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Ramez Sabry
The Department of Otolaryngology, Faculty of Medicine, Beni Suef University, Egypt

Ramez Reda
The Department of Otolaryngology, Faculty of Medicine, Beni Suef University, Egypt

M. Sherif A. Abdelmonem
The Department of Otolaryngology, Faculty of Medicine, Beni Suef University, Egypt

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Ramez Sabry, Ramez Reda, M. Sherif A. Abdelmonem
The Department of Otolaryngology, Faculty of Medicine, Beni Suef University, Egypt

Correspondence to: Ramez Reda, Email: drramez2003@yahoo.com

The frontal recess area has always been considered the most difficult area to be dissected due to its complex and varied anatomy. Axillary flap approach for frontal sinus was first used in 2002. It was claimed that this approach is an excellent approach for frontal sinus using 0° endoscope. This study was done to assess the axillary flap approach for chronic frontal sinusitis. Thirty patients (56 sides) with computerized tomography (CT) evidence of frontal sinus disease underwent axillary flap procedure to the frontal recess between March 2010 and January 2012. The frontal sinus ostium was identified in 100% of frontal sinuses. At the end of follow up period, recurrence of frontal sinus symptoms was encountered in only 2 sides (3.6%) and minimal disease recurrence in postoperative CT in 6 sides (10.7%), all were managed medically and no need for reoperation. It was found that the axillary flap approach is easy, safe and gives excellent anterior access to the frontal recess area and frontal sinus ostium. Also, coverage of the raw area of bone using axillary flap prevents scarring and adhesions in the frontal recess.

Keywords: Axillary flap, frontal recess, endoscopic frontal sinus surgery.

INTRODUCTION

Chronic infection of the frontal sinus is the result of mucosa-lined, rigid cavity with a small opening for drainage. This small opening is easily obstructed and may result in an infection that can be difficult to treat effectively.[1]

Standard endoscopic frontal sinusotomy is advocated by most as the surgical treatment of choice to establish culture, drainage and aeration necessary to augment medical therapy.[2] Maintenance of mucous membrane in the frontal sinus drainage pathway is the key to a successful functional outcome.[3] In an attempt to improve healing and postoperative results, surgeons try to preserve the mucosa in the sinuses by using through-cutting instruments and powered microdebriders.[4]

The incidence of frontal sinusitis following functional endoscopic sinus surgery (FESS) is not exactly known. Published reports over the last decade quote a 2% to 11% rate of persistent frontal sinusitis symptoms with 1% to 5% of patients requiring revision surgery.[5]

The most common causes of surgical failure in the frontal recess include remnant frontal recess cells, a retained uncinate process, middle turbinate lateralization, osteoneogenesis, scarring or inflammatory mucosal thickening and recurrent polyposis.[6]

The concept of removal of the anterior wall of the agger nasi cell to achieve improved access to the frontal recess is not new. May and Schaitkin (1995)[7] with their nasofrontal approach I (NFA I) and Schaefer and Close (1990)[8] have advocated a similar approach. In the NFA I procedure, the anterior face of the agger nasi cell was removed for access into the frontal recess, whereas Schaefer and Close advocated removal of the bone above the insertion of the middle turbinate.

Wormald (2002)[9] claimed that the disadvantage of these approaches is the raw edge of mucosa and bone that is left

in the axilla of the middle turbinate, which can scar and pull the middle turbinate laterally. He wrote that this can be largely overcome if a mucosal flap is raised and rapped at the end of the procedure over this raw area.

So, this prospective study was done to assess the effect of removal of the anterior face of the agger nasi cell in the frontal sinus surgery after creation of axillary flap which used to cover the raw area at the end of procedure.

PATIENTS AND METHODS

The present study was conducted on 30 patients with computerized tomography (CT) evidence of frontal sinus disease who presented to the Otorhinolaryngology clinic of faculty of medicine of Beni Suef University between March 2010 and January 2012.

17 patients were males and 13 were females, with male to female ratio was 1.3:1. The age of patients ranged between 24- 47 years.

Preoperatively all patients were subjected to complete history taking, general examination, Otorhinolaryngological examination, diagnostic nasal endoscopy and computerized tomography.

The indication for frontal recess surgery was based on the presence of significant frontal sinus disease on CT scan ± frontal sinus symptoms as forehead pain, discomfort and headache.

Twenty-six patients had bilateral frontal sinus disease (52 frontal sinuses) and four patients had unilateral frontal sinus disease, giving a total 56 frontal recesses were operated (Table 1). Fifty-three percent (16 patients) of patients had chronic rhinosinusitis (15 bilateral and one unilateral frontal sinus affection), thirty percent (nine patients) of patients had bilateral nasal polypi on nasal endoscopy and seventeen percent of patients (five patients) had fungal sinusitis (two bilateral and three unilateral frontal sinus disease).

