing the degree of Pneumatization.

Table 4.4: Association between Pneumatization in sinuses and gender:

			Gender		Chi-Square
			Male	Female	(P-value)
Pneumatization in right sinuses	Yes	Count	22	18	0.334
		%	62.9%	51.4%	
	No	Count	13	17	
		%	37.1%	48.6%	
Pneumatization in left sinuses	Yes	Count	25	24	0.794
		%	71.4%	68.6%	
	No	Count	10	11	
		%	28.6%	31.4%	

Table 4.5: Association between Pneumatization in sinuses and age:

			Age					Chi-Square
			20 years or less	21-30 years	31-40 years	41-50 years	More than 50 years	(Pvalue)
Pneumatization in right sinuses	Yes	Count	4	9	13	12	2	0.131
		%	66.7%	40.9%	54.2%	75.0%	100.0%	
	No	Count	2	13	11	4	0	
		%	33.3%	59.1%	45.8%	25.0%	.0%	
Pneumatization in left sinuses	Yes	Count	6	16	16	9	2	0.123
		%	100.0%	72.7%	66.7%	56.2%	100.0%	
	No	Count	0	6	8	7	0	
		%	.0%	27.3%	33.3%	43.8%	.0%	

Table 4.6: Association between the degree of Pneumatization and gender:

			Gender		Chi-Square
			Male	Female	(P-value)
Right sinuses type	Sellar	Count	27	21	0.350
		%	77.14%	60.0%	
	Pre-sellar	Count	8	14	
		%	22.86%	40.0%	
	Conchal		0	0	
			.0%	0%	
Left sinuses type	Sellar	Count	29	26	0.494
		%	82.86%	74.28%	
	Pre-sellar	Count	6	9	
		%	17.14%	25.72%	
	Conchal	Count	0	0	
		%	.0%	0%	

Table 4.7: Association between the degree of Pneumatization and age:

			Age					Chi-Square
			20 years or less	21-30 years	31-40 years	41-50 years	More than 50 years	(P-value)
Right sinuses type	Sellar	Count	5	12	15	13	2	0.392
		%	83.33%	54.54%	62.5%	81.25%	100.0%	
	Pre-sellar	Count	1	10	9	3	0	
		%	16.67%	45.46%	37.5%	18.75%	.0%	
	Conchal	Count	0	0	0	0	0	
		%	.0%	.0%	.0%	6.2%	.0%	
Left sinuses type	Sellar	Count	6	17	17	13	2	0.452
		%	100%	77.27%	70.83%	81.25%	100.0%	
	Pre-sellar	Count	0	5	7	3	0	
		%	0%	22.72%	29.71%	18.75%	.0%	
	Conchal	Count	0	0	0	0	0	
		%	.0%	.0%	.0%	0%	.0%	

CHAPTER FIVE

DISCUSSION, CONCLUSON &RECOMMENDATION

5.1 Discussion

Table (4.1) and Figure (4.1) show that 70 patients were evaluated in this study with different gender 35male and 35 female.

Table (4.2) and Figure (4.2) show that the most (34.3%) of participants were 31-40 years old and (31.4%) of them were 21-30 years, since (22.9%) of them were 41-50 years old, while only (8.8%) of were 20 years or less, and only (2.9%) of them were more than 50 years old.

Table (4.3) and Figure (4.3) show that most of participants have a Pneumatization in both right and left sinuses.

Table (4.3) and Figure (4.3) show that type of sinuses for most of participants seller in both right and left sinuses, that (73.58%) ,(36.42%) of them were pre-seller, while (0%) of them were conchal for both sinuses.

Notes from the table (4.4), there was Pneumatization in sinuses for most (62.9%) and (51.4%) respectively for males and females in right side, and most (71.4%) and (68.6%) respectively for males and females in left side.

Notes from the table (4.5), there was Pneumatization in sinuses for most of all age groups in both sides, except for 20 or less and more than 50 years old in right side.

Notes from the table (4.6), the sinuses' type for most (77.14%) and (60.0%) respectively for males and females was seller in right side, compared to (82.86%) and (74.28%) respectively for males and females in left side.

