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Outcomes of trans-nasal trans-sphenoid endoscopic approach in isolated sphenoid sinus and sellar lesions

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Abstract:

Introduction: Isolated sphenoid sinus lesions cause symptoms such as headache and visual abnormalities. Endoscopic examination and imaging modalities are mandatory to reach a diagnosis.

Objectives: To validate the importance of a direct trans-nasal trans-sphenoid endoscopic approach as a minimally invasive surgical strategy in isolated sphenoid sinus and sellar lesions.

Patients & Methods. There are 21 patients in our study, collected over 2 years period. we recorded all patients with isolated sphenoid sinus and sellar lesions. These patients were scheduled for a direct trans-nasal trans-sphenoid endoscopic approach for surgical management. Pituitary adenomas affect ten of them, and isolated sphenoid sinus lesions affect eleven. Complete medical history was taken, as well as general examination and local examination including full ENT examination including endoscopic examination, neurological examination, and ophthalmological examination. Routine laboratory investigations, hormonal assay (in patients with pituitary tumors), and radiological evaluation were done.

Results*:* We faced 21 patients 10 of them had pituitary adenomas and 11 of them had isolated sphenoid sinus lesions. 7 patients had non-secretory pituitary adenomas, 3 patients had secretory adenomas, 4 patients had sphenoid sinus mucoceles, 2 patients had spheno-choanal polyps, 2 patients had isolated sphenoid sinus fungal sinusitis, one patient had a granulomatous lesion, one patient had a neoplastic lesion (squamous cell carcinoma), and one patient had unilateral isolated sphenoiditis.

Conclusion: Direct trans-nasal trans-sphenoid endoscopic approach is the preferred option for optimal surgical management of patients with isolated sphenoid sinus and sellar lesions.

Keywords: Isolated sphenoid sinus disease, sellar lesions, pituitary adenomas, direct trans-nasal trans-sphenoid endoscopic approach.

Introduction

The sphenoid sinuses are pair of asymmetric cavities within the sphenoid body that are separated by a bony septum. Sphenoid sinuses are related to the pituitary gland superiorly, nasopharynx inferiorly, and related to the optic nerve, internal carotid artery, and the cavernous sinus laterally. The sinus ostium is located in the anterior wall of the

sinus and opens into the spheno-ethmoidal recess [1] .

The sella turcica is a thin bony plate that separates the pituitary gland from the sphenoid sinus and protects the lower anterior and posterior margins of the pituitary gland. [2] .

Isolated sphenoid sinus lesions are either inflammatory or neoplastic. Most lesions are inflammatory (due to fungal sinusitis, sphenoid sinus mucocele, or pyocele) [3] . Sellar lesions may be pituitary adenoma (91%), cystic lesions (Rathke's cleft cyst, craniopharyngioma, and arachnoid cyst), other neoplasms (meningioma, germ cell tumor, chordoma, granular cell tumor, glioma, metastasis, and lymphoma) and inflammations and infections (sarcoidosis, tuberculosis, pituitary abscess, Langerhans histiocytosis, and lymphocytic hypophysitis). The majority of primary pituitary tumors are benign adenomas that arise from the anterior pituitary gland (adenohypophysis). Endocrine function (aided by immunostaining), light microscopy (with routine histological staining), electron microscopic appearance, and lesion size are all ways to classify pituitary adenomas [4] .

Classification according to size: 1. Microadenoma: a pituitary tumor with a diameter of less than one centimeter. At the time of diagnosis, 50% of pituitary tumors are less than 5 mm in size. These could be difficult to locate during surgery. 2. Macroadenoma is a tumor with a diameter of more than one centimeter [5] .

Also, Pituitary tumors are classified as either functioning (or secretory) or non-functioning (which are either non-secretory or else secrete products such as gonadotropin that do not cause endocrinologic symptoms).

Secretory tumors, in general, present earlier as a result of symptoms generated by the physiologic effects of excess hormones secreted. Non-secretory tumors don't normally show up until they've grown large enough to produce neurologic impairments due to mass impact [6] .

Two lines of treatment are used, alone or in combination. Medications that inhibit excessive hormone secretion or surgery (removal of the tumor) if medical treatment fails. Surgery is required when tumors compress neighboring vital structures. The effectiveness of surgery depends on the type of tumor, its location, size, and if it has invasion to surrounding structures [7] .

Transcranial adenomectomy and trans-sphenoidal adenomectomy are the two main surgical methods. In the latter, the tumor is reached and removed through the nasal cavity [8].

The trans-sphenoidal approach can be done either microscopic guided or endoscopic guided. The trans-sphenoidal approach has the advantages of not touching any other parts of the brain, a low rate of neurological complications, and no visible scar. The procedure is performed through the nose with no external incision and requires only a brief hospital stay.

The study aims to confirm the value of a direct trans-nasal trans-sphenoid endoscopic approach as a minimally invasive surgical technique for isolated sellar and sphenoid sinus lesions.

Materials and Methods

Setting and patients: The study population includes 21 patients 10 of them have pituitary adenomas and 11 of them have isolated sphenoid sinus lesions. Patients were collected over 2 years period between October 2018 till the end of October 2020, we recorded all consecutive patients with isolated sphenoid sinus and sellar lesions. Patients were selected from ENT and neurosurgery outpatient clinics in Sohag University Hospital. These patients were scheduled for a direct trans-nasal trans-sphenoid endoscopic approach

for surgical management of sphenoid sinus and sellar lesions. All patients were operated on in sohag university hospital in ENT and neurosurgery departments.

Methods:

Complete medical history was taken from all patients, as well as general medical examination and local examination including endoscopic examination by 0° and 45° endoscope, neurological examination, and ophthalmological examination which includes visual acuity, visual field examination, ocular motility examination, and fundus examination. Investigations were done including routine laboratory investigations, hormonal assay in patients with pituitary tumors, and radiological evaluation including CT nose and paranasal sinuses, MRI nose, paranasal sinuses, and MRI brain.

Surgical technique: The operations were done under general hypotensive anesthesia with the patient in the supine position. The patient's neck was slightly extended and positioned with the forehead-chin line set horizontally, and the head of the bed was lifted 20 degrees. To reduce venous hemorrhage, the level of the head was raised slightly above that of the heart. Ophthalmic eye ointment was applied to the cornea and conjunctiva. A 2-inch gauze was stuffed into the oropharynx. We used 4 mm endoscopes with 0° and 45° lenses video-imaging system, light source connections, and a variety of endoscopic surgical equipment. The video monitor was placed a few feet away from the patient's head to face the surgeon directly. All patients were subjected to a direct trans-nasal trans-sphenoid endoscopic approach. The surgery was done by both the neurosurgeon and the otolaryngologist in cases of sellar lesions. The otolaryngologist provided access, exposure, and skull base reconstruction if needed and the neurosurgeon resects the tumor in patients with sellar lesions. The patient was subjected to strict follow-up for 6 months to detect the rate of remission and occurrence of any

Statistical analysis:

Data were verified, coded by the researcher, and analyzed using IBM-SPSS 24.0 (Statistical Package for Social Science). Descriptive statistics: Means, standard deviations, median, range, frequency, and percentages were calculated.

