



Role of Modified Endoscopic Medial Maxillectomy in persistent chronic maxillary
sinusitis

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Abstract

Objective: Functional endoscopic sinus surgery (FESS) has a long-term high rate of success for symptomatic improvement in patients with medically refractory chronic rhinosinusitis. As the popularity of the technique continues to grow, however, so does the population of patients with postsurgical persistent sinus disease especially in those with a large window for ventilation and drainage. In addition chronic infections of the sinuses especially fungal sinusitis have a higher incidence of recurrence even though a wide maxillary ostium had been performed earlier. This subset of patients often represents a challenge to the otorhinolaryngologist. We

have performed modified endoscopic medial maxillectomy (MEMM) for such patients' with persistent maxillary sinus disease as a means of providing effective drainage and clearance of secretions.

Design: A retrospective review was done of all patients with persistent maxillary sinus disease who had undergone modified endoscopic medial maxillectomy between 2009 and 2012. We studied patient demographics, previous surgical history, follow up details and categorized the types of Endoscopic Medial Maxillectomies performed in different disease situations.

Subjects and interventions: We performed Modified endoscopic medial maxillectomies (MEMM) in 37 maxillary sinuses of 24 patients.

Results: The average age was 43.83 years. Average follow up was 14.58 months. All patients had good disease control in the post operative visits with no clinical evidences of recurrences.

Conclusion: Modified endoscopic medial maxillectomy appears to be an effective surgery for treatment of chronic, recalcitrant maxillary sinusitis.

Key words: endoscopic medial maxillectomy, maxillary sinusitis

Introduction

The central dogma of FESS is restoration of the natural sinus physiology namely mucociliary clearance and ventilation. The causes for failure include mucosal, environmental and iatrogenic factors. Iatrogenic factors involve inadvertent stripping of sinus mucosa, damage to the cilia bearing mucosa with the micro-debrider or other instruments, exposure of bone, circumferential damage to the sinus ostium; improper widening of sinus ostium permitting recirculation of mucous, poor mucociliary clearance etc. The mucociliary clearance of the maxillary sinus which is the largest of all the paranasal sinuses is always towards the natural ostium. It begins from the floor of the sinus and proceeds along its walls towards the natural ostium and hence is against gravity, a factor which can work against the restoration of normal physiology in a disease situation. Previous surgeries such as Caldwell-Luc damage the maxillary sinus mucosa leading to a loss of mucociliary function ⁽¹⁾. Allergic fungal rhinosinusitis (AFRS) is believed to account for 5-10% of chronic rhinosinusitis cases ⁽²⁾. The disease is typically recalcitrant despite medical and surgical therapy ⁽³⁾. Systemic steroids often provide some relief, but relapse usually follows once the steroids are withdrawn ⁽³⁾. Surgery is the cornerstone of treatment. The goals of surgery are threefold: complete extirpation of all allergic mucin and fungal debris, permanent drainage and ventilation for the affected sinuses while maintaining intact mucosa, and post-operative access to the previously diseased areas ⁽⁴⁾. Both systemic and topical steroids are important in preventing the recurrence of disease ⁽⁵⁾. However in spite of the above measures a proportion of the cases presents with recurrences and need revision surgery. Revision FESS aims to overcome these shortcomings but can fall short due to irreversible damage to the mucous membrane due to prior surgery. Endoscopic medial

maxillectomy is a radical procedure which includes removal of uncinate process, bulla, inferior turbinate, middle turbinate, medial maxillary wall with the nasolacrimal duct ⁽⁶⁾. At present its indication is for resection of sinonasal tumours namely sinonasal papillomas ⁽⁶⁾. We have performed variations of this technique in patients with chronic recalcitrant maxillary sinusitis in accordance with the status and extent of the sinus disease. The purpose of this paper is to share the cumulative experience of all the cases operated using this technique and to highlight the effectiveness of this technique in dealing with persistent maxillary sinusitis. We have also categorized the types of Endoscopic Medial Maxillectomies performed in different disease situations.

