



Sellar Reconstruction Post Endonasal Pituitary Surgeries: Case Series with Our Protocol

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Abstract: Sella turcica is a bony depression situated on the intracranial surface of the sphenoid bone, and in order to prevent the postoperative leakage of cerebrospinal fluid (CSF) during transsphenoidal surgery, it is crucial to undergo complete sellar floor reconstruction. This study aimed to evaluate the effectiveness of endonasal reconstruction of the sella turcica to prevent CSF leakage. This study included a case series of (83) patients admitted to Kirkuk Teaching Hospital in northern Iraq, from the period (2015) to (2021), and they underwent endoscopic transsphenoidal approach by performing rescue flap bilaterally with preserving the blood supply in all cases. This was followed by evaluation of intraoperative cerebrospinal fluid leak according to Daniel F. Kelly classification of graded repair protocol with some of our necessary modifications to obtain the best outcome. The results confirmed that out of a total of 83 cases, the most common pathology for which surgery was performed was adenoma (62). In (49) patients, there was no leakage (grade 0) during surgery, (19) patients had (grade 1), (10) had (grade 2), and only (5) cases had (grade 3). In all cases, we reconstructed the saddle according to the grade of defect, type (1) repair was the most common followed by type (2). Also, postoperative cerebrospinal fluid leakage was observed in only (4) patients. It was concluded that our modified protocol for intraoperative CSF leaks grading and the repair techniques designed using sellar reconstruction after endoscopic resection of the pituitary tumors have proven to be an effective and reliable approach for postoperative CSF leak prevention and controlling.

Keywords: Sella turcica, endonasal reconstruction, transsphenoidal surgery.

Introduction

The sphenoid bone is composed of a central section, which is distinguished by two large and two small wings that project outward from the sides of the body, as well as two pterygoid processes. Uppermost surface of the body is the saddle-shaped sella turcica [1,2]. Majority of its synonyms are related to shape and function of a seat or saddle with a strong correlation to its role as a seat for pituitary gland. These synonyms as: Turkish saddle, fossa pituitaria, sella ossis, and sella sphenoidalis [3-4]. Sella turcica consists of three components: tuberculum sellae, hypophysial fossa (also known as pituitary fossa), a saddle-like depression in the middle for the pituitary gland. The third component is the dorsum sellae, situated in the back and constructed from a square bone plate on the body of the sphenoid [5,6]. Its shape might be round, oval, or flat, and the anterior height of sella is greater in females [7]. In order to access the pituitary gland during endonasal pituitary surgery, the surgeon might have to remove a part of sella [8]. Following a surgical procedure, it may be required to reconstruct the sella to prevent leak of cerebrospinal fluid (CSF) and provide support to the surrounding structures [9].

It is important to note that a variety of techniques, such as the use of synthetic materials, bone grafts, and autologous tissue, are may use for sellar reconstruction. The selection of the reconstruction method is reliant upon the specific characteristics of patient and size of sellar defect [10,11]. The most serious complication of transsphenoidal pituitary adenoma surgery is still postoperative CSF leaking [12]. As patient is more vulnerable to potentially fatal bacterial contamination as a result of the CSF leak, which can result in a variety of serious infections, including meningitis [13]. Currently, several grading systems have been proposed to assess intraoperative CSF leaks based on the extent of the arachnoid defect or the flow of CSF [14]. The objective of this study was to assess the efficacy of endonasal reconstruction of the sella turcica in preventing cerebrospinal fluid (CSF) leaking.

