Kufa Medical Journal | Vol. 18, No. 2, 2022

Original article | DOI: https://doi.org/10.36330/kmj.v18i2. 10385

Submitted at: 22 oct. 22
Accepted at: 5 Nov. 22

Evaluating Skull base Defect Reconstruction after Endoscopic Transsphenoidal Approach among Iraqi Patients

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Abstract

Background: Endoscopic skull base surgery is a well-established technique for the treatment of skull base pathologies. Once the resection is complete, reconstruction of the sellar floor is performed. Fat and fascia lata are used in an underlay fashion and then the dural sealant is placed over the repair.

Aim of the study: The study aims to assess the reconstruction of skull base defects after trans sphenoidal endoscopic surgery.

Patients and Methods: A total of 15 patients, 11 females & 4 males, were exposed to a cross-sectional study. The age of the participant ranged between 13 to 73 years old. The present work was carried out at Al-Hayat Private Hospital for the period starting from October 2017 to October 2021. All patients were followed up for at least 6 months' duration to assess the final outcome of the surgical operation. All the patients were informed of the aim of the study and they willingly agreed to participate; written consents were obtained from all of them.

Results: No CSF leak happened postoperatively in the patients. In spite of the small group of patients in the study, it can be concluded that the way of reconstructing the skull base has been effective

Key words: Skull base defects, Skull base pathology, trans sphenoidal.

Introduction

The nose develops from a number of mesenchymal processes around the primitive mouth during the fourth week of gestation. Collections of neural crest cells undergo proliferation and form the nasal placodes. Sinking of the nasal placodes leads to formation of the nasal pits which further deepen to form the nasal sac. Adjacent mesoderm cells proliferate to give rise to the medial and lateral nasal prominences of the frontonasal process which surround the nasal pit and sac to eventually become the nares. The maxillary processes grow anteriorly and medially to fuse with the medial nasal prominences and frontonasal process to close off the nasal pits and form separate nasal cavities. The primitive nasal cavity and mouth are initially separated by the bucco nasal membrane which gradually thins as the nasal sacs extend posteriorly and eventually breaks down to form the choanae. The lateral nasal prominences form the nasal bones, upper lateral cartilages and lateral crus of the lower lateral cartilages[1]. Tumors and pathologies in the skull base are a challenging problem to all surgeons due to difficult approaches and access in addition to high morbidity and mortality rate. With the increase in the popularity of skull base surgeries , transsphenoidal endoscopic surgery become important and used technique due to its flexibility with respect to classical techniques. These approaches allow to widen the surgical management horizon for many tumors even the more aggressive ones. However, reconstruction after resection in skull base surgeries and its potential for complications could affect patients quality life and satisfaction with the outcome[2,3]. Therefore, the present study tried to evaluate the procedure of reconstructing the skull base defects after transsphenoidal endoscopic surgery among 15 Iraqi patients who were operated on; data were collected in combined (retro-prospective) design.

Patients and Methods

Study design

This cross sectional study has been conducted during the period from 2017 to 2021 with follow up for 6 months duration. All cases performed at Al-Hayat Private Hospital in Najaf. All participants were informed about the study, and a written consent was obtained. A total of 15 patients, 11 females & 4 males, whose age ranged between 13 to 73 years, were included in this study.

Inclusion criteria

The patients subjected to present study were exposed to the same criteria which include :

a- preoperative evaluation
b- Surgical technique
c- Post-operative management

Exclusion criteria:

None.

Preoperative assessment

The following parameters were adopted prior to all the surgical protocol. Again, the same parameters were monitored for up to six months after the surgery .

Clinical parameters:

Signs and symotoms: like headache,, double vision watery rhinorrhea, etc.

Hormonal Analysis: The analysis included testosterone, follicle stimulating hormone (FSH), estradiol, cortisol, free thyroxin, corticotrophin, luteinizing hormone (LH), prolactin (PRL), thyrotropin (TSH), and growth hormone (LH).

Imaging:

Magnetic resonance imaging (MRI): All the patients were exposed to MRI to identify precisely tumor criteria prior to surgical intervention. Again, the patients were

referred for Coronal and axial computerized tomography (CT) where a CT scan helps in the evaluation of nasal cavity and paranasal sinuses anatomy, type of sphenoid sinus pneumatization and the attachment of its septa.