Materials and Methods:

Endoscopic medial maxillectomy as a means of treating recalcitrant maxillary sinusitis was performed on 24 patients between 2009 to 2012 in the Sinus and Nose hospital, Santhome, Chennai which is a tertiary care centre for nasal and sinus diseases. These patients had undergone multiple endoscopic surgeries elsewhere or our centre in the past but were still symptomatic. Patients' comprised of those with chronic sinusitis, nasal polyposis, AFRS, osteomyelitis and persistent sinusitis following surgery and chemotherapy. All patients underwent a diagnostic nasal endoscopy. All of them had a wide middle meatal antrostomy but the antral mucosa was found to be unhealthy with persistent disease. A Methylene Blue dye test was performed in these patients to evaluate the efficiency of the mucociliary clearance mechanism.

This was done in two ways. When there was a large ostium 0.5 cc of Methylene Blue dye was instilled into the antrum taking care not to soil the nasal mucosa. Alternatively the dye could also be instilled into the sinus through a trocar in the canine fossa. We wait for 10-15 minutes after which we look for the movement of the dye. We can deduce three conclusions from this test. Decision to surgically intervene and to determine the type of surgery was inferred by performing the dye test.

a. Normal movement of the dye

This was indicated by movement of the dye as 'blue streaks' along the walls of the maxillary sinus towards the natural ostium. In patients with a normal functioning sinus this movement is observed within minutes of instilling the dye

b. Delayed movement of the dye

There appears to be some movement of the dye in a few pockets but it does not quite reach the natural ostium.

c. No movement of the dye

There is no movement of the dye at all.

It should be noted that we do not perform the dye test in patients with fungal balls or polyps in the maxillary sinus as the mucosa is deemed to be abnormal. We assess the extent of surgery based on the findings on table.

All patients underwent a preoperative CT scan and surgical profile. Preoperative CT scan is mandatory in all patients undergoing revision sinus surgery as it defines the bony anatomy (or rather the loss of it due to previous surgery) well ⁽⁷⁾. The middle meatal antrostomy should be

examined for aspects of retained uncinata process in the region of the natural ostium of the maxillary sinus or unventilated cells missed on the primary procedure, such as the infraorbital (Haller) cells ⁽⁷⁾. The frontal recesses should be identified, and patency should be determined. Careful attention should be paid to the underlying bone for evidence of osteitis represented radiographically as thickened irregular bone ⁽⁷⁾.

The surgery was performed under general anaesthesia. Details of the surgery are described in the surgical method. Following surgery a merocoel pack is kept in the maxillary sinus and ethmoid cavity which is removed after 5 days. The patient receives parenteral antibiotics during his stay in the hospital (usually 24 hours) and is discharged on oral medications. Patients with AFRS were started on oral steroids which were gradually tapered. We recommend nasal douche with saline solution once every alternate day for a period of 3 weeks after pack removal as it facilitates in the cleaning of the post operative cavities. We follow up the patient at 1st week, at one month PO, 3 months PO and at 6 monthly intervals thereafter.

Surgical method:

The aim of the surgery is to provide gravity dependent drainage of the maxillary sinus. All procedures were done under general anesthesia. Pre-operative packing was done with 4% lignocaine and ephedrine soaked pledgets in all of our patients. Infiltration of 2% xylocaine with 1/200,000 adrenaline was given. We have performed 3 types of Modified Endoscopic Medial Maxillectomies (**see table 1**). Type I, Type II a and b are performed for inflammatory disease of

the Maxillary sinus. The radical medial maxillectomy is reserved for Maxillary sinus tumours, which falls outside the range of discussion in this article.