Method and patients

This case series study was conducted on a total of (83) patients aged (15-74) years old, (37) males versus (46) females admitted at Kirkuk Teaching Hospital in northern Iraq, during the period from (2015) until (2021). All those patients underwent endoscopic transsphenoidal approach surgery by a consultant otolaryngologist

(Dr. Tunjai Namiq Faiq), in collaboration with neurosurgical team from whom these patients were referred. Approval from the local health directorate was obtained, as well as informed consent from all study participants. In all cases, endoscopic surgery was done by performing the rescue flap bilaterally with preserving the blood supply. After removal of the pathology, the cerebrospinal fluid leak was evaluated and classified according to our protocol in reconstruction and repair types, as shown in Table (1). Due to the

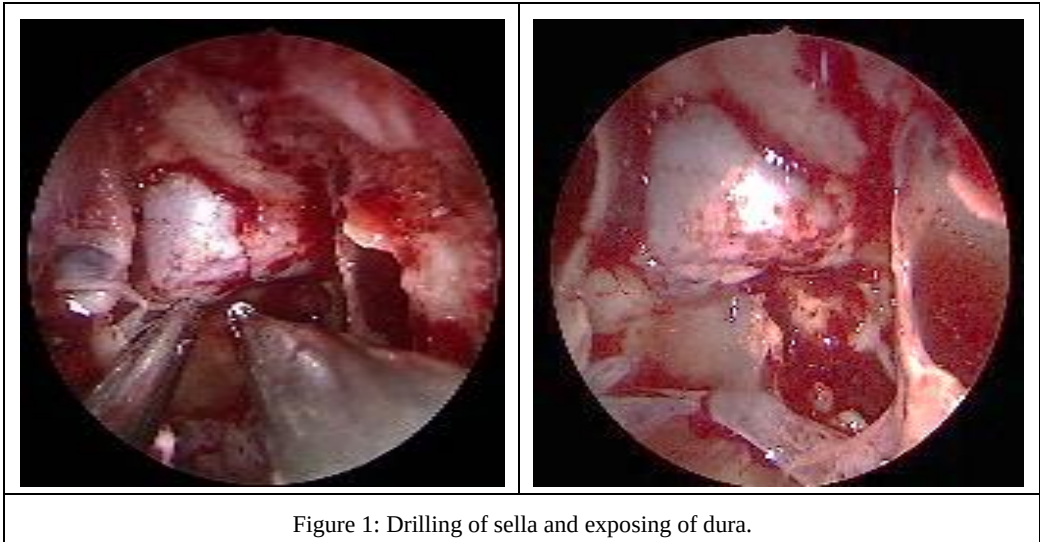
fact that in 2007 Daniel F. Kelly categorized intraoperative CSF leaks and established graded repair protocol, but, the outcome was insufficient, particularly in cases of large (Grade 3) leaks [15], so it required us to make some modifications to have our own protocol or approach. Descriptive statistical analysis of data was performed by SPSS (IBM), and results were tabulated as frequencies and percentages.

Table 1: Grading of CSF leak according our protocol and repair types of studied patients.

Leak Grade	Description of CSF leak	Repair layers	Repair type
0	No CSF leak by Valsava maneuver	1-Fat graft 2-Surgicel 3- Gelfoam	Type 1
1	Small leak by Valsalvamanuever (defect is less than 1mm)	1-Fat graft 2-Surgicel 3-Tensorfascia-lata	Type 2
2	Moderate CSF leak even without Valsalva (defect is more than 1mm)	1-Fat 2-Surgicel 3- Facia lata 4- Surgicel 5- Haddad flap 6- Surgicel	Type 3
3	Large CSF leak, (flour of fourth ventricle seen)	1-Fat 2- Surgicel 3- Facia lata 4- Surgicel 5- Haddad flap 6- Surgicel	

Surgical steps

Surgery was performed under general anesthesia using a bilateral nasal approach, in which the inferior and middle turbinate was pushed laterally, and a bilateral rescue flap was performed at the beginning of surgery, when necessary it was converted to a full Haddad flap to reconstruct the defect, and approximately 5 mm posterior septectomy done. The rostrum was then removed by chiseling or drilling to totally expose the sphenoid sinus and all the mucosa of the sphenoid sinus was removed to see a panoramic view from carotid, drilling of sella started by thinning bone of sella and removal of anterior wall by rongour forceps exposing dura (Fig.1).



The dura was simply cauterized and opened with a sickle knife (Fig. 2), after which a biopsy of the tumor was obtained and tumor excision was continued until the diagrammatic sella was clearly seen (Fig. 3), and in this step we checked for CSF leak. Where it was obvious and sometimes small and was seen during Valsava or there was no leak at all. In cases of leak absence, it was considered grade 0, and type I was repaired by fat and gel foam.