Ophthalmologic examination:
This examination was applied to symptomatic patients with optic chiasma compression.

procedure:
All cases were undergoing surgical operations under general anesthesia with endotracheal tube, and placement of throat pack. Endoscopic sinus surgery and skull base surgery sets should be prepared. The patient is placed in the supine position, with the operating table raised to 30 degrees and the head slightly extended is performed under general anesthesia with safe hypotension, maintaining a mean arterial pressure of approximately 70mm Hg. lumbar drain during and after the operation in all the patients were not put.

A 4 mm diameter and 180 mm length rigid endoscope, with zero, 30 and 45-degree lenses, applied to variable steps of the surgery were used. All patients underwent extended endoscopic end nasal transsphenoidal surgeries (EETS) which include the following steps :

A- a two nostril approach
B- removal of the middle turbinate
C- posterior septectomy
D- excision of vomer and sphenoid sinus walls to enable a wide access of the skull base for the so called four handed, two surgeons approach .
E- The sphenoid bone plenum, tuberculum Sella and upper and mid thirds of the clivus were dissected relative to the tumor invasion.
F- Multiple layer reconstruction was carried out for the repair skull base defect by using adipose tissue graft, fascia lata graft, (Gelfoam®) and dural sealant (Duraseal®).
G- fascia lata and/or fat were harvested by superolateral thigh incision.

The defects of the dura and the sella were plugged tightly with the fat and fascia lata and enforced by gelfoam and Duraseal. The fascia lata graft applied both intradural and extradural. Finally, the Duraseal was applied to the area and occluding the sphenoid sinus with the Duraseal .

The Dura Seal Sealant system consists of two dilute aqueous precursor liquids that crosslink to form a solid gel within 1-2 seconds of spraying. The resulting polyethylene glycol (PEG) based hydrogel sealant is adherent to tissue, strong enough to withstand elevated CSF pressures during the dura heals, and then breaks down and absorbs within 4-8 weeks. Following absorption, the liberated PEG molecules are then cleared primarily through the kidneys.

The gel also contains Blue dye, which allows accurate determination of applied sealant thickness and coverage. The PEG based hydrogel composition makes the sealant highly tissue compatible

All patients admitted to the ward, had Merocel® nasal packs inserted and removed at day 5 postoperatively, then the patients were discharged home (at day 6), and advised to have bed rest & avoid exercises and heavy lifting, and taken the following treatment:

A. Intravenous triple antibiotic (cephalosporin, gentamicin and metronidazole) .
B. Acetaminophen infusion on need.
C. Acetazolamide 500mg injection
D. Dexamethasone ampule
E. Desmopressin (in those who develop Diabetes Insipidus).
F. And patients are monitored for vital signs and measuring the urine output.

Post- operative assessment:
All patients assessed postoperatively at 10 days, 1st month, 3rd month and 6th month for monitoring the following parameters:

1 (-symptoms of hypotension and diabetes insipidus .
2 (-Hormonal Analysis:
The analysis included testosterone, follicle stimulating hormone (FSH), estradiol, cortisol, free thyroxin, corticotrophin, lutei-nizing hormone (LH), prolactin (PRL), thyrotropin (TSH) & growth hormone (LH).
3- (Imaging by MRI: To evaluate the extent of surgical resection.
4- (Ophthalmologic examination: This examination was applied to symptomatic patients with optic chiasma compression.
5- (-Histology biopsy was taken from the lesions for histopathological examination .

Statistical analysis:
All the obtained data were statistically evaluated by using statistical package for social sciences (SPSS version 26). Variables presented as frequencies (No.), percentages, mean and standard errors accordingly. Mean scores for items calculated as the average score of responses of patients toward items out of 6. Overall mean score calculated as the average of mean score for all items. Fisher's exact test was used to compare frequencies while Wilcoxon non-parametric test was used to compare the mean scores (pre vs. post-operative). Level of significance set at 0.05 and less to be significant. Finally, results were presented in tables and figures with an explanatory paragraph for each by using Microsoft Office Word and Excel Software version 2016.

Results

A total of 15 patients were enrolled in this study with a mean age of 36 (range: 13 – 73) years. Females were dominant with a ratio of 2.75 to one, (Table 1).

