Management of Chronic Frontal Sinusitis Using the Axillary Flap Approach

AYMAN SAMIR, M.Sc.; NASSIM T. GHOBRIAL, M.D.; FADI M. GHARIB, M.D.; ADEL S. EL-ANTABLY, M.D. and MOHAMED AL-AYADI, M.D.
The Department of Otorhinolaryngology, Faculty of Medicine, Cairo University

Abstract

Background: Surgery of the frontal recess continues to provide several challenges which include understanding the gross and endoscopic anatomy of the frontal recess and the frontal outflow pathway, several approaches have been described, the axillary flap approach is based on the dissection on the close relationship of the agger nasi with the frontal recess.

Objective: To evaluate the access to the frontal recess using the axillary flap approach by identifying the frontal ostium during endoscopic sinus surgery.

Patients and Methods: Prospective study applied on thirty patients (54 sides) with Computerized Tomography (CT) evidence of frontal sinus disease underwent axillary flap exposure of the frontal recess between May 2014 and August 2015. Demographic data, identification of the frontal ostium, the presence of post-operative symptoms and revision surgery were collected. The operative technique is presented.

Results: The frontal sinus ostium was identified in 98% of patients (53 of 54 sides). After six months of follow-up, recurrence of frontal sinus symptoms was encountered in only 3 sides (5.6%) and minimal disease recurrence in post-operative CT in 6 sides (11.1%), 2 patients have required revision surgery, 3 sides (5.6%) had adhesions in the frontal recess requiring division under local anesthesia.

Conclusion: The axillary flap approach to the frontal recess provides excellent access to the frontal recess and allows clearance of cells in the recess with identification of the frontal ostium in the vast majority of cases. Also, coverage of the raw area of bone using axillary flap prevents scarring and adhesions in the frontal recess.

Key Words: Axillary flap – Frontal recess – Endoscopic sinus surgery.

Introduction

The approach to the frontal sinus and the frontal recess is still considered the most difficult and challenging part of Endoscopic Sinus Surgery (ESS). The obscure location of this area, its variable anatomy and its intimate proximity to the eye and brain may prevent the surgeon from performing an adequate dissection and may expose the patient to major complications. The need for experienced frontal sinus surgeons is growing; as ESS has become the standard treatment for chronic sinusitis, there has been an increasing occurrence of iatrogenic frontal sinus disease secondary to previous anterior ethmoidectomy that failed to preserve a patent frontal sinus outflow [1,2].

Several approaches to the frontal recess have been described. These include the postero-anterior approach where the skull base is identified in the posterior ethmoids or the sphenoid sinus and traced anteriorly to identify the skull base and the frontal recess [3]. This approach may be justified when there is concomitant pathology in the posterior group of the paranasal sinuses but is unnecessary when the pathology is limited to the anterior group of the paranasal sinuses and more so if it is isolated in the frontal sinus [4].

The axillary flap approach will give a better access to the frontal recess area and based on the dissection on the close relationship of the agger nasi with the frontal recess. The anterior wall of the agger nasi is removed following the elevation of the axillary flap. The frontal recess dissection is carried out systematically depending on the CT information and preoperative planning, removing the bulla and the surrounding cells to open the frontal recess as wide as possible [5].

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

This is a prospective study that was conducted on 30 patients with CT evidence of frontal sinus disease including chronic rhinosinusitis, nasal polyps and allergic fungal sinusitis, who presented to the Otorhinolaryngology Outpatient Clinic, Kasr Al-Ainy Hospital, Faculty of Medicine, Cairo University between May 2014 and August 2015. Fourteen patients were males and sixteen patients were females, with male to female ratio was 1:1.14. The age of patients ranged between 15-48 years. Thirty-seven percent of frontal sinuses had undergone previous sinus surgery (Table 1).

Table (1): Pre-operative symptoms and history of previous sinus surgery.

<table>
<thead>
<tr>
<th>Disease</th>
<th>No.</th>
<th>Pre-operative frontal sinus symptoms (frontal discomfort, headache or pain)</th>
<th>Revision surgery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic rhinosinusitis</td>
<td>24</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>Nasal polyps</td>
<td>22</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>Allergic fungal sinusitis</td>
<td>8</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>54</td>
<td>42 (77.7%)</td>
<td>20 (37%)</td>
</tr>
</tbody>
</table>

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. 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-four (24) patients had bilateral frontal sinus disease (48 frontal sinuses) and 6 patients had unilateral frontal sinus disease, giving a total 54 frontal recesses were operated (Table 1). 43.3% (13 patients) of patients had chronic rhinosinusitis (11 bilateral and 2 unilateral frontal sinus affection), 36.7% (11 patients) of patients had bilateral nasal polyp on nasal endoscopy and 20% of patients (6 patients) had fungal sinusitis (2 bilateral and 4 unilateral frontal sinus disease).