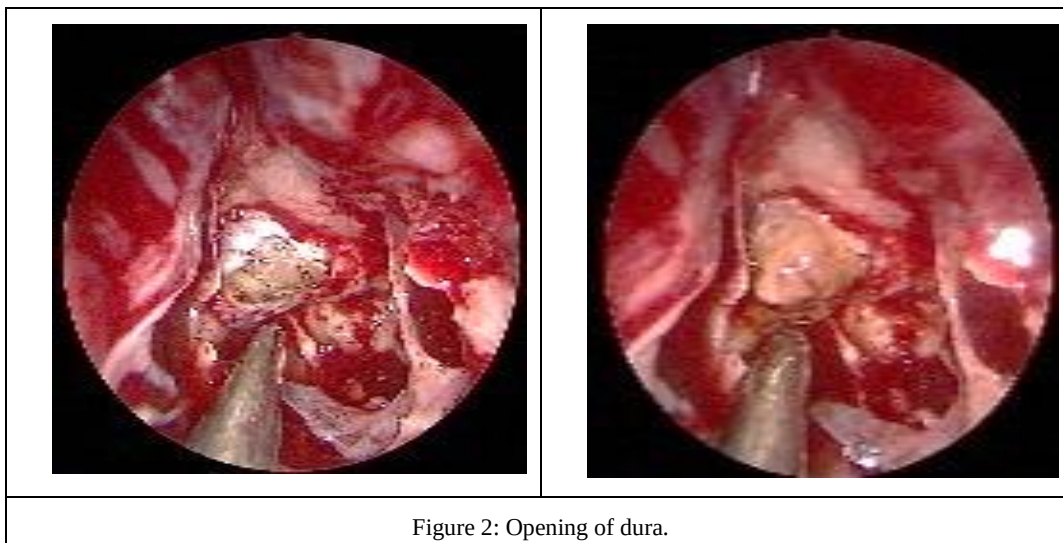


Figure 2: Opening of dura.