Type I modified endoscopic medial maxillectomy

The procedure involves removal of intervening tissue between the two windows. This is done in patients with a prior inferior meatal antrostomy and a middle meatal antrostomy(Caldwell luc) . Using a back biting forceps the antrostomy is widened anteriorly. A straight punch is then used to extend it up to the posterior wall of the maxillary sinus. A cut is given using an osteotome at the anterior border of the attachment of the middle turbinate. This cut passes through the inferior turbinate encompassing the inferior meatal opening. The inferior cut is given along the floor of the nasal cavity in the inferior meatus extending posteriorly up to the posterior wall of the maxillary sinus. The superior and inferior cuts are joined by the posterior cut using an osteotome. Note that the middle turbinate, nasolacrimal duct and anterior portion of the inferior turbinate are preserved.

Type IIa modified endoscopic medial maxillectomy

This is performed for patients with delayed dye clearance. The surgery begins with the type I modified endoscopic medial maxillectomy. Here the medial wall of the maxillary sinus is removed right down to the nasal floor inferiorly and up to the posterior wall posteriorly. The anterior limit of dissection is the nasolacrimal duct. The anterior end of the inferior turbinate and the medial wall anterior to the nasolacrimal duct is preserved. The drainage of the sinus is by gravity. Post operative nasal douching will be very effective for these patients. However the inferior turbinate is resected to provide complete exposure of the maxillary sinus for drainage.

The nasolacrimal duct should be identified and preserved. In case of inadvertent injury, it should be transposed higher up near the attachment of the middle turbinate.

Type IIb modified endoscopic medial maxillectomy

This surgery is an extension of the type IIa modified endoscopic medial maxillectomy wherein the antral mucosa is completely stripped off by a canine fossa Caldwell-Luc approach.

Endoscope facilitates the removal of mucosa from all nooks and corners of the antrum. A type IIa modified endoscopic medial maxillectomy is performed. Infiltration is then given in the sublabial region with 2% xylocaine and 1:200,000 adrenaline. A canine fossa antrostomy is made and the opening is widened using bone nibbler. A freer's elevator is then used to elevate the maxillary sinus mucosa. It is important to note that these patients have been operated previously with varying degrees of damage to the mucous membrane. Hence there will be scarring which will make mucosal elevation and stripping a challenging exercise and requires patience on the part of the surgeon. The areas which may offer difficulty include the sinus recesses and the anteromedial wall. In these areas, the mucosa may be adherent and may require drilling with a diamond burr.

Results:

We performed Modified endoscopic medial maxillectomies (MEMM) in 37 maxillary sinuses of 24 patients. The average age was 43.83 years. 16 patients had history of previous surgery. 4 patients had AFRS of which one had been previously operated. 6 patients had prior Caldwell Luc

surgery. 4 patients had fungal balls and one patient had chronic indolent fungal sinusitis. 3 patients had osteomyelitis of the maxilla due to prior surgery or fungal infection. The details of the patients are listed in **table 2**.

Average follow up was 14.58 months. One patient had post operative bleeding from sphenopalatine artery which was controlled in the operation theatre by cauterization. One patient had hypoplastic maxillary sinus 6 months after surgery though he remains asymptomatic at present. All patients had good disease control in the post operative visits with no clinical evidences of recurrences.

Discussion

Medial Maxillectomy through a lateral rhinotomy incision involves the removal of the lateral nasal wall, ethmoid labyrinth, and medial portion of the maxilla. It was the gold standard for the removal of inverted papilloma. It has the advantages of excellent exposure of the lateral nasal wall and paranasal sinuses ^(8,9). Endoscopic Modified Medial Maxillectomy is transnasal removal of removal of uncinate process, bulla, inferior turbinate, middle turbinate, medial maxillary wall with the nasolacrimal duct ⁽⁶⁾. Hitherto Endoscopic MMM was reserved for tumours of the Maxillary Sinus only ⁽⁶⁾. In the recent times, this thinking is slowly but steadily changing and one finds a few reports of Endoscopic Medial Maxillectomy for recalcitrant Maxillary Sinusitis ^(11,12,13,14). Daniel Simmen et al had described three types of maxillary sinusotomy ⁽¹⁰⁾. Type I involves widening of the natural ostium to a diameter of 1cm. Type II involves widening it posteriorly and inferiorly to a maximum of 2cm. Type III involves widening