Ethical considerations:

This research was revised by the Scientific Ethical Committee of Sohag University Hospital and was performed following the ethical guidelines of the 1964 Declaration of Helsinki and its 2013 revision. Informed consent has been taken from all patients.

Results

Over 2 years period, we faced 21 patients 10 of them had pituitary adenomas and 11 of them had isolated sphenoid sinus lesions. 7 patients had non-secretory pituitary adenomas, 3 patients had secretory adenomas, 4 patients had sphenoid sinus mucoceles, 2 patients had spheno-choanal polyps, 2 patients had isolated sphenoid sinus fungal sinusitis, one patient had a granulomatous lesion, one patient had a neoplastic lesion (squamous cell carcinoma), and one patient had unilateral isolated sphenoiditis. All patients were subjected to a direct trans-nasal trans-sphenoid endoscopic approach for surgical management. Merocele pack was applied and removed after 48 hours. Patients were kept in the postoperative observation hospital room overnight. Patients with pituitary tumors were admitted post-operatively to ICU. They were discharged home the following days after surgery ranging from 2-to

7days. Postoperative pain was usually mild and did not necessitate the use of powerful painkillers.

Table 1: Baseline Demographic Characteristics of the studied patients:

Variable	Category	n = 21
Age in years	• **Mean ± SD**	39.76 ± 12.1
	• **Median (Range)**	38 (20 – 66)
Sex	• **Male**	13 (61.9%)
	• **Female**	8 (38.1%)

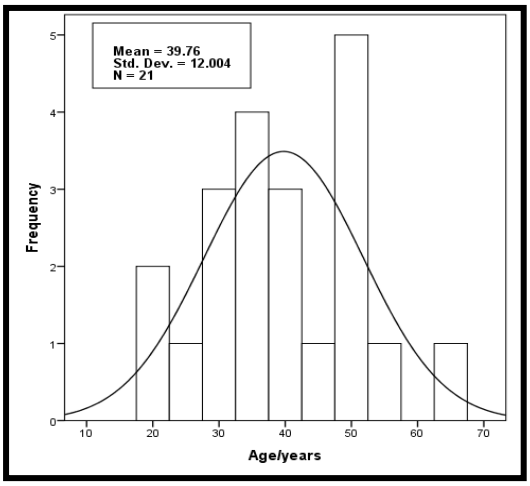

Fig. 1: Age Frequency of studied sample.

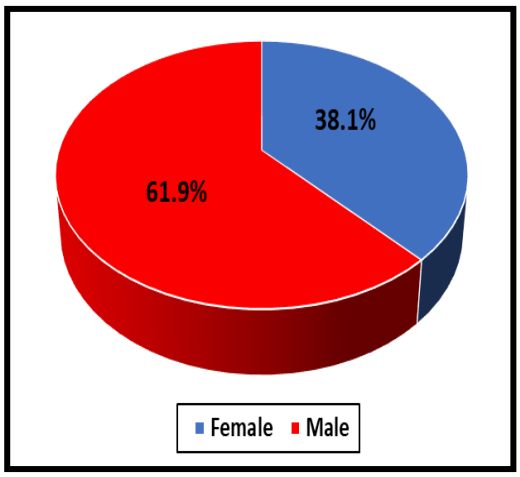

Fig. 2: Sex Distribution of studied patients

There were 21 patients, their age range from 20 to 66 years with a mean age was 39.76 years,13 patients (61.9%) were males and 8 patients (38.1%) were females. **(Fig. 1, fig. 2)**

Table 2: Clinical Presentation of the studied patients:

Segment	n = 21
Preoperative clinical presentation	
• Deterioration of Vision	3 (14.3%)
• Headache	6 (28.6%)
• Headache + Deterioration of Vision	9 (42.9%)
• Headache + Nasal Obstruction	2 (9.5%)
• Headache + Nasal Obstruction + Diplopia + Squint	1 (4.8%)
Postoperative improvement of pre-operative symptoms	
• Yes	19 (90.5%)
• No	2 (9.5%)

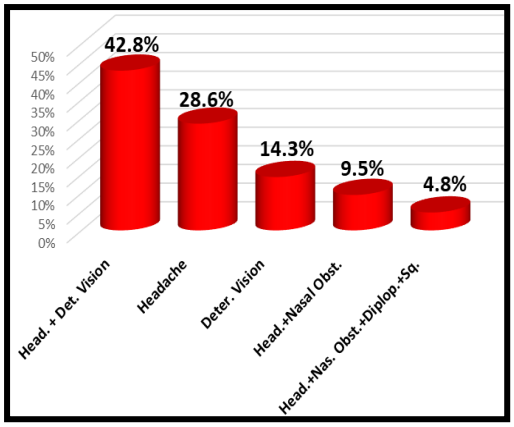

Fig. 3: Distribution according to pre-operative clinical presentation.

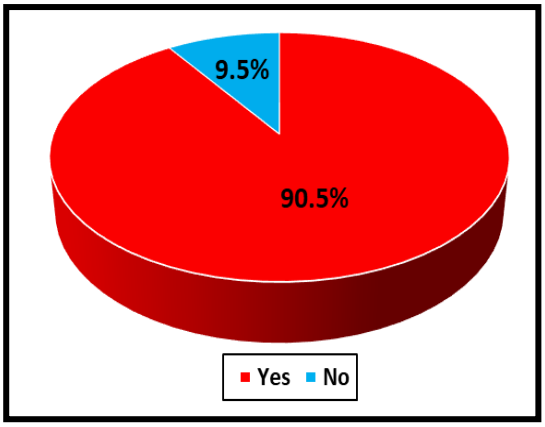

Fig. 4: Rate of postoperative improvement of symptoms.