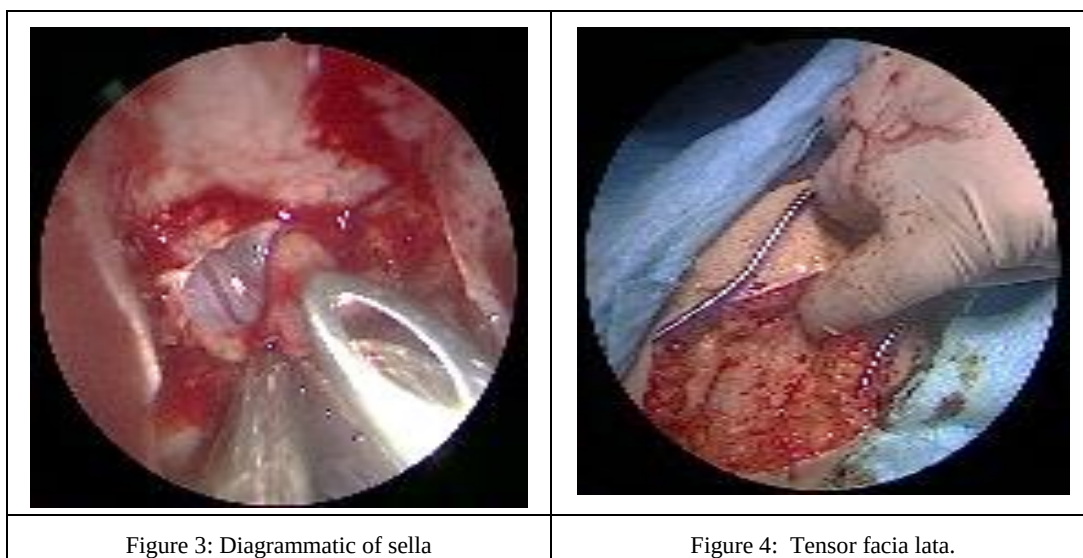
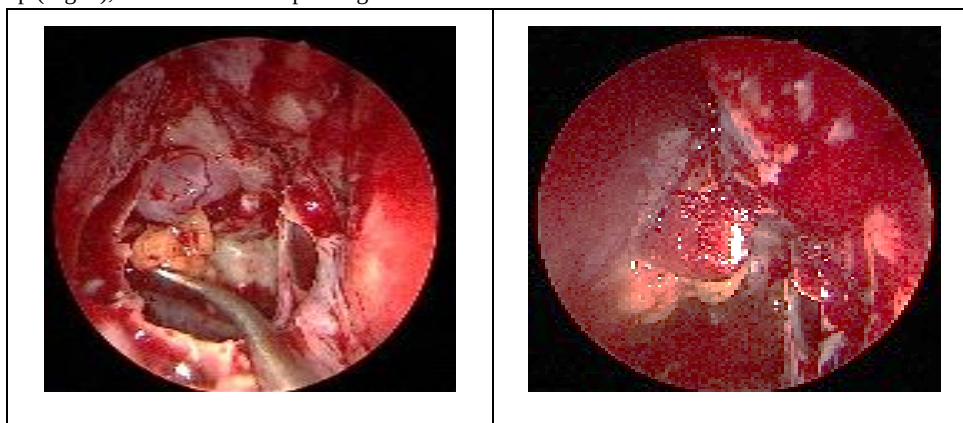
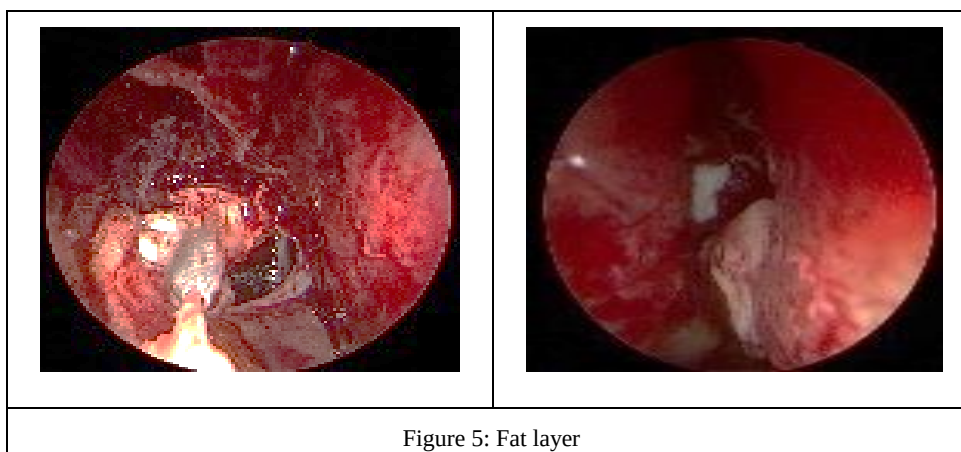


Figure 3: Diagrammatic of sella

Figure 4: Tensor fascia lata.

In cases of grade 1 CSF leak the defect was less than 1 mm, and type 2 repairs were performed with fat, gel foam, tensor fascia lata, and fat with fascia lata taken from the thigh (Fig.4). In cases of grades 2 or 3 CSF leaks, the same previous step was performed in addition to rescue flap converting to Haddad flap (Fig. 5), after that anterior packing done.





The pack removed in 2nd post-operative day and the patient discharged on parenteral antibiotics which changed to oral antibiotic after 5 days, on the second post-operative day the tilt test was done for patients by tilting the head for 30 seconds to see if the patient has CSF-rhinorrhea, in cases without leakages we discharged them to home. In cases with leakage of CSF we kept them in hospital and continued on parenteral antibiotic, bed rest, no straining with use of diuretic till CSF leak stopped and patient discharged home.

Results

Of the 83 patients, there were 46 (55.42%) females and 37 (44.58%) males, age ranged (15 -74) years and most of them were within age group (65-74) as in Table (2), no one of them had previous surgery and all were operated on by endoscopic approach by the author and neurosurgical team.