A definite protocol for evaluation was followed in all patients. This included detailed history taking, otorhinolaryngological examination, diagnostic nasal endoscopy and computerized tomography.

**Surgical technique:** Initially, the nasal cavity was instilled with a mixture of 1:100000 adrenaline saline solution. The surgical steps were then performed using a 4mm 0° endoscope in the majority of cases, 30° endoscope was used in few situations.

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 elevation Fig. (1A).

After uncinctomy, 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. 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). 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. 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 Fig. (1B). The exposed anterior bony wall of agger nasi cell was removed by a forward-biting Hajek Kofler punch Fig. (1C). 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. (1D).

After approaching the frontal recess, the recess was cleared completely and the frontal ostium was identified Fig. (1E). 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 53 sides (98%) of the 54 sides, so a minitrephine was done through the anterior table of the frontal sinus in that side. At the end of the procedure the axillary flap was replaced to cover the raw bone which was created with removal of the anterior face of the agger nasi cell Fig. (1F).
Fig. (1A): Injection of the axillary flap area (right side).

Fig. (1B): Incisions and elevation of the axillary flap.

Fig. (1C): The exposed anterior bony wall of the agger nasi cell was removed by Hajek Kofler punch.

Fig. (1D): Clearance of the frontal recess by ethmoidal curette.

Fig. (1E): Frontal ostium was identified.

Fig. (1F): The axillary flap was replaced to cover the raw bone.

Fig. (1A-F): Surgical steps of the axillary flap approach to the frontal recess.

All patients were followed-up weekly during the first post-operative month and every 2 weeks during the 2nd postoperative month then monthly till the end of the 6th month post-operatively. At each post-operative 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. Post-operative CT scan was performed at the end of the 6th month.

Results

This study included 30 patients. 14 patients (46.6%) were males and 16 patients (53.4%) were females, with male to female ratio 1:1.14. Their age ranged from 15 to 48 years with an average age of 31.5 years. 13 patients (43%) had chronic rhinosinusitis, 11 (36.6%) had bilateral nasal polypi and 6 patients (20%) had allergic fungal sinusitis. 24 patients had bilateral axillary flaps and frontal recess clearance and 6 patients had surgery on only 1 side. Thus 54 axillary flaps were performed in total. Only one patient at one side had Khun type 3 frontal cell and the cell was completely removed using 30º angled endoscope during this approach. Access to the roof of the Khun type 3 cell was achieved by the exposure obtained from the axillary flap, which allowed passage of the curette over the top of the cell before the cell fractured and removed. As regards postoperative complications, no major complications (significant hemorrhages, orbital complications or cerebrospinal fluid leak) occurred. At the end of follow-up period (6 months), all patients were assessed subjectively by presence of post-operative symptoms and objectively by post-operative nasal endoscopic examination and CT scan. Subjective assessment revealed only recurrence of frontal sinus symptoms (frontal discomfort, headache or pain) in 3 sides (5.6%) (Table 2). All symptomatic patients have been managed medically. Objective postoperative endoscopic assessment (Table 2) revealed patency of the frontal sinus ostium that was confirmed by visualization...
of the naso-frontal isthmus in 51 sides (94.4%) and adhesions in the frontal recess obscuring the frontal ostium in 3 sides (5.6%). Three sides (13.6%) of the 22 sides (11 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 (25%) (2 patients) of the 8 sides (6 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) (4.2%) of the 24 sides of chronic sinusitis patients had residual muco-purelent discharge in the frontal recess area with endoscopic mucosal edema. Four sides of these 6 sides were managed medically and only 2 sides (fungal sinusitis) required revision endoscopic sinus surgery.

Table (2): Post-operative symptoms, endoscopic and CT scan findings.

<table>
<thead>
<tr>
<th>Disease</th>
<th>Post-operative frontal sinus symptoms (frontal discomfort, headache or pain)</th>
<th>Post-operative Endoscopic examination and CT scan</th>
<th>Adhesions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic rhinosinusitis</td>
<td>1</td>
<td>1 recurrent infection (4.2%)</td>
<td>1</td>
</tr>
<tr>
<td>Nasal polypi (not fungal)</td>
<td>1</td>
<td>3 recurrent polypi (13.6%)</td>
<td>1</td>
</tr>
<tr>
<td>Fungal sinusitis</td>
<td>1</td>
<td>2 recurrent fungi (25%)</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>3 (5.6%)</td>
<td>6 (11.1%)</td>
<td>3 (5.6%)</td>
</tr>
</tbody>
</table>

Fig. (2A): Pre-operative nasal endoscopy (right side) showing a polyp filling the middle meatus and frontal recess area.