The main preoperative presentation of our studied patients was headache and deterioration of vision. 18 patients (85.7%) had headache at the time of their presentation (8 of those patients had pituitary adenomas, 4 patients had sphenoid sinus mucoceles, 2 patients had a spheno-choanal polyp, one patient had isolated sphenoid sinus fungal sinusitis, one patient had sphenoid sinus squamous cell carcinoma, one patient had sphenoid sinus granulomatous lesion and one patient had isolated sphenoiditis). 13 patients (61.9%) had visual abnormalities including a decrease in visual acuity, visual field defects, diplopia and limitation in ocular motility (7 of those patients had pituitary adenoma, 2 patients had sphenoid sinus mucoceles, 2 patients had isolated sphenoid sinus fungal sinusitis, one patient had sphenoid sinus granulomatous lesion and one patient had sphenoid sinus squamous cell carcinoma). Postoperatively, 19 patients (90.5%) had a dramatic improvement in the presenting symptoms**. (Fig.3, Fig.4)**

Table 3: Ophthalmological assessment and a hormonal assay of the studied patients:

Segment	n = 21
Preoperative Ophthalmological Evaluation	
• Abnormal	13 (61.9%)
• Normal	8 (38.1%)
Postoperative Ophthalmological Evaluation	
• Improved/Recovered	11 (85%)
• Not Improved	2 (15%)
Preoperative Hormonal Evaluation	
• Normal	18 (85.7%)
• High ACTH	1 (4.8%)
• High Prolactin	2 (9.5%)
Post-operative Hormonal Evaluation	
• Normal	18 (85.7%)
• Decrease in ACTH	1 (4.8%)
• Dramatic Decrease in Prolactin	2 (9.5%)

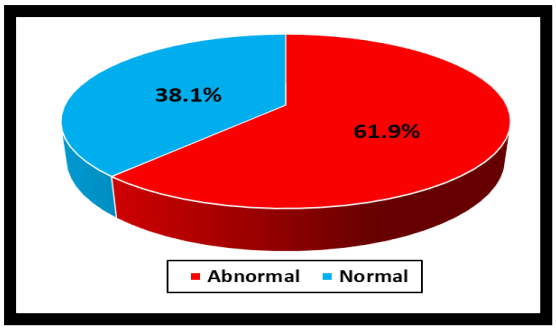

Fig. 5: Distribution according to pre-operative ophthalmological evaluation.

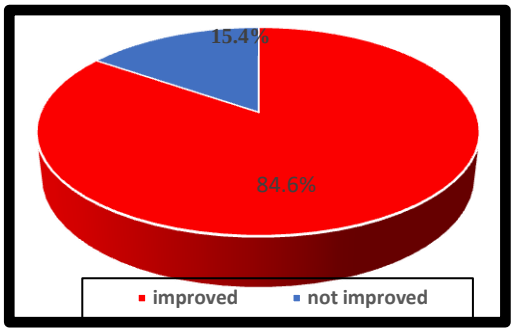

Fig. 6: Rate of postoperative improvement of vision.

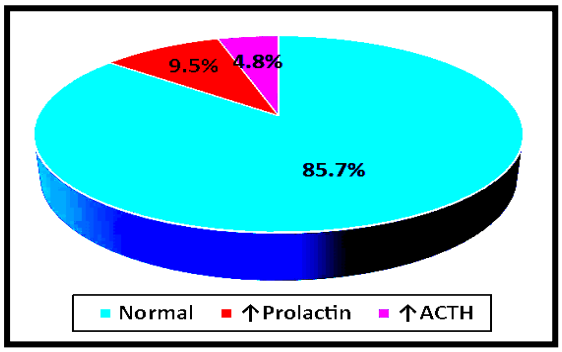

Fig. 7: Distribution according to pre-operative hormonal evaluation.

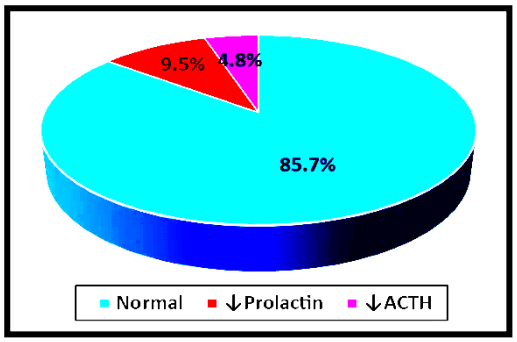

Fig. 8: Rate of postoperative improvement of hormonal level.

All our studied patients were subjected to pre-operative ophthalmological evaluation and hormonal assay. 13 of our patients (61.9%) had abnormal ophthalmologic evaluation including a decrease in visual acuity, visual field defects, affection of ocular motility, and optic neuritis. 11 patients (84.6%) improved after surgical intervention and 2 patients didn't improve. **(Fig.5, Fig. 6)** As regards hormonal assay, 2 patients had high prolactin levels and one patient had high ACTH levels, the three patients showed a decrease in the hormonal level postoperative. **(Fig.7, Fig.8)**

Table 4: Surgical Data of the studied patients:

Segment	n = 21
Surgical Approach to Sphenoid Sinus	
• Trans-nasal	21 (100%)
Inter-Sphenoid Septum Removal	
• Yes	15 (71.4%)
• No	6 (28.6%)
Use of Hadad Flap Technique	
• Yes	10 (47.6%)
• No	11 (52.4%)
Approach Laterality	
• Unilateral	7 (33.3%)
• Bilateral	14 (66.7%)

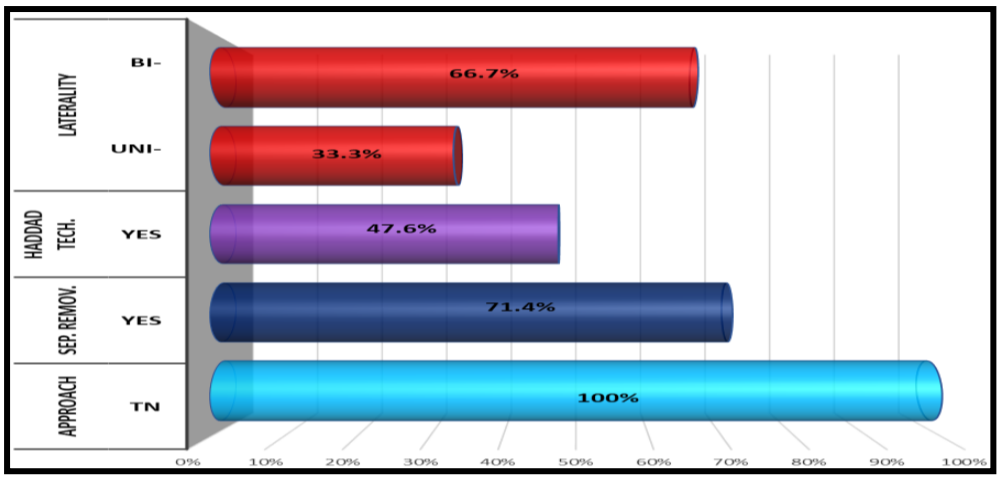

Fig. 9: Surgical Data of the Studied patients.