A computed tomography scan revealed that Pituitary macroadenoma was the more frequent detected pathology among the studied group which contributed to about 53.3% (8/15). Left sphenoid sinus mass in 2 patients (13.3%), other findings are less frequent, (Table 2).

Magnetic resonance imaging revealed macroadenoma, Invade Right cavernous sinus, encase carotid artery in 3 (20%) of patients for each, Press on optic chiasma in 2 (13.3%) patients; other findings are less frequent, in one patient for each (Table 3).

Macroadenoma was the more frequent Histopathological finding, it was reported in 7/15 (46.7%), Prolactinoma in 2 patients (13.3%), other findings are less frequent, in one patient for each, while 4 patients (26.7%) had negative Histopathological finding, (Table 4).

Table 5 shows a significant change in the mean score of patients' concerns about their appearance; it improved from a score of 4 to 5.7 postoperatively, (P. value < 0.05, significant). Also there was an improvement in concerns about weight and change in skin appearance but the difference did not reach statistical significance (P>0.05, not significant); patients reported that they did not have any concerns regarding easy bruising at pre- and postoperative, in both the mean score was 6/6. However, the comparison of overall mean score of patients concern revealed a significant increase (improvement); 5.05 at preoperative to 5.88 postoperative, (P<0.05), (Table 5). This was included in the patient's questionnaire to evaluate the effect of pituitary adenomas on the patient quality of life and post operatively and to assess patient improvement clinically.

Table 1. Age and gender distribution of the studied group

Variable		Value
Age (year)	Mean	36.0
	SD	15.9
	Range	13 – 73
Gender N (%)		Female 11 (73.3)
		Male 4 (26.7)

Table 2. Preoperative - Computed tomography scan findings of the studied group

CT finding	No.	%
Pituitary macroadenoma	8	53.3
Left sphenoid sinus mass	2	13.3
RT ethmoid sinus defect	1	6.7
Micradenoma	1	6.7
Mass in the right ethmoid extend to skull base	1	6.7
Defect in roof of RT.ethmoid sinus	1	6.7
CSF leak ,defect in right sphenoid sinus	1	6.7
Total	15	100.0

Table 3. Preoperative-Magnetic resonance imaging findings of the studied group

MRI finding	No.	%
Macroadenomas confined to the sella turcica	3	20.0
Macroadenomas with cavernous sinus invasion and/or carotid encasement	3	20.0
Macroadenomas compressing the optic chiasm	2	13.3
Ethmoid mass with intracranial extension	1	6.7
Defect with meningocele	1	6.7
CSF leak	1	6.7
Craniopharyngioma	1	6.7
Microadenoma	1	6.7
Left sphenoid meningoencephalocele	1	6.7
Defect with no meningocele	1	6.7
Total	15	100.0

Table 4. Preoperative -Histopathological findings of the studied group

Histopathology finding	No.	%
Macroadenoma	7	46.7
Prolactinoma	2	13.3
Craniopharyngioma	1	6.7
Extracranial meningioma	1	6.7
None	4	26.7
Total	15	100.0

Table 5. Comparison of pre and post-operative scores of patients' concerns

Item	Preoperative		Postoperative		P. value
	Mean	SE	Mean	SE	
Appearance	4.0	0.72	5.7	0.12	**0.026 ***
Weight	5.4	0.41	5.9	0.07	0.109
Changes in skin appearance	4.8	0.64	5.9	0.09	0.084
Easy bruising	6.0	0.00	6.0	0.00	1.00
Overall mean score for all items	5.05	0.39	5.88	0.07	0.025*

Score range 0-6, with 0 score for Too much concern about item, 6 score for not at all, *significant difference, SE: standard error of mean