Table 1. Preoperative symptoms and History of previous sinus surgery.

Disease	No.	Preoperative frontal sinus symptoms	Recurrent disease
Chronic rhinosinusitis	31	29	11
Allergic nasal polypi	18	8	9
Fungal sinusitis	7	5	4
Total	56	42 (75%)	24 (42.8%)

Forty three percent of frontal sinuses had undergone previous sinus surgery and were revision cases.

In this study, using CT scan, proper anatomical assessment of the three dimensional area of the frontal recess, the superior insertion of the uncinate process and presence of frontal cell(s) and its relation to agger nasi cell was carried out before starting the operation using Kuhn[10] classification (Table 2).

Table 2. Kuhn[10] classification of Frontal Cells.

Frontal cells	
Type 1	Single frontal recess cell above agger nasi.
Type 2	Tier of cells in frontal recess above agger nasi.
Type 3	Single massive cell pneumatizing into frontal sinus.
Type 4	Isolated cell in the frontal sinus.

Surgical Technique: All patients were operated under hypotensive general anesthesia. The flap area (a part from the lateral nasal wall that lies superior and anterior to the axilla of the middle turbinate) was injected with saline adrenaline 1:200.000 to minimize bleeding and easier flap creation.

After uncinectomy, creation of a posteriorly based full thickness axillary flap was done using a 0° endoscope. By number 15 scalpel blade on a normal knife handle, a superior incision was made approximately 8mm above the axilla of the middle turbinate and starting approximately 6mm posterior to the axilla. The incision was turned vertically down to the level of the axilla (Fig. 1a). Then it was curved backward at the level of axilla onto the middle turbinate. This incision was continued for 2mm posteriorly along the medial aspect of the middle turbinate (inferior incision) (Fig. 1b).

The full thickness mucosal flap was then raised with a suction freer dissector. It is important that the flap must be elevated till behind the root of middle turbinate (Fig. 1c).

Then, the flap was reflected completely away from surgical field between the middle turbinate and septum. This exposed the anterior bony wall of the agger nasi cell.

The exposed anterior bony wall of agger nasi cell was removed by a forward-biting Hajek Kofler sphenoid punch (Fig. 1d). Usually two or three punches were necessary before the entire anterior face of the agger nasi cell was removed exposing the medial, posterior walls and the roof of agger nasi cell. By a 45° angled ethmoid curette the medial wall, roof and posterior wall of the agger nasi cell were removed. This allowed anterior access into the frontal recess (Fig. 1e).