We used a **direct trans-nasal trans-sphenoid endoscopic approach** for surgical management of all our studied patients. The procedure involved lateralization of the middle turbinate, identification of the sphenoid sinus ostium in the spheno-ethmoidal recess just medial to the superior turbinate, sphenoidotomy, removal of the posterior part of the nasal septum, and opening of the anterior face of the sphenoid sinus.

Inter-sphenoid septum was removed in 15 patients (71.4%) to allow exposure and complete eradication of the pathology (10 of those patients had pituitary adenomas, 2 patients had isolated sphenoid sinus fungal sinusitis, one patient had sphenoid sinus granulomatous lesion, one patient had sphenoid sinus squamous cell carcinoma and one patient had sphenoid sinus mucocele).

Hadad flap technique (pedicled naso-septal flap) was done in all patients with pituitary adenomas (10 patients) (47.6%), 2 patients of them had intra-operative C.S.F leak for skull base reconstruction preventing communication between brain and sinuses, used

A bilateral approach (through both nostrils) was used in 14 patients (66.7%), (10 patients with pituitary adenomas, 2 patients with isolated sphenoid sinus fungal sinusitis, and one patient with sphenoid granulomatous lesion, and one patient of sphenoid neoplastic lesion). A bilateral approach was used to allow a 4-hands technique in which both otolaryngologist and neurosurgeon could use their 2 hands in the operative field. The surgical data of our studied patients are shown in **Fig.9.**

Table 5: Postoperative complications of the studied patients:

Segment	**n = 21**
Postoperative Complication	
• Yes (Blindness)	1 (4.8%)
• No	20(95.2%)

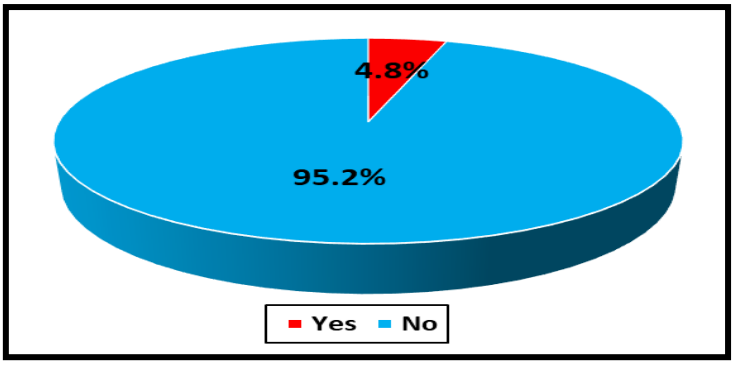

Fig. 10: Postoperative Complications of the Studied patients.

Only 1 of our studied patients who had pituitary adenoma developed a postoperative complication in form of postoperative blindness due to optic neuritis which had no direct relation to the performed surgical technique. The condition improved within 1 month after taking the full dose of systemic steroid **(Fig.10).**

Table 6: Postoperative histopathology of the studied patients:

Segment		n=21
Postoperative histopathology:		
• Non-secretory pituitary adenoma		7 (33.3%)
• Secretory pituitary adenoma	▪ Prolactin	2 (9.5%)
	▪ ACTH	1 (4.8%)
• Sphenoid sinus mucocele		4 (19%)
• Spheno-choanal polyp	▪ Right	1(4.8%)
	▪ Left	1 (4.8%)
• Sphenoid sinus mass	▪ Granulomatous lesion.	1 (4.8%)
	▪ Neoplasm	1 (4.8%)
• Isolated sphenoid sinus fungal sinusitis		2 (9.5%)
• Isolated left sphenoditis		1 (4.8%)

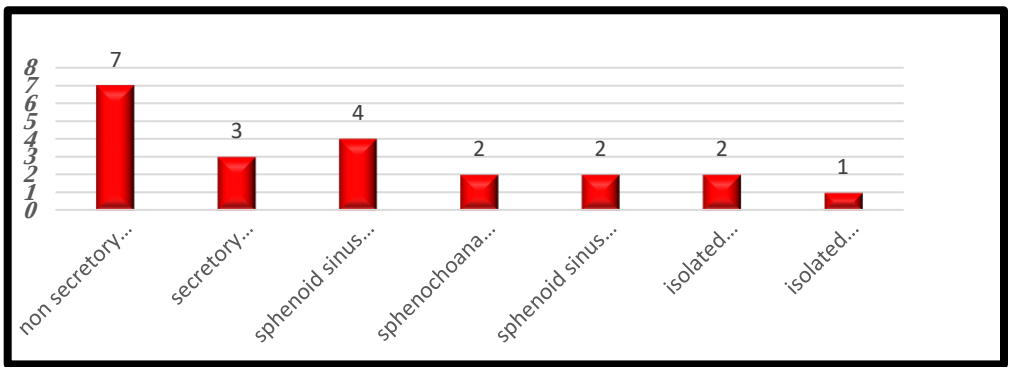

Fig. 11: postoperative histopathology of the Studied patients.

Preoperative evaluation, operative data, and postoperative histopathological examination revealed that 7 patients (33.3%) were non-secretory pituitary adenomas, 3 patients (14.3%) were secretory adenomas, 4 patients (19.1%) were sphenoid sinus mucoceles, 2 patients (9.5%) were spheno-choanal polyps, 2 patients (9.5%) were isolated sphenoid sinus fungal sinusitis, one patient (4.8%) was a granulomatous lesion, one patient (4.8%) was neoplastic lesion (squamous cell carcinoma), and one patient (4.8%) was unilateral isolated sphenoiditis **(Fig.11).**