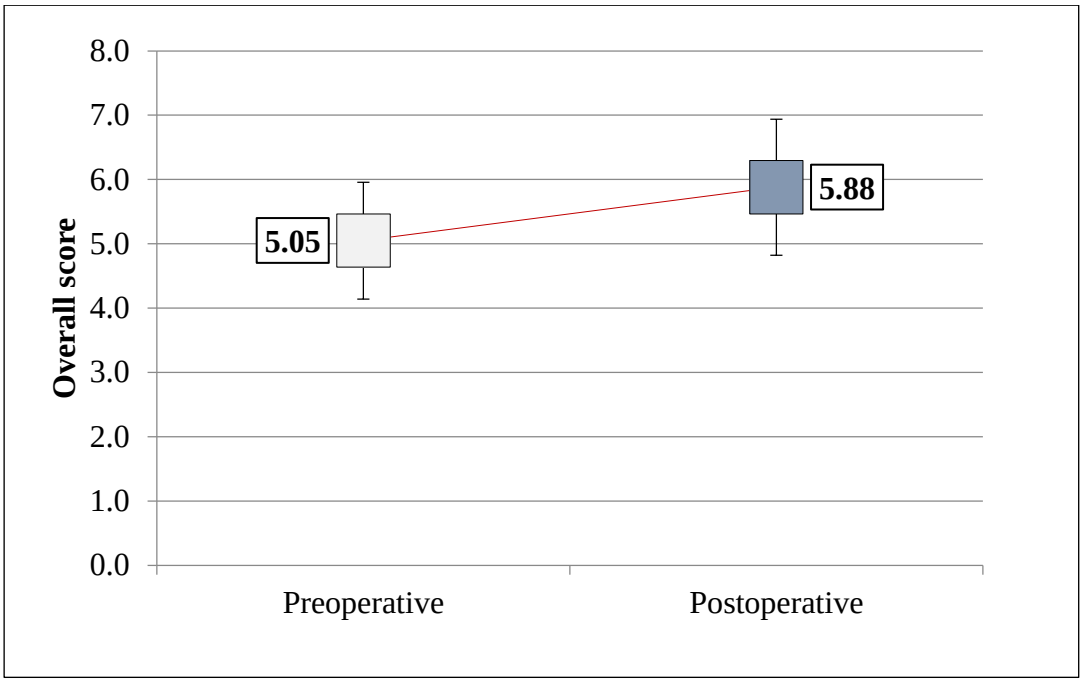

Figure1. A Comparison of pre- and post-operative overall scores of patients' concerns

There is a significant change in the mean score of patients' condition when they asked to rate the interference of their problem with their activities and life. In all items, the patients' scores increased significantly at postoperative evaluation, and the overall mean score was 1.89 at preoperative improved significantly to 5.78 at postoperative (P=0.001) about their appearance; it improved from a score of 4 to 5.7 postoperatively (P. value < 0.05, (Figure 1).Fig. 2 summarizes the mean scores of patients' problem at pre- and postoperative, where Headache, Rhinorrhea and Peripheral vision improved significantly (P<0.05). Other items were also improved where none of the patients further experienced a problem, at postoperative, but the difference did not reach the statistical significance. From a preoperative point of view, in some items such as crustations, diplopia, muscle weakness, swallowing food , irritability and inability to control anger, patients had no problem at all. The overall mean score for all items was improved but the difference was statistically insignificant, (Figure 2).