Notes from the table (4.7), the sinuses type for most of all age groups in both sides was sellar.

5.2 conclusions:

As conclusions this study found that the type of sinuses for most of participants was sellar in both right and left sinuses age which agrees with classification of Hammer and Radberg which classified the sinus into three general types: sellar (86%), presellar (11%), and conchal (3%). And it also shows that Pneumatization in both sinuses is independent on gender and independent on age.

The anatomical variations of the sphenoid sinus in this study were remarkably common and the degree of pneumatization too. Ct scan should be used in pre-surgical evaluation of patients under consideration of trans-sphenoid sinus surgery to minimize the damage of neural and vascular injuries. It is expected that this study will help the neurosurgeons working on the pituitary as it will show light on anatomical variations of the sphenoid air sinus.

This study was limited in terms of sample size and number of variations studied, future studies with larger samples and include all the variations in sphenoid sinuses and different population.

5.3 Recommendations

- Sudanese population sphenoid sinuses morphology differs from other studied populations and also the differences take place between males and females. These Anatomic differences of the sphenoid sinus between genders should be taken into consideration during surgery.
- Large sample size should be used in future studies.
- Different ethnic group with different ages should be used in future.
- Further studies could be made to compare between CT scan technique and other modalities to explain the suitable technique that produce highly quality image and more diagnosable.

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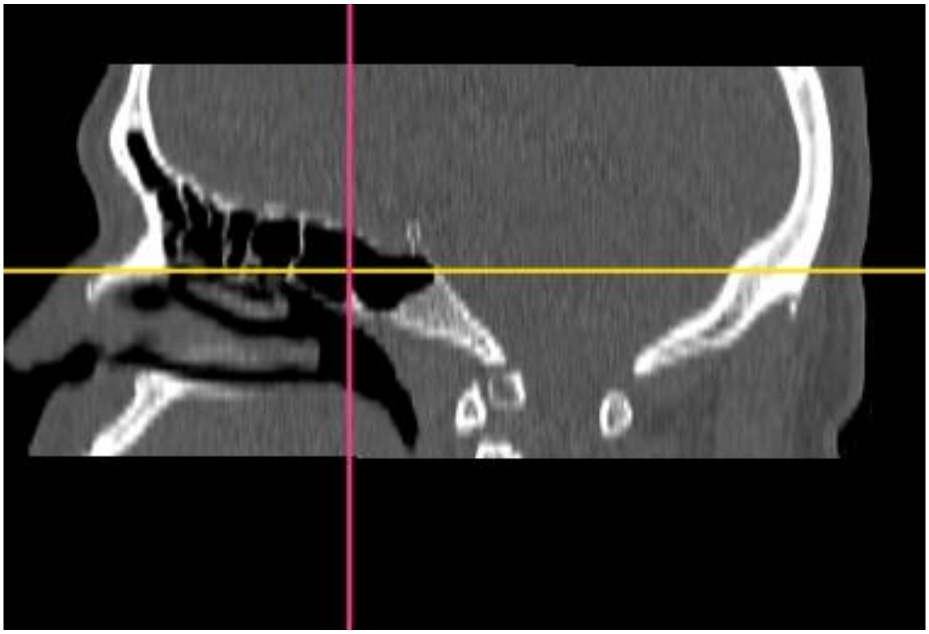
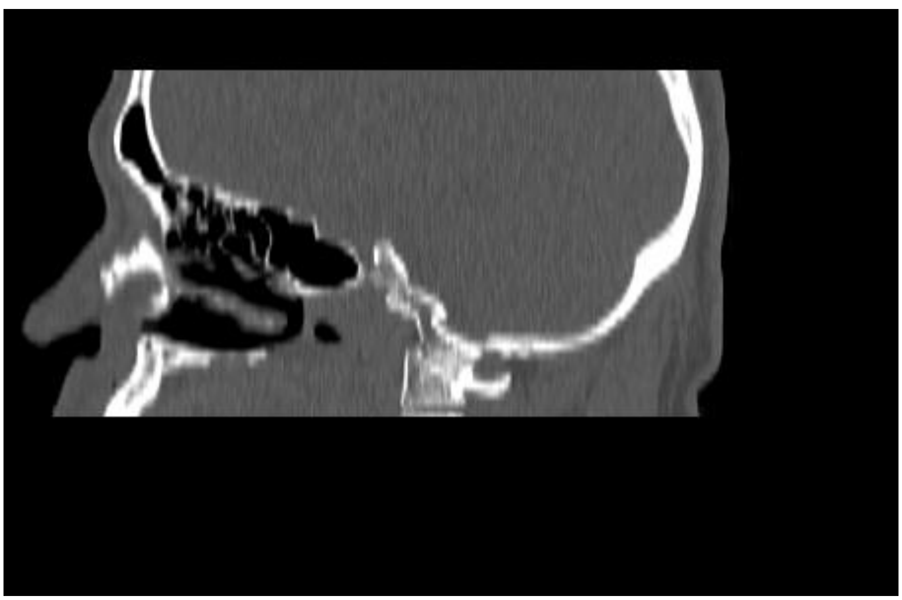
Appendixes:

Data sheet for anatomical variation of the sphenoid sinuses

	Name	Gender	age	Pneumatization		Degree of pneumatization		
				Right	Left	Sellar	Presellar	Conchal

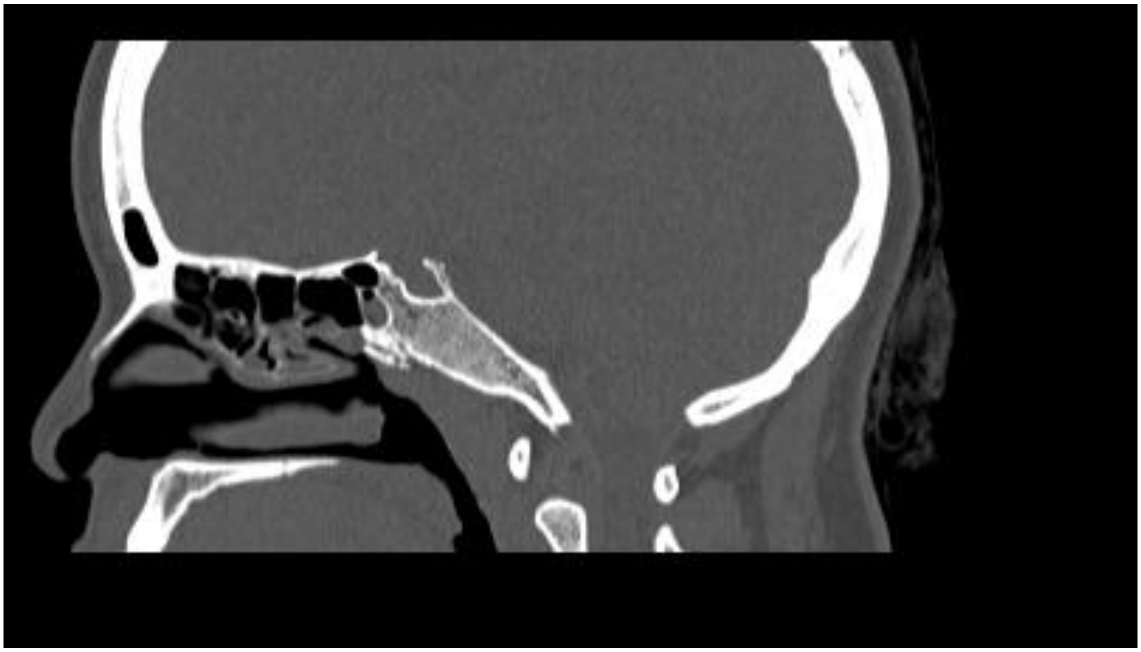


A: the sellar type(right sinus)