it close to the level of the posterior wall of the maxillary antrum and anterior to the lacrimal sac and inferiorly to the base of the inferior turbinate. They recommend type III for extensive sinus disease, antrochoanal polyp removal and previous surgery. We feel that merely taking down the medial wall of the maxillary antrum does not serve the purpose in patients with irreversible mucosal injury and necessitates a more radical procedure like a type IIb modified endoscopic medial maxillectomy. This is because the goblet cells keep secreting mucus which accumulates in the sinus and leads to a 'sump' effect. In patients with chronically diseased maxillary sinuses, poor mucociliary clearance may result from long-standing inflammation or scarring from previous surgery. This subset of patients often has persistent sinus disease despite medical therapy and adequate antrostomy. We are of the opinion that the mucociliary clearance is the single most important factor in determining the outcome in maxillary sinus after surgery. If the mucociliary clearance is competent, we have a functioning sinus otherwise the disease continues to persist. At present there are no definitive guidelines for the treatment of this subset of patients. Woodworth et al reported that in a retrospective review comprising 19 patients that modified endoscopic medial maxillectomy are both a safe and an effective treatment for chronic maxillary sinusitis refractory to standard medical and endoscopic surgical management ⁽¹¹⁾. Wang et al reported complete resolution of the disease in 80% of their patients' ⁽¹²⁾. Cho et al performed an endoscopic mega antrostomy which involved extending the antrostomy through the posterior half of the inferior turbinate down to the floor of the nose, creating a significantly enlarged antrostomy in 28 patients and reported a success rate of 74% ⁽¹³⁾. An interesting study conducted by Shatz Anat et al on 15 children with cystic fibrosis

revealed marked improvement in sinus drainage and symptoms after performing medial maxillectomy and Caldwell Luc ⁽¹⁴⁾.

The patients on whom we have operated can be likened to those suffering from cystic fibrosis as there is partial or complete loss of normal mucosa and hence mucociliary clearance due to the previous surgery. Hence we feel we are justified in performing a procedure aimed at providing gravity dependent drainage for the sinus. We have also performed Modified Endoscopic Medial Maxillectomy for patients with AFRS and fungal ball of the maxillary sinus. We have observed no recurrence of the disease in any of these patients (**see table2**).

Our study is an attempt to define this subset of patients and a protocol for the treatment of these patients (**see algorithm 1**). We have attempted to evaluate the sinus physiology using a simple and easily reproducible Methylene blue dye test which can be performed in the office setup. Based on the ciliary movement and nasal endoscopy findings we advocate 3 solutions to resolve the problem.

1. Normal movement of dye

A wide middle meatal antrostomy is usually sufficient in this subset of patients. These patients usually have normal maxillary sinus mucosa and their persistent symptoms are a result of frontal or sphenoidal disease. Some patients have multiple windows for drainage namely, an inferior antrostomy and a middle meatal antrostomy. . These patients are still symptomatic due to recirculation phenomenon where there is circular movement of the mucous around the artificially created window. In these patients it is preferable to perform a type 1 modified endoscopic medial maxillectomy (see table1).

2. Delayed movement of dye

This indicates that there is a certain degree of mucociliary clearance which in spite of being present is inadequate to prevent recurrent infection of the sinus. We advocate a surgery which would ensure gravity dependent drainage of the sinus. In these patients we performed a type 2a modified endoscopic medial maxillectomy (see table 1). We do not advocate mucosal stripping in these patients due to presence of viable mucosa.

3. No movement of dye

This indicates irreversible loss of ciliary function and hence a simple widening of the already widened ostium (i.e. a mega ostium) would not suffice. We advocate a surgery which would ensure gravity dependent drainage of the sinus as it will be the only means for drainage in the absence of viable mucosa. We performed a modified endoscopic medial maxillectomy type 2b (**see table 1**) for patients with this finding.