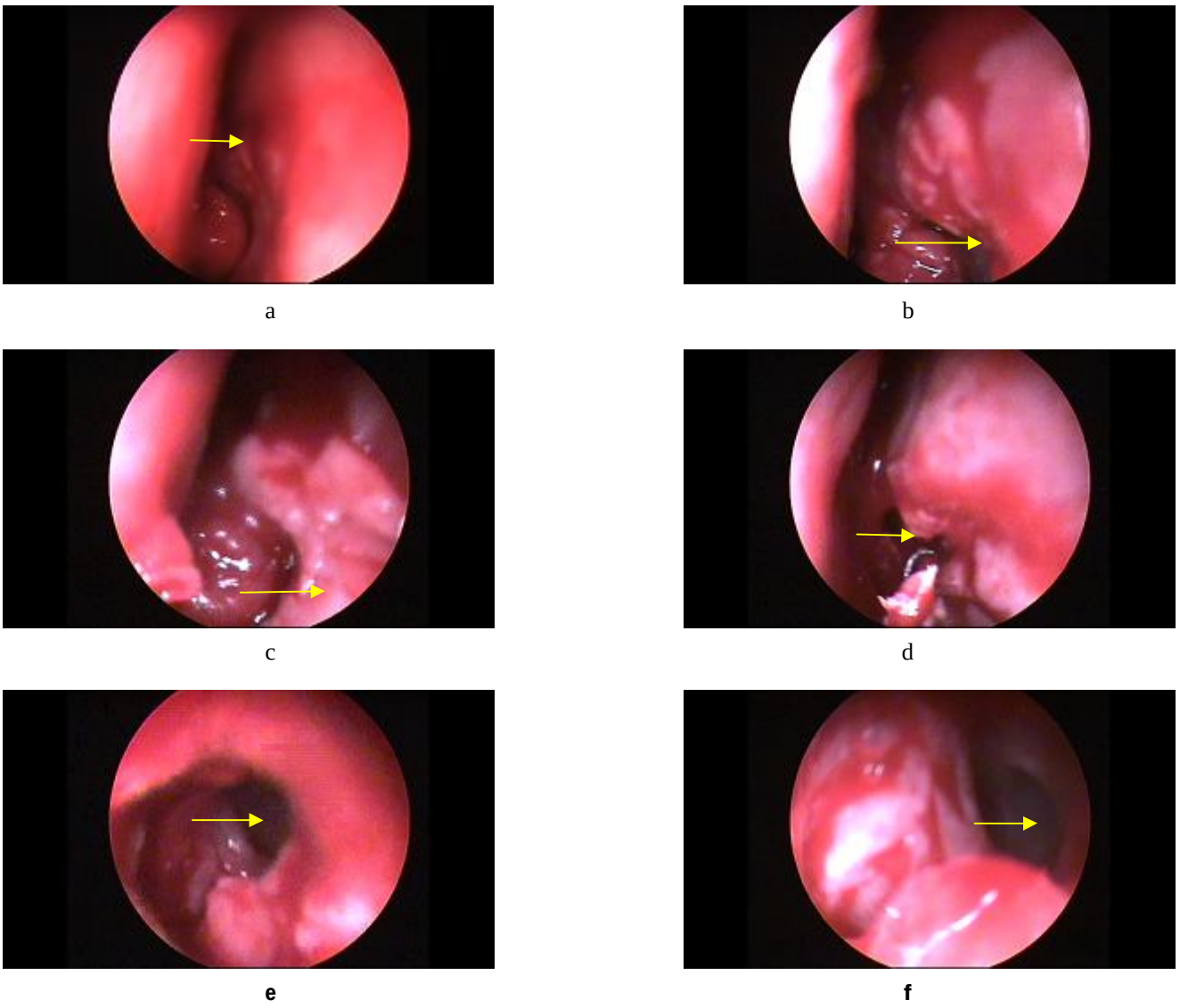

Fig 1. Surgical technique (left side); a) Superior and vertical incisions, b) Inferior incision, c) Flap was created, d) Punching of agger nasi with Hajek, e) The frontal recess was entered, and f) Frontal ostium was identified.

If frontal cells were present, they were visualized and removed. Depending on how these cells were situated and their relation to agger nasi cell, each frontal cell was identified and entered and its posterior wall and roof were removed. In most of cases this can be achieved by 0° endoscope, but in few cases the 30° endoscope was used to insure complete removal of the roof of frontal cell e.g. Kuhn type (3) cells.

After approaching the frontal recess, the recess was cleared completely and the frontal ostium was identified (Fig. 1f). The frontal ostium was not instrumented unless a frontal cell or polyp was blocking it. If this occurred the frontal cell or polyp was removed until complete clearance of the ostium was achieved. If work must be performed in the frontal ostium or in the frontal sinus through the ostium, a 30° endoscope may be used with the help of angled instruments.

The frontal sinus ostium was identified (by placing the frontal sinus probe through the visualized frontal ostium into the frontal sinus) in all cases, so there was no need for minitrephine through the anterior table of the frontal sinus with injection of saline stained fluorescein.

At the end of the procedure the axillary flap was rapped over lateral side of middle turbinate.

During the operation, any arterial bleeding was controlled by either saline adrenaline packs or by cauterization with bipolar diathermy. At the end of surgery, anterior nasal packing was performed for all patients for 48 hours.

All patients were followed up at weekly interval during the first postoperative month and at 2 weeks interval during the 2nd postoperative month then at monthly interval till the end of the 6th month postoperatively. At each postoperative visit, patients were subjected to questionnaire for recurrence of symptoms and complete nasal examination including nasal endoscopy during which any blood clot, debris, secretion or minimal adhesions were dealt with either by suction or cutting the adhesion under local anesthesia if needed. Postoperative CT scan was performed at the end of the 6th month.

RESULTS

Thirty patients were included in this study. Twenty-six patients had bilateral axillary flaps and frontal recess clearance and four patients had operated on only one side. So, fifty six axillary flaps were performed in total.

Only one side, Kuhn type (3) frontal cell was found and the cell was completely removed using 30° angled endoscope during this approach.

As regards postoperative complications, no major complications (significant hemorrhages, orbital complications, or cerebrospinal fluid leak) occurred. No flaps were damaged during the procedures.

At the end of follow-up period (6 months), all patients were assessed subjectively by presence of postoperative symptoms and objectively by postoperative nasal endoscopic examination and CT scan.

Subjective assessment revealed only recurrence of frontal sinus symptoms (frontal discomfort, pain or headache) in 2 sides (3.6%) (Table 3). All symptomatic patients have been managed medically with no need for revision surgery till the time of writing.