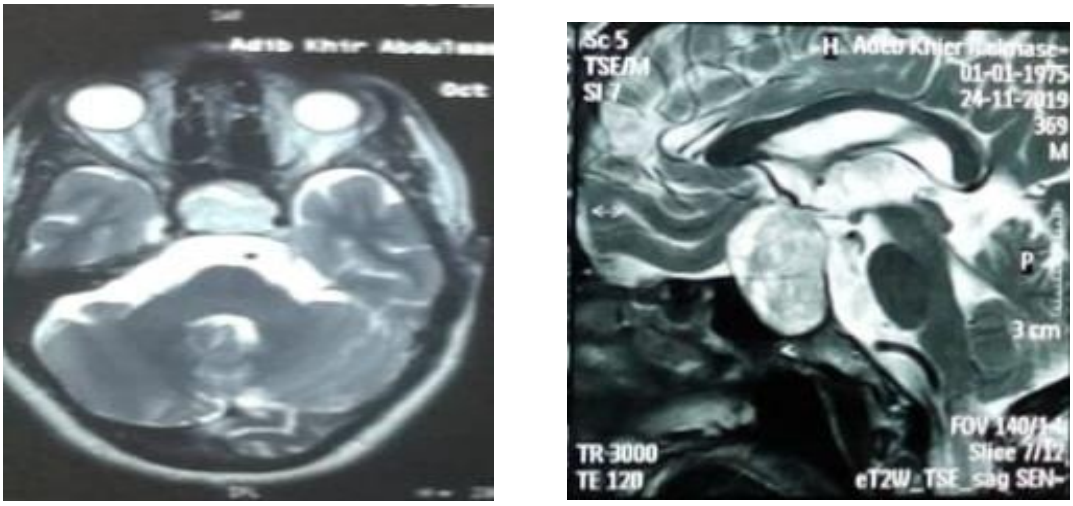

Fig. 12: M.R.I brain showing pituitary adenoma

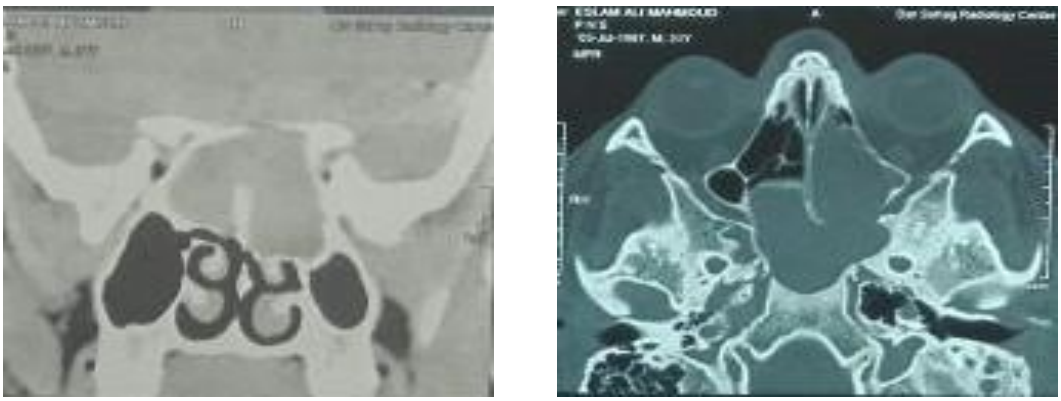

Fig. 13: C.T nose and paranasal sinuses showing left sphenoid sinus mucocele.

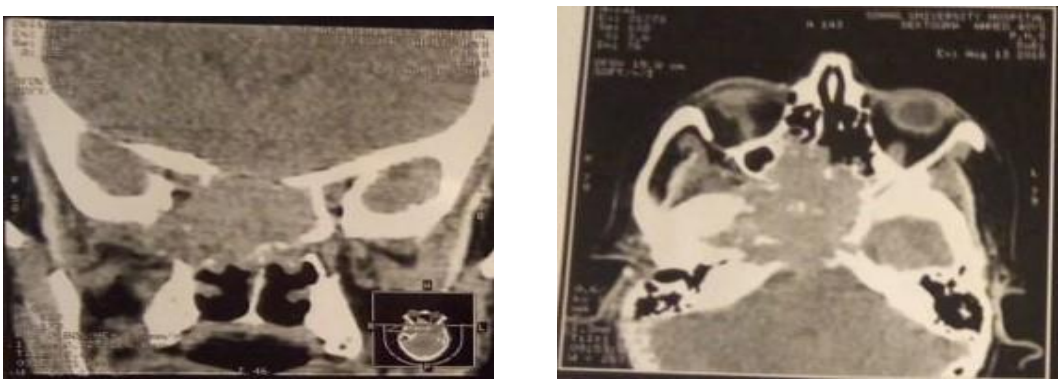

Fig. 14: C.T nose and paranasal sinus showing isolated sphenoid sinus fungal sinusitis

Table 7: Postoperative radiological evaluation and follow-up:

Segment		n = 21
Postoperative MRI residual lesion		
• Yes	▪ Minimal Lesion (1*1 cm)	2 (9.5%)
	▪ Very Minimal Lesion (5*5 ml)	2 (9.5%)
• No		17 (81%)
Recurrence	• Yes	1 (4.8%)
	• No	20 (95.2%)

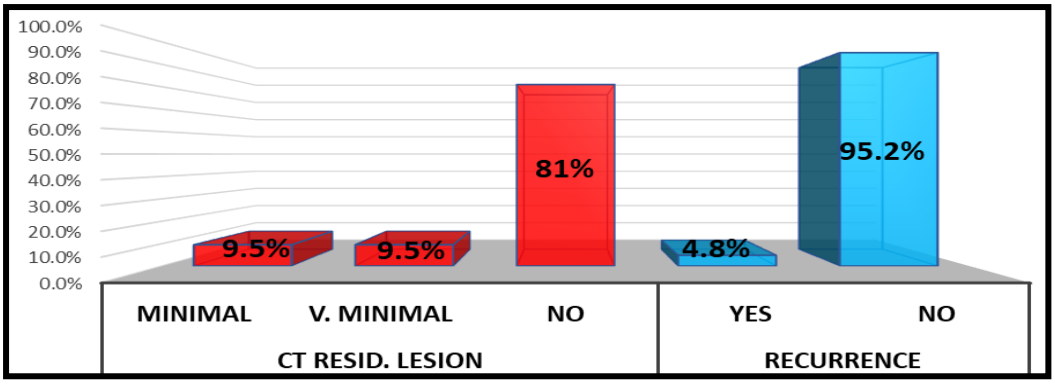

Fig. 15: Postoperative radiological evaluation and follow-up of the studied patients.

All patients were subjected to pos-toperative radiological evaluation to detect any residual lesions. 18 patients (81%) have no significant residual, and 4 patients with pituitary adenomas had very minimal residual which has no clinical significance. In certain cases, complete removal of the tumor was inaccessible as the tumor was encasing the internal carotid artery or there was cavernous sinus extension.

During the 6 months of follow-up, only one patient (4.8%) with pituitary ad-enoma developed recurrence discov-ered on routine radiological evaluation. The lesion had suprasellar extension encasing the internal carotid artery bilateral. the patient was subjected to a gamma knife **(Fig. 15).**

Discussion

Diagnosis of isolated sphenoid sinus disease necessitates a high index of suspicion, as well as the utilization of diagnostic nasal endoscopy and radiologic imaging. Nasal endoscopy is a very important tool to reach a proper diagnosis A mass arising from the sphenoid sinus or the spheno-ethmoidal recess may be visible. Nasal endoscopy is particularly important for determining the exact location of a CSF fistula within the sphenoid sinus [(9).]

Trans-nasal trans-sphenoid endoscopic approach is a safe and effective approach for gaining access to the sphenoid sinus. Delay in proper diagnosis and management can be fatal due to proximity to vital structures of the skull base. Endoscopically controlled procedures for the sphenoid sinus provide the surgeon with a clear alternative to the traditional approaches [(10)] . The minimally invasive trans-nasal trans-sphenoid endoscopic approach for management of sellar lesions allows for safe tumor removal under direct vision, in the long term, this will result in a higher surgical radicality [(11)] .