Table 2: Baseline characteristics of studied patients .

Baseline characteristics		Patients =83	
		Frequency	%
Gender	Female	46	55.42
	Male	37	44.58
Age	15-24	2	2.41
	25-34	5	6.02
	35-44	12	14.46
	45-54	21	25.30
	55-64	21	25.30
	65-74	22	26.51

Table 3 shows the types of pathologies that underwent surgery, where Adenoma 62(74.70%) was the most common, while Apoplexy 2 (2.41%) was the least.

Table 3: Types of pathology.

Pathology	Frequency	%
Adenoma	62	74.70
Apoplexy	2	2.41
Arachnoid cyst	3	3.61
Craniopharyngioma	6	7.22
Meningioma	10	12.05
Total	83	100

In all of 83 patients, 49 (59.04%) patients had no leak during surgery grade zero, and 19 (22.89%) patient had grade1, 10 (12.05%) had grade 2, 5(6.02%) grade 3, as shown in Table (4).

Table 4: Per-operative grading of CSF leak .

Grades	Frequency	%
0	49	59.04
1	19	22.89
2	10	12.05
3	5	6.02
Total	83	100

In all cases we performed reconstruction of the sella according to the grade of defect; type 1 repair was the most common followed by type 2 as in Table (5).

Table 5: Type of repair.

Repair type	Frequency	%
Type 1	49	59.1
Type 2	19	22.9
Type 3	15	18
Total	83	100

Out of 83 patients there were only 4 (4.82%) patients with postoperative CSF leaks as in Table (6).

Table 6: post-operative CSF leaks .

CSF leak	Frequency	%
CSF leak	4	4.82
No CSF leak	79	95.18
Total	83	100

According to types of pathology for which the surgery done craniopharyngioma 3 (75%) and arachnoid cyst 1(25%) were the most pathologies associated with post-operative leak as shown in table (7).

Table 7: CSF leak post-operative according to pathology.

Pathology types	CSF leak	
	Yes (%)	No (%)
Adenoma	0 (0)	62 (78.48)
Apoplexy	0 (0)	2 (2.53)
Arachnoid cyst	1(25)	2 (2.53)
Craniopharyngioma	3 (75)	3 (3.80)
Meningioma	0 (0)	10 (12.66)
Total	4(100)	79 (100)

The most grades associated with post-operative leak were grade 2 (75%) and grade 3(25%), as shown in table (8).

Table 8: postoperative CSF leak

Grades	CSF leak		Total (%)
	Yes (%)	No (%)	
0	0 (0)	49 (62.03)	49 (59.04)
1	0 (0)	19 (24.05)	19 (22.89)
2	3 (75)	7 (8.86)	10 (12.05)
3	1(25)	4 (5.06)	5 (6.02)
Total	4 (100)	79 (100)	83 (100)

Although the CSF leak was very low, only (4) cases in 83 patients but according to type of repair all of them were with type 3 repair which included grade 2& 3 diaphragmatic defects as in tables (9) and (10).

Table 9: Relation of type of repair with postoperative CSF leak

Repair Type	CSF leak		Total
	Yes	No	
Type 1	0	49	49
Type 2	0	30	30
Type 3	4	0	4
Total	4	79	83

Three of the four repair failures detected after discharging from hospital were treated conservatively by rest, avoiding strain, diuretic, and all of them recovered completely without the need for lumbar drain

Table 10: Relation of grades and type of repair with postoperative CSF leak .

Grades	Repair Type	CSF leak
0	Type 1	0
1	Type 2	0
2	Type 3	3
3	Type 3	1
Total		4

Discussion

The transsphenoidal approach is a common method used for the resection of pituitary adenomas, taking advantage of the fact that these tumors usually originate under the sellar diaphragm, outside the arachnoid membrane and subarachnoid space. This anatomical position minimizes the risk of disturbing the arachnoid membrane and subsequent leaks of cerebrospinal fluid (CSF) during the surgical process [16,17]. The endoscopic method is especially helpful in cases with large-scale tumors with extended extension. However, as with conventional transsphenoidal surgery, there is still a high risk of complications after the operation; including CSF leakage .These leakages can expose patients to life-threatening infections such as meningitis, encephalitis, and pituitary abscesses [18,19].