Fig. (B-1,2): Post-operative nasal endoscopy (right side) of the same patient after 1 year follow-up (post axillary flap approach) showing.

(1): The frontal recess area opened and free of disease. (2): Frontal Sinus Ostium (FSO) is clearly seen and easily visualized. (AEA): Anterior Ethmoidal Artery.

Fig. (2A,B): A case of bilateral sinonasal polypi underwent axillary flap approach.

**Discussion**

The frontal recess remains the most difficult area in which to operate endoscopically because access is traditionally achieved with angled telescopes and curved instruments [6]. In addition, the most vulnerable part of the skull base, the lateral wall of the olfactory fossa, forms the medial wall of the recess. Injudicious removal of bone and cells can result in a cerebrospinal fluid leak [6]. This causes surgeons to approach this area with caution, and inadequate clearance of the frontal ostium often results in persistent disease post-operatively [7,8].

In this study, 37% of the patients had undergone prior sinus surgeries. These patients had persistent disease in the frontal recess as a consequence of inadequate clearance at the primary sinus operation. This illustrates the importance of addressing disease that is present in the frontal recess and removing this common cause of ESS failure. Studies have shown that one of the commonest causes of the failure of endoscopic surgery of the sinuses is persistence of original disease in the frontal recess due to incomplete surgery. Excessive mucosal trauma resulting in an unstable middle turbinate which lateralizes to obstruct the frontal outflow tract is common cause of iatrogenic disease of the
frontal sinus [4]. In our study, 2 cases of allergic fungal sinusitis had recurrence and required revision FESS and this is due to incomplete removal of agger nasi cell. In the present study, recurrence of frontal sinus symptoms was encountered only in 3 sides (5.6%), all symptomatic patients had been managed medically. Post-operative endoscopic assessment revealed patency of the frontal sinus ostium in 51 sides (94.4%) and only 3 sides (5.6%) were obscured by adhesions which required division under local anesthesia in the outpatient setting. This is considered a low recurrence rate compared with published success rates for endoscopic frontal sinus surgery of 79% to 98% [9-11]. This 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 [12].

Wormald 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 0º endoscope. In addition, he wrote that axillary flap approach gives sufficient access to Kuhn type 3 cells using 30º endoscope without the need for combined external and endoscopic approach [13].

Various approaches to the frontal recess have been recommended. Stammberger et al., advocated clearance of the frontal recess from below, using angled telescopes and curved instruments [14]. This technique becomes increasingly difficult if frontal cells extend toward the skull base, especially if they reach the skull base and impinge on the frontal recess or frontal sinus (Kuhn type 3 cells) [15]. Difficulty is also increased if significant polyposis and mucosal disease are present because these increase the vascularity of the tissues. The technical skill required to work with angled telescopes and angled instruments is also considerable [6,15]. Stammberger et al., stated, “it is rare, and happens only when access is very broad, that a direct view into the frontal sinus can be obtained” [14]. In this study, the access provided by the axillary flap approach allowed 98% of the frontal sinus ostia to be identified with visualization of the frontal sinus through the ostia. The remaining frontal ostium required use of the minitrephine to clear and visualize the ostium.

Kuhn et al., recently described the “frontal sinus rescue procedure” that uses a mucosal flap from the middle turbinate remnant [16]. In this study, although the axillary flap has similar aspects to that of Kuhn et al., (use of a mucosal flap), the indications for the two procedures are vastly different. The axillary flap technique is suitable for patients who have not had extensive previous dissection in the frontal recess and who still have agger nasi and frontal cells present, whereas the technique of Kuhn et al., is designed for patients with scarring of the frontal ostium that cannot be successfully opened with normal endoscopic techniques.

An alternative to the wholly intranasal approach is the combined external and endoscopic approach. This has been advocated for the difficult frontal recess, especially for Kuhn type 3 cells impinging on the frontal ostium and sinus [8,15]. In the present study, the axillary flap approach gives good access to the frontal recess. It allowed Kuhn type 3 cells to be fully cleared by using 30º angled endoscope, access to the roof of the Khun type 3 cell was achieved by the exposure obtained from the axillary flap, which allowed passage of the curette over the top of the cell before the cell fractured and removed. With the axillary flap approach, most surgery in the frontal recess can be performed with a 0º endoscope, and this gives the surgeon the advantage of not having to work around the corner with angled telescopes and instruments. In our study, only one side of total 54 sides required a minitrephine of the frontal bone to visualize and clear the frontal sinus. So the axillary flap approach, by providing adequate access to the frontal recess, can avoid the morbidity associated with an external incision and trephination of the frontal bone.