Although the view is two-dimensional, the endoscopic guided trans-sphenoidal approach provides a more panoramic picture. Angled endoscopes improve the surgeon's visibility of the lateral extent of large tumors in the suprasellar area, allowing them to work more successfully at the field's edges. The suprasellar compartment and the medial portion of the cavernous sinus may be more accessible to the surgeon, allowing larger invasive tumors to be removed under direct vision. The 4-hands technique can be done by endoscopic approach, both otolaryngologist and neurosurgeon can use their 2 hands in the operative field. The main advantage of the trans-nasal trans-sphenoid endoscopic approach was that the 45-degree angled lens allowed direct visualization of hidden anatomical corners such as the diaphragma sella and the suprasellar region. The corners of the sella and sphenoid sinus are directly visualized

by rotating the angled lens endoscope. It gives a panoramic image of the sphenoid sinus, showing the bony protuberance of the optic nerves and carotid arteries. The endoscope's use in sinonasal surgery has expanded dramatically over the last two decades [12] .

Our study included 21 patients**,** 11 of them had isolated sphenoid sinus lesions and 10 patients had pituitary adenomas with an age range was (20-66) years with a mean age of (39.76 ± 12.1) years; and male to female ratio was 1.6 to 1. This comes in agreement with Nour and his colleagues who studied the age and sex-specific prevalence of isolated sphenoid sinus lesions. forty patients with isolated sphenoid sinus lesions were reviewed. There were 23 males (57.5 %) and 17 females (42.5%) with an age range of 8–70 years (mean 38.6 ±17.98 years) [13] . Also, our study results come in agreement with Nasseri and his colleagues who reviewed 180 patients with pituitary adenomas approached by direct trans-nasal trans-sphenoidal endoscopic approach; 94 males (52.5%) and 86 females (47.7%) with a mean age at operation of 51.4 years (range, 15–86 years) [14] .

Isolated sphenoid sinus lesions are uncommon, usually develop slowly, and can cause nonspecific symptoms such as headache and visual abnormalities. The most common presenting symptom is headache, which can occur in both inflammatory and expansile sphenoid sinus lesions [15] . Because the sphenoid sinus is closely related to the vidian, optic, abducens, and maxillary nerves; neurological symptoms and signs such as diplopia, ptosis, facial numbness, diminished visual acuity, and visual field abnormalities might be the first signs of a sphenoid sinus lesion [16] . The optic nerve frequently protrudes into the sinus, and the bony wall of the sinus may be thin or even dehiscent [17] . Regardless of the pathological nature of isolated sphenoid sinus lesions, a visual disturbance was reported; therefore, there is widespread agreement that early diagnosis of isolated sphenoid sinus lesions through a high index of suspicion and timely radiological evaluation will reduce the risk of permanent neuro-ophthalmological sequelae [13] .

In our study, the main preoperative presentation was headache and deterioration of vision; 18 patients (85.7%) had headache at the time of their presentation and 13 patients (61.9%) had visual abnormalities including a decrease in visual acuity, visual field defects, diplopia and limitation in ocular motility. This comes in agreement with The Medical College of Wisconsin study which included 29 patients with isolated sphenoid sinus lesions; who reported that headache was the most prevalent symptom in 20 patients (69%) among all patients, unilateral nasal obstruction in 7 patients (24%), decreased visual acuity or diplopia in 6 patients (21%), facial pain in 5 patients (17%), purulent rhinorrhea in 3 patients (10%) [18] .

Atkinson Morley's hospital study, the largest study of preoperative symptomatology in 260 patients with pituitary adenomas, the headache was recorded as a symptom in two-thirds of the patients. Reduction in the size of the visual fields was more noticeable than the reduction in visual acuity, the most common problem was the loss of vision in one or both temporal fields; this occurred in 86 % of cases [19] .

Radiological evaluation (including CT nose and paranasal sinuses, MRI nose and paranasal sinuses, and MRI brain) has a very important role in the diagnosis of patients with isolated sphenoid sinus lesions in our study. This comes in agreement with ***Aaron Friedman*** and his colleagues who stated that in patients with normal endoscopy; CT scanning represents a complemen-

tary tool in diagnosis. It also can help delineate the full extent of disease, especially in patients with tumors. In patients scheduled for endoscopic sinus surgery, routine use of a CT scan is recommended to effectively define the sphenoid sinus pathology. Based on endoscopic and CT findings; the most common indication of magnetic resonance imaging (MRI) was a sphenoid mass. To rule out cavernous venous thrombosis, a magnetic resonance venogram is indicated [(9)] .

All our studied patients were subjected to pre-operative ophthalmological evaluation. 13 of them (61.9%) had abnormal ophthalmologic evaluation including a decrease in visual acuity, visual field defects, affection of ocular motility, and optic neuritis; (7 of those patients had pituitary adenomas, 2 patients had sphenoid sinus mucoceles, 2 patients had isolated sphenoid sinus fungal sinusitis, one patient had sphenoid sinus granulomatous lesion and one patient had sphenoid sinus squamous cell carcinoma). This comes in agreement with *P. Castelnuovo who* studied 41 patients with isolated sphenoid sinus lesions. He stated that 7 patients (17%) had abnormal findings in preoperative ophthalmological evaluation; (3 patients had sphenoid sinus fungal sinusitis, 3 patients had a spheno-choanal polyp and one patient had chondrosarcoma of the sphenoid sinus) [(10)] .

Wang's study, 2008 studied 201 patients with pituitary adenomas (402 eyes). Visual field defects were observed in 155 eyes (38.5%) and visual acuity defects in 166 eyes (41.3%) of the 402 eyes examined [(20)] .

The higher incidence of pre-operative visual abnormalities in our series than in other studies in literature can be explained by the late presentation of our patients. Visual abnormalities are important alarming signs which affect the patient's quality of life and interfere with his work.

When a pituitary tumor becomes large enough to compress the optic chiasm, it causes visual disturbances. When chiasmal compression reaches a certain level, this becomes apparent. Furthermore, if the tumor grows laterally rather than vertically, visual affection is more severe [(21)] .

The pre-operative hormonal assay was done for all patients with pituitary adenomas (10 patients), 7 of them (70%) had a normal hormonal profile (non-secretory pituitary adenoma), 2 of them (20%) had high prolactin level (prolactinoma) and one patient (10%) had high ACTH level (adrenocorticotropic hormone-secreting adenoma). Our results are matching to *Kovacs* and his colleagues, a substantial number of pituitary adenomas are clinically nonfunctioning, and they are not associated with clinical and biochemical evidence of hormone excess [(22)] .