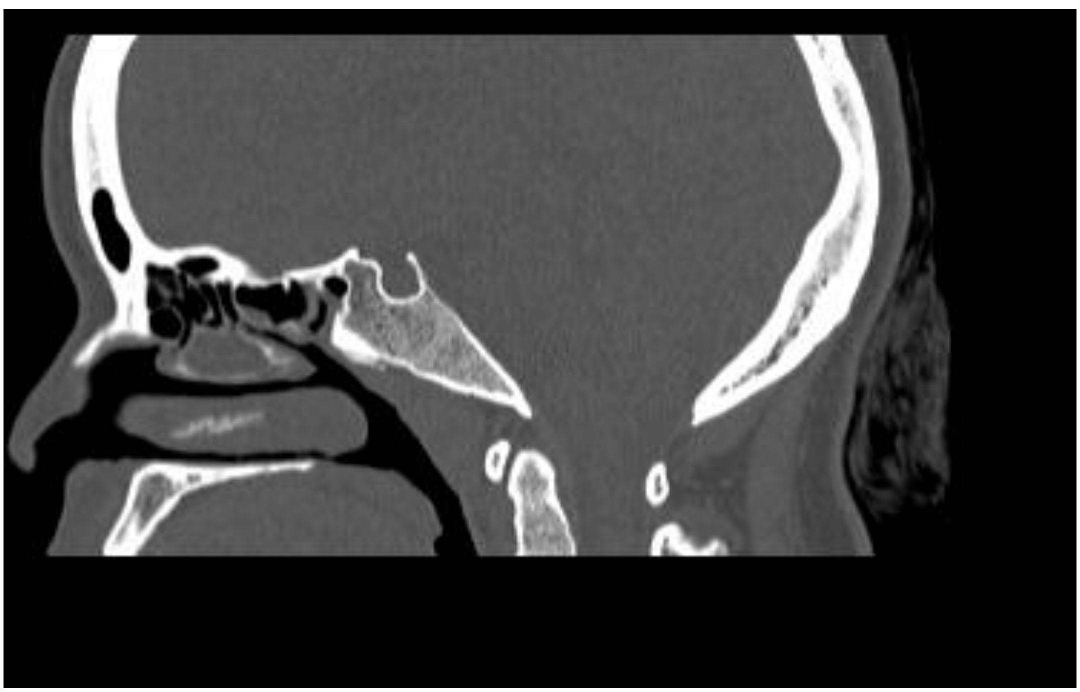


B: sellar type(left sinus)

Image 1: Sagittal CT image of 40 years old male show the sellar type

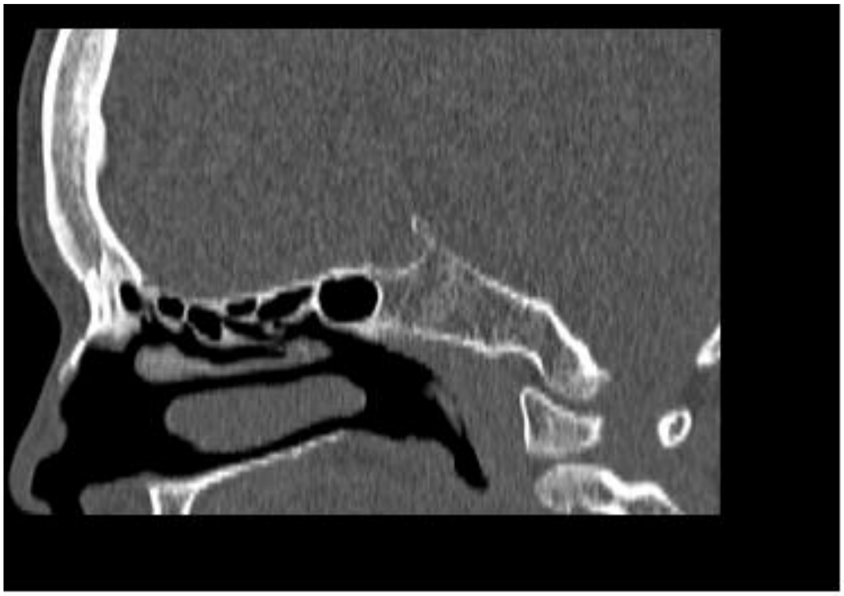


A: pre sellar type(left sinus)



B: presellar type(right sinus)

Image 2: Sagittal CT image of 37 years old female



A: sellar type(right)

B: presellar type(left sinus)

Image 3:sagittal image of 48years female with sellar(right) and presellar type(left).