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 with their nasofrontal approach I (NFA I) and Schaefer and Close 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 [17], whereas Schaefer and Close advocated removal of the bone above the insertion of the middle turbinate [18]. 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. This scarring can also inhibit endoscopic access to the frontal recess postoperatively for cleaning and diagnosis. This can be largely overcome if a mucosal flap is raised and redraped at the end of the procedure over this raw area [13]. As shown in our study, by the axillary flap approach only 3 sides of total 54 sides developed adhesions in the frontal recess area.

Conclusion:
The axillary flap approach to the frontal recess provides excellent access to the frontal recess and
allows clearance of cells in the recess with identification of the frontal ostium in the vast majority of cases. 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.

References


علاج الالتهابات المزمنة بالجيب الأنفي الجبهي

باستخدام نهج الرقعة الإبطية

لا يزال يعتبر نهج الجيب الأنفي الجبهي والردب الجبهي هو الجزء الأكثر صعوبة ومتكررة في جراحات تنظير الجيب الأنفي، فيسبب الموقع المتخيم والتشريح المتغير لهذه المنطقة وقربيها الشديد من العين والمغد تمنع الجراح من إجراء خطوات تشريحيّة مقبولة وذلك قد يعرض المريض لمضاعفات خطيرة.

وقد أظهرت الدراسات أن واحدا من الأساليب الأكثر شيوعا لتشجيع البقاء بالنظر في الجيب الأنفي هو إستقرار ووجود المرض الأصلي في الجيب الأنفي الجبهي بسبب عملية جراحية غير مكتملة، وقد يؤدى التشريح غير الصحيح في الردبين الجبهي بالإضافة إلى الرضوع المفرطة للغشاء المخاطي إلى عدم إستقرار القرين الأوسط فتدى بعضها جنبه، ذلك إلى عرقة مجرى الدم جداً الشبيه وذلك يعتبر سبباً شائعاً لحدوث مرض بسبب جراحة سابقة في الجيب الأنفي الجبهي.

وقد تم توصيف عدة مناهج الردبين الجبهي، وتشمل على: النهج الخلفي الأمامي حيث يتم تحديد قاع الجمجمة في الجيب الغرطي الخلفي أو الجيب الوتدى ومتبعًا علكة تحميد قاع الجمجمة والردبين الجبهي، يمكن تلافي هذا النهج عندما يكون هناك أمراض مصاحبة في المجموعة الخلفية من الجيوب الأنفية، ولكن يكون غير ضروريا عندما يقتصر المرض على المجموعة الأمامية من الجيوب الأنفية أو عندما يكون المرض في الجيب الجبهي فقط.

النهج الآخر هو نهج الرقعة الإبطية للقرين الأوسط المؤدي إلى الردبين الجبهي، وهو سيطرة وصول أفضل إلى منطقة الردبين الجبهي ويستند على التشريح في وجود علاقة وثيقة لناية الأذى مع الردبين الجبهي، يتم إزالة الجدير الأمامي لثقب الأذى بعد رفع الرقعة الإبطية، يتم تشريحة الردبين الجبهي بمستوى أطعمة الأشعة المقطعية والخطوتي المسبصة للجراحة ثم يتم إزالة القانية والخلايا المحيطة لتفتح الردبين الجبهي على أوسط نطاق مكاني.

وقد أظهرت النتائج في هذه الدراسة باستخدام نهج الرقعة الإبطية للردبين الجبهي أثناء معالجة التهاب الجيب الأنفي الجبهي الزمن، أنه قد تم التعرف على قوة الجيب الجبهي في 98% من المرضى، وبعد ستة أشهر من المتابة واجهنا تكرار أعراض المرض في الجيب الأنفي الجبهي في 3 جوانب فقط (6.7%) وحوالي إرتفاع سريع للمرض في الأشعة المقطعية بعد عملية الجراحة في 6 جوانب (11.1%). وقد تطلب إجراء جراحة مراجعة في إثنين من المرضى، ووجدت التصويرات في الردبين الجبهي في 2 جوانب (2.9%) وتمت إزالتها تحت تأثير التخدير الموضعي، ويعتبر هذا المعدل منخفض مقارنة مع معدلات النجاح المتورطة لمناظير جراحة الجيب الأنفي الجبهي والتي تصل من 29% إلى 79%.

و هذا المعدل المنخفض من التكرار بسبب إتباع المراقبة أثناء الجراحة والعناية بالردبين الجبهي، أيضاً تغطية منطقة العظم المكشوفة من القرين الأوسط يمكن تكون الإنصافات كما يمكن تكرار المرض.