We used a **direct trans-nasal trans-sphenoid endoscopic approach** in all patients. the safety of the direct transnasal trans-sphenoidal endoscopic approach is based on some basic surgical principles: 1) precise sphenoid sinus landmarks must be identified, particularly the posterior end of the middle turbinate; 2) the ostium of the sphenoid sinus must be located in the sphenoethmoidal recess between the septum and the superior turbinate, and 3) a safe distance from the orbit and the anterior cranial fossa must be maintained [(23)] . *Enrico de Divitiis* stated that the standard endoscopic trans nasal trans-sphenoidal procedure allows very wide exposure of the sellar, parasellar, and suprasellar regions, and has proven to be extremely beneficial in the treatment of the vast majority of lesions in this area. [(24)] .

The traditional external surgical approach for benign and isolated sphenoid sinus lesions is no longer used because

of external scarring and potential cosmetic deformity, severe intraoperative bleeding and longer hospital stay. Nowadays, the authors prefer the direct endonasal endoscopic approach in inflammatory disease and in mucoceles. The trans-ethmoidal endoscopic approach is still required in patients with tumors or when there is a need for a wide exposure (for instance in fungal pathology). Endonasal endoscopic routes are nowadays the gold standard for sphenoid sinus surgery, and the endoscopic approach is a safe and effective technique enabling an excellent visualization of the whole sinus inducing less surgical trauma and consequently offering better functional outcome in a long-term follow-up [10].

One common disadvantage for all approaches, except direct trans-nasal, is that they require surgical violation of other structures, such as other sinuses or the nasal septum, to approach the sphenoid sinus itself. This procedure may be appropriate in patients in which those structures require simultaneous exploration. However, if the sphenoid sinus is the only sinus that requires exploration, violation of other structures may have some degree of unnecessary morbidity [13] .

In our study, The Inter-sphenoid sinus septum was removed in 15 patients (71.4%) to allow full exposure and complete eradication of the pathology. This comes in agreement with ***Enrico de Divitiis et.al.*** study, they removed inter-sphenoid sinus septum in their standard endoscopic direct trans-nasal trans-sphenoid approach for trans-nasal trans-sphenoidal hypophysectomy for their series of pituitary adenoma patients [24].

Gustavo Hadad's study stated that the Hadad flap technique (pedicled nasoseptal flap) is a novel technique using a neurovascular pedicled flap of the nasal septum mucoperiosteum and mucoperichondrium based on the nasoseptal artery, a branch of the posterior septal artery and the terminal branch of the internal maxillary artery. It is a reliable reconstructive technique for defects of the anterior, middle, clival, and para-sellar skull base. Its use has resulted in a significant reduction in the incidence of postoperative CSF leakage after expanded endonasal approaches [25]. ***In our study,*** this technique was done in all patients with pituitary adenomas (10 patients, 47.6%), and 2 of them had intra-operative C.S.F leak.

Enrico de Divitiis et.al. study, 2002 stated that when the working room is inadequate or the approach angle to the lesion is unfavorable for proper surgical actions, in terms of view or instrument maneuverability. This is the case for different conditions for which a bilateral endoscopic endonasal approach can be employed successfully, with some benefits and no further nasal damage. ***In our study,*** the bilateral nasal approach was used in 14 patients (66.7%), (10 patients with pituitary adenomas, 2 patients with isolated sphenoid sinus fungal sinusitis, and one patient with sphenoid sinus granulomaatous lesion and one patient with sphenoid neoplastic lesion). A bilateral nasal approach was used to allow a 4-hands technique in which both otolaryngologist and neurosurgeon could use their 2 hands in the operative field.

One patient only in our study with pituitary adenoma developed postoperative blindness due to optic neuritis which had no direct relation to the performed surgical procedure. The condition improved within one month after a full dose of systemic steroids. This comes in agreement with ***Socher et al*** study, ***(2008)*** which reviewed 109 patients with isolated sphenoid sinus lesions subjected to a direct trans-nasal trans-sphenoid endoscopic approach and stated that almost all patients had no complications and in a three-year follow-up, the patients were cured with

no complications or relapse [26]. Our results are comparable to ***Linsler et. al (2013)*** who reviewed 210 patients with pituitary adenomas and other sellar lesions who underwent a direct trans-nasal trans-sphenoid endoscopic approach, there was no mortality, no severe or hazardous permanent sequelae [11].

Headache, retro-orbital pain or facial pain, and visual symptoms were the main presentations of our patients, although their examination had minimal endoscopic findings. Their full diagnosis was achieved by CT scan and MRI and this validates the importance of radiologic evaluation for the diagnosis of those patients. This comes in agreement with the literature. ***Filippo Giovannetti's study, 2008*** reviewed 75 patients with isolated sphenoid sinus mucoceles, all those patients had minimal endoscopic findings, and the diagnosis was based on radiological evaluation by CT and MRI nose and paranasal sinuses [27].

During the 6 months ***of follow-up,*** only one patient (4.8%) with pituitary adenoma developed recurrence discovered on routine radiological evaluation, and the patient was subjected to gamma knife; The lesion had suprasellar extension encasing internal carotid artery bilateral. ***Our results are comparable to Laurent Gilain (1994),*** who reviewed 12 patients with isolated sphenoid sinus lesions, his study stated that there were good results in all cases [29].

Conclusion

Diagnosis of isolated sphenoid sinus disease requires a high index of suspicion as well as the utilization of diagnostic nasal endoscopy and radiologic imaging. The main presentation of patients with isolated sphenoid sinus lesions and pituitary adenomas is headache and or visual symptoms. These symptoms are nonspecific, and diagnosis can be easily missed. So, a high index of suspicion and radiological assessment is mandatory. The direct trans-nasal trans-sphenoid endoscopic approach is the preferred method for optimal surgical management of patients with isolated sphenoid sinus and sellar lesions.