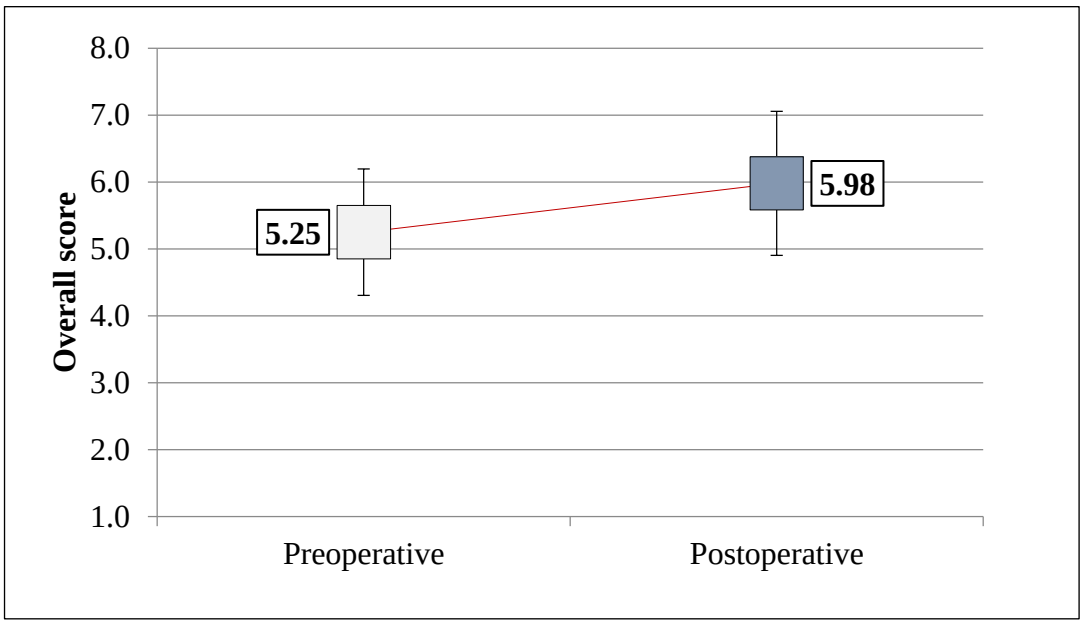

Figure 2: Comparison of pre and post-operative overall scores of patients' problems

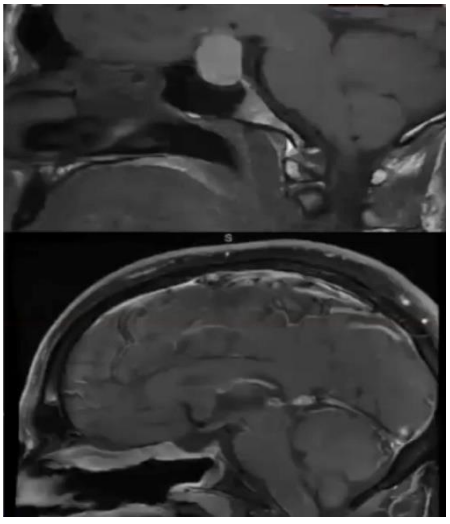

Figure 3. pituitary gland adenoma pre and postoperatively.

Figure 4. traumatic anterior skull base defect.

Discussion

It is well documented by many institutes that tumors and pathologies which affect skull base are too difficult to manage and considered to be the most obstacles to the majority of the surgeons. These obstacles attributed to the difficult approaches in addition to the high mortality and morbidity rates.

However, those difficulties have been eased by the invention of endoscopic trans sphenoid approaches which led to a lower rate of morbidity and mortality as a consequence[4] of the above approaches. The present study aims to evaluate the procedure of reconstructing skull base defects after trans sphenoidal endoscopic surgery among 15 Iraqi patients who were operated on. The data were collected in combined (retro-prospective) design (Table 1). The findings showed that the morbidity was significantly improved. They are in line with other investigators who reached the same conclusion [4].

On the other hand, CSF rhinorrhea is the most common complication following trans sphenoidal surgery (TSS) for pituitary tumors resection [4]. As a matter of fact, the cerebrospinal fluid leak through the nose is considered to be a popular problem that could be noticed after any trans sphenoid approach[4]. It has been shown equivocally that the frequency of this complication was in the range of 0.5% up to 15.0%. The non-adenoma tumor plus the existence of any leak during surgery associated with higher incidence of leak postoperatively in TSS. However, in the revision cases, it has been shown that the risk also increases if the patients exposed to radiotherapy [4]. However, according to the present study, the incidence of CSF leak is of zero percentage (0%) which attributed mostly to the low number of sample or low pressure pathologies or related to type of the reconstructed technique.

Furthermore, it has been reported that the incidence of Meningitis complication is about 0,4% - 9% [5]. Indeed, in the present study, no postoperative meningitis has been noticed because of either the absence of CSF leak in the present cases or probably the use of triple antibiotics which has been adopted in here though other investigations revealed that any postoperative CSF after leak could be an important factor for the presence of Meningitis after surgical operation [6]. On the other hand, further work reported a rare complication of postoperative CSF leak after the TSS (tension pneumo-

cephalus)[7]. No tension pneumocephalus complication was noticed during the course of the present investigation. It has been reported that Meticulous closure of the sellar defect has been applied to minimize or prevent any complications. Thus, cartilage, adipose tissue etc. has been used widely for Sella turcica reconstruction. This approach obviously aimed at preventing any postoperative CSF fistulas [8,9]). Indeed, the present study stress the use of fat, facia lata grafts, and dural sealant during skull base defect repair.

Conclusions:

The present study is in favor of the combination of fat graft, fascia lata graft, duraseal and gelfoam in the endoscopic repair of skull base defect though a much larger sample is highly recommended before any final conclusion could be reached.

Competing interests:

We have no competing interest to declare.

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