Objective postoperative endoscopic assessment (Table 3) revealed patency of the frontal sinus ostium that was confirmed by visualization of the naso-frontal isthmus in 53 sides (94.65%) and adhesions in the frontal recess obscuring the frontal ostium in 3 sides (5.35%). Three sides (16.7%) [of the 18 sides (9 patients) that had polypi before surgery] had evidence of minimal recurrence of polypi on nasal endoscopy (confirmed with postoperative CT scan) none of them complain of symptoms of blockage. Two sides (28.6%) (2 patients) of the 7 sides (5 patients) in which fungus was found at the time of surgery and preoperative CT scan had recurrence of nasal discharge with endoscopic evidence of diseased mucosa and probable fungal recurrence that was confirmed with postoperative CT scan. One patient [one side (3.2%)] had residual muco-purelent discharge in the frontal recess area with endoscopic mucosal edema. All these six sides (10.7%) were managed medically and revision surgery was not indicated.

Table 3. Postoperative symptoms and endoscopic and CT scan findings.

Disease	Postoperative Symptoms	Postoperative Endoscopic ex. and CT scan	adhesions
Chronic rhinosinusitis	1	1 recurrent infection (3.2%)	1
Nasal polypi (not fungal)	0	3 recurrent polypi (16.7%)	1
Fungal sinusitis	1	2 recurrent fungi (28.6%)	1
Total	2 (3.6%)	6 (10.7%)	3 (5.35%)

DISCUSSION

The frontal recess area has always been considered to be the most difficult area to be dissected. The complex and varied anatomy, acute naso-frontal angle and proximity of critical structures such as the olfactory fossa, skull base and orbit contribute to the technical difficulty of the frontal sinus surgery.[11]

Many authors reported that Stammberger technique for frontal recess using angled telescopes (30°, 45°, and 70°) and curved instruments is very difficult. It is more difficult if frontal cells extend toward the skull base e.g. Kuhn type 3 cells.[9,10]

This makes many surgeons approach this area with caution and inadequate clearance of the frontal recess which results in postoperative persistence or recurrence of disease.[4]

Wormald (2002)[9] claimed that the axillary flap approach to the frontal recess gives excellent access and allows identification of the frontal ostium in the vast majority of patients using 0° endoscope. In addition, he wrote that axillary flap approach gives sufficient access to Kuhn type 3 cells using 30° endoscope without the need for combined external and endoscopic approach.

In this study, 30 patients (56 sides) with computerized tomography (CT) evidence of frontal sinus disease underwent axillary flap approach to the frontal recess between March 2010 and January 2012. There was 42.8% of frontal sinuses had prior sinus surgeries. This is due to inadequate clearance of the frontal recess in the previous surgeries.

In the present series, the access to the frontal recess provided by the axillary flap approach allowed 100% of the frontal sinus ostia to be identified with visualization of the frontal sinus through the ostium. There was no need for the minitrephine to clear and visualize the frontal sinus.

In the present study, most of the steps of surgery in the frontal recess were performed with a 0° endoscope, and this gave the surgeon the advantage of not having to work around the corner with angled telescopes and instruments. The 30° endoscope was necessary mainly in Kuhn type (3) cell to achieve frontal ostium clearance. This goes with the result of Wormald (2002).[9]

In the present study, recurrence of frontal sinus symptoms was encountered only in 2 sides (3.6%) and postoperative endoscopic assessment revealed patency of the frontal sinus ostium in 53 sides (94.65%) and only 3 sides (5.35%) were obscured by adhesions.

In our opinion, this very low recurrence rate is due to wider field and better access to the frontal recess. Also, coverage of raw area of lateral side of middle turbinate prevents adhesions and recurrence.

Although, this technique is similar to the frontal sinus rescue procedure described by Kuhn et al, (2000),[12] in that a mucosal flap is raised during the frontal sinus surgery, but the frontal sinus rescue procedure is used for patients with stenosed frontal ostium after failed previous standard endoscopic sinus surgery that cannot be successfully opened with routine endoscopic techniques.

We agree with Wormold (2002)[9] that axillary flap technique can be used for all patients undergoing frontal recess or sinus surgery including previously operated patients but with preserved ager nasi.

Many authors recommended combined external and endoscopic approach for frontal sinus in cases of Kuhn type (3) cells impinging on the frontal ostium. In the present series, the axillary flap approach gave adequate access to the frontal recess that allowed complete removal of Kuhn type (3) cell through the frontal ostium and from the frontal sinus from below.

In this study, destabilization of the middle turbinate was expected by removal of the anterior wall of the agger nasi cell (axilla of middle turbinate) that may lead to lateralization of the middle turbinate. This did not occur due to preservation of the horizontal portion of the ground lamella that maintains stability of the middle turbinate. Also, the preservation of the mucosal flap to cover the raw area of bone at the end of the procedure prevents scarring and pulling the middle turbinate laterally.

CONCLUSION

The axillary flap approach is easy, safe with excellent anterior access to the frontal recess area that allows complete clearance of the frontal recess, identification of the frontal sinus ostium and total removal of Kuhn type (3) frontal cell from below through the frontal sinus ostium.

The replacement of created axillary flap to cover the raw area of bone prevents scarring and adhesions in the frontal recess which prevents lateralization of middle turbinate.

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