References

1- V. budu, Carmen aurelia mogoantă, B. fănuţă, I. bulescu "The anatomical relations of the sphenoid sinus and their implications in sphenoid endoscopic surgery." Romanian Journal of Morphology & Embryology. 2013; 54(1): 13-16.
2- Domenico solari, Luigi maria cavallo, and Paolo cappabianca "Surgical approach to pituitary tumors." Handbook of Clinical Neurology, 2014; vol.124: 291-301.
3- Aaron K. Remenschneider, Laura D'Amico BS, Stacey T. Gray, Eric H. Holbrook, Richard E. Gliklich, Ralph Metson "The EQ-5D: a new tool for studying clinical outcomes in chronic rhinosinusitis." The laryngoscope. 2015; 125(1): 7-15.
4- Ashok Asthagiri, M. Beatriz S. Lopes "Neuropathological considerations of pituitary adenomas." Pituitary Surgery – A Modern Approach, 2006; 34: 206-235.
5- Wolfgang Saeger, Dieter K Lu¨ decke, Michael Buchfelder, Rudolf Fahlbusch, Hans-Ju¨rgen Quabbe and Stephan Petersenn "Pathohistological classification of pituitary tumors: 10 years of experience with the German Pituitary Tumor Registry." European Journal of Endocrinology, 2007; 156(2): 203-216.
6- Xuefei Shou, Ming Shen, Qilin Zhang, Yichao Zhang, Wenqiang He, Zengyi Ma et.al, "Endoscopic endonasal pituitary adenomas surgery: the surgical experience of 178 consecutive patients and learning curve of two neurosurgeons." BMC Neurology, 2016; 16(1): 1-8.
7- Deepak Regmi, Amit Thapa, Bidur KC, Bikram Shakya "Endoscopic endonasal transsphenoidal approach to

pituitary adenoma: a multi-disciplinary approach." J Nepal Health Res Counc, 2017; 15(2): 174-177.

8- Robert John, Nicholas Hirsch "Pituitary disease and anesthesia." Anaesthesia & Intensive Care Medicine, 2014; 15(4): 185-188.

9- Aaron Friedman, Pete S. Batra, Samer Fakhri, Martin J. Citardi, and Donald C. Lanza "Isolated sphenoid sinus disease: etiology and management." Otolaryngology-Head and Neck Surgery, 2005; 133(4): 544-550.

10- Paolo Castelnuovo, Fabio Pagella, Lucia Semino, Francesca De Bernardi, Giovanni Delù "Endoscopic treatment of the isolated sphenoid sinus lesions." Eur Arch Otorhinolaryngol, 2005; 262(2): 142-147.

11- Stefan Linsler, Michael Robert Gaab, Joachim Oertel "Endoscopic endonasal transsphenoidal approach to sellar lesions: a detailed account of our mononostril technique." Journal of Neurological Surgery part B, 2013; 74(03): 146-154.

12- P. Cappabianca, A. Alfieri, E. de Divitii, "Endoscopic endonasal transsphenoidal approach to the sella: towards functional endoscopic pituitary surgery (FEPS)." Minim Invasive Neurosurg 1998; 41(2): 66-73 41(02): 66-73.

13- Yasser Ahmed Nour, Ayman Al-Madani, Ahmed El-Daly, Alaa Gaafar "Isolated sphenoid sinus pathology: spectrum of diagnostic and treatment modalities." Auris Nasus Larynx, 2008; 35(4): 500-508.

14- Shawn S. Nasseri, Jan L. Kasperbauer, Scott E. Strome, Thomas V. McCaffrey, John L. Atkinson, and Fredric B. Meyer "Endoscopic transnasal pituitary surgery: report on 180 cases." American Journal of Rhinology, 2001; 15(4): 281-287.

15- **15)** Dharambir S. Sethi "Isolated sphenoid lesions: diagnosis and management." Otolaryngology-Head and Neck Surgery, 1999; 120(5): 730-736.

16- Si Whan Kim, Dae Woo Kim, Il Gyu Kong, Dong-young Kim, Seok-Won Park, Chae-Seo Rhee & Yang-Gi Min "Isolated sphenoid sinus diseases: report of 76 cases." Acta Oto-Laryngologica, 2008; 128(4): 455-459.

17- Naoyuki kanoh, Renzong Xu, Zheng-Min Wang, Chun-Fu Dai, Fang-Lu Chi, David L. Kutler et.al, "Isolated sphenoid sinus disease: an analysis of 122 cases." Ann Otol Rhinol Laryngol, 2002; 111(4): 323-327.

18- Timothy J. Martin, Timothy L. Smith, Michelle M. Smith, Todd A. Loehrl "Evaluation and surgical management of isolated sphenoid sinus disease." Arch Otolaryngol Head Neck Surg.,2002; 128(12): 1413-1419.

19- S. G. Elkington "Pituitary adenoma. Preoperative symptomatology in a series of 260 patients." Brit. J. Ophthal. ,1968; 52(4): 322.

20- Hanbin Wang, Wei Sun, Zhuang Fu, Zhichao Si, Vufang Zhu, Guode Zhai et.al, "The pattern of visual impairment in patients with pituitary adenoma." The Journal of International Medical Research, 2008; 36(5): 1064-1069.

21- H. Ikeda, T. Yoshimoto "Visual disturbances in patients with pituitary adenoma." Acta Neurologica Scandinavica, 1995; 92(2): 157-160.

22- Kalman Kovacs, Eva Horvath and Sergio Vidal "Classification of pituitary adenomas." Journal of Neuro-Oncology**,** 2001; 54(2): 121-127.

23- Laurent Gilain, Didier Aidan, Andre' Coste, and Roger Peynegre, "Functional endoscopic sinus surgery for isolated sphenoid sinus disease." Endoscopic Surgery of Sphenoid Sinus Head & Neck, 1994; 16(5): 433-437.

24- Enrico de Divitiis, Paolo Cappabianca, Luigi Maria Cavallo "Endoscopic transsphenoidal approach: adaptability of the procedure to different sellar lesions." Neurosurgery, 2002; 51(3): 699-707.

25- Gustavo Hadad, Luis Bassagasteguy, Ricardo L. Carrau, Juan C. Mataza, Amin Kassam, Carl H. Snyderman, Arlan Mintz"A novel reconstructive technique after endoscopic expanded endonasal approaches: vascular pedicle nasoseptal flap."Laryngoscope, 2006; 116(10): 1882-1886.

26- Jan alessandro socher, Michele cassano, Claudeomiro Augustino

filheiro, Pasquale cassano & Alexandre felippu ″Diagnosis and treatment of isolated sphenoid sinus disease: a review of 109 cases." Acta Oto-Laryngologica ,2008; 128(9): 1004-1010.

27- Filippo Giovannetti, Fabio Filiaci, Valerio Ramieri, Claudio Ungari "Isolated sphenoid sinus mucocele: etiology and management." The Journal of Craniofacial Surgery, 2008; 19(5): 1381-1384.

28- I. Tsitouridis, M. Michaelides, A. Bintoudi, V. Kyriakou "Frontoethmoidal mucoceles: CT and MRI evaluation." The Neuroradiology Journal, 2007*;* 20(5): 586-596.

29- Laurent Gilain, Didier Aidan, Andre' Coste, and Roger Peynegre "Functional endoscopic sinus surgery for isolated sphenoid sinus disease." Endoscopic Surgery of Sphenoid Sinus Head & Neck, 1994; 16(5):433-437.