For decades those patients with pituitary tumors in our governorate ,Kirkuk city were referred to other specialized centers as there was none in the city making the patient suffer the burden of travelling with his coexistent morbidity ,in addition to the cost spent during the journey the patient and his relatives had to bear the cost of accommodation in that city, so we started a team in our center to help those patients keeping in mind to be so careful avoiding future complications and with less risk for the patient to have a further surgical interference, and that's why we depended on Daniel F. Kelly classification for sorting the patients but the type of repair advocated for Grade 2 and 3 was as we named type 3 repair which involved using the same layers for repair in patients with those grades[15].

Although some studies show that if there is no CSF leak intra-operatively there is equal chance of CSF leak postoperatively [20] but, we rather performed a type 1 repair to be on the safe side and as some studies like that done by Zixiang Cong says that no case of postoperative CSF leak was reported in those group reconstructed with sellar floor flap repair, whereas 7 cases were reported in the non-reconstruction group [21], other study states that delayed CSF leaks are likely resulted from missed intra-operative CSF leaks or postoperative changes. Universal sellar reconstruction can preemptively treat missed leaks and provide a barrier for postoperative changes [22].

There are different ways for seller reconstruction and some may use synthetic materials such as titanium mesh or methyl methacrylate (which are both not available in our center), bone grafts, and autologous tissue [23], We depended on autologous tissue, such as fat and tensor facia lata and nasal mucosa which is known as Haddad flap for sellar reconstruction. These tissues are readily available and can be obtained during the surgery itself plus some other materials which are readily available in most hospitals like surgical [24].

The choice for the layers of reconstruction made after reviewing many articles and other centers job and the possibility of being applicable in our hospital taking in account the benefit of the patients so we reached to the f criteria mentioned before and repairing even grade zero CSF leak with Facia lata and Haddad flap being chosen for type 3 repair to ensure eliminating the possibility of the postoperative CSF leak as larger defects has greater incidence for postoperative CSF leak and that's why only four cases developed CSF leak postoperatively where grade 2 & 3 and this approximately accounts for (4.8%). This seems fair compared to other studies that used a graded approach showed a postoperative CSF leak rate of 2.5 percent as the intraoperative leak of CSF in the microscopic approach of the endonasal transsphenoidal pituitary was classified by Esposito and colleagues [25]. according to the size of the defect and the severity of the leak was grade 0 if no leakage was observed, grade 1 if a small leak was observed without an obvious diaphragmatic defect, grade 2 if a moderate leakage was observed, and grade 3 if a large diaphragmatic or dural defect was observed. They repaired the cranial base using a collagen sponge in grade 0 in some cases, two layers of collagen sponge with titanium mesh buttress in grade 1 in some cases, intra sellar and sphenoid sinus fat grafts with collagen sponge overlay and titanium buttress in grade 2 and grade 3 in some cases, and CSF diversion in most cases involving patients in grade 3 patients. The procedures discussed previously have been modified by Kong et al., who took into account the size of the aperture in the arachnoid membrane less than or greater than (5) millimeters. They used a simple closure without tissue grafting in grade 0 (without intraoperative CSF leak) and reconstructed the sellar floor (non-randomly) in other grades using free tissue grafting, such as fat and mucosal grafting or the gasket-seal method, resulting in postoperative CSF leaks of 10% [26]. Close postoperative follow-up and adequate management of CSF leaks are crucial to minimizing complications and achieving optimal patient outcomes as all of four cases with postoperative CSF leak were managed conservatively.

Conclusion

Perfect sellar reconstruction after endoscopic resection of pituitary tumor even in presence of per operative CSF leak is effective in

controlling the postoperative leak and their complication, and there is no universally applicable approach for sellar reconstruction after endoscopic resection of the pituitary tumor. Graded approach for seller defects makes it easier to decide choice of a repair technique.

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