Conclusions:

Though many would be reluctant to advocate a radical surgery like a medial maxillectomy for persistent maxillary sinusitis it is imperative to understand the physiology and its alteration following surgery and chronic infection which leads to a radical change in the functioning capacity of the maxillary sinus. The sinus has to work against gravity to expel its waste material is the single most important factor in the production of recalcitrant sinusitis which does not respond to surgical methods described hitherto. Bringing the medial maxillary wall to the level of the nasal floor appears to alleviate symptoms in these patients. Though the ciliary

mechanism is lost, the goblet cells continue to secrete mucous which results in stasis, is an additional factor. These patients would require removal of secreting mucosa in addition to MEMM. We have attempted to highlight this point through this article.

Conflict of interest: None

Financial Disclosures: None

Authorship Contribution

P Thulasidas: Study design, data collection, data interpretation, analysis

V Venkatraman: Data collection, manuscript, analysis

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Table 1

Types of modified endoscopic medial maxillectomy and indications (MEMM)

Type	Indication	Procedure
I	-Recirculation mechanism due to two windows in middle meatus and inferior meatus (e.g.; previous Inferior meatal antrostomy)	Middle meatus and inferior meatal windows are joined created a mega ostium, inferior turbinate partially resected
II	Abnormal dye test indicating disease of maxillary sinus mucosa	
a	- Delayed clearance of dye - Allergic fungal rhinosinusitis	Modified endoscopic medial maxillectomy, nasolacrimal duct preserved, maxillary sinus mucosa left intact
b	No clearance of dye	Modified endoscopic medial maxillectomy, nasolacrimal duct preserved, maxillary sinus mucosa stripped off by through an antral window

Table 2**PATIENT DETAILS**

Age	History	Surgery (MEMM)	Complications	Follow up	Recurrence
42	2* ESS	Type IIa u/l	Post operative bleeding	6 months	None
48	Caldwell luc	Type I u/l	none	24 months	None
20	Fungal ball with osteomyelitis	Type IIa u/l	none	14 months	None
62	ESS	Type IIa b/l	none	24 months	None
40	Caldwell luc 5* ESS	Type IIb b/l	none	7 months	None
61	Fungal ball	Type IIa u/l	none	8 months	None
49	Fungal ball	Type IIa u/l	none	7 months	None
53	Chronic sinusitis post radiotherapy and chemotherapy	Type IIb u/l	Hypoplastic maxillary sinus	5 months	None
65	Osteomyelitis	Type I u/l	None	5 months	none
45	AFRS	Type IIb b/l	none	36 months	None
45	3* ESS	Type IIb u/l	none	8 months	None
19	AFRS	Type IIa b/l	none	5 months	None
44	Caldwell luc	Type I u/l	none	26 months	None
42	AFRS 3* ESS	Type IIa b/l	none	24 months	None
50	2* ESS	Type IIa b/l	none	8 months	None
41	2 *ESS Caldwell luc	Type IIa and Type IIb	none	19 months	none
44	3* ESS	Type IIa b/l	none	22 months	None
52	2* ESS	Type IIa u/l	none	21 months	None
48	Caldwell luc	Type I b/l	none	4 months	None
29	Caldwell luc Fungal ball	Type IIa u/l	none	9 months	none
34	2* ESS	Type IIa b/l	none	17 months	None
44	3* ESS	Type IIb b/l	none	21 months	none
37	AFRS	Type IIa b/l	none	12 months	None
38	3* ESS	Type IIa b/l	none	18 months	None

u/l= unilateral

b/l= bilateral

* = indicates number of previous operations

ESS= endoscopic sinus surgery

AFRS= allergic fungal rhinosinusitis

Algorithm 1:

Treatment of chronic recalcitrant maxillary sinusitis

Patient with recalcitrant, persistent maxillary sinusitis

- Post operative
- Fungal origin



- CT scan

- Diagnostic nasal endoscopy



Perform Methylene blue dye test



Normal clearance

Delayed clearance

No clearance



- Type I MEMM

Type IIa MEMM

Type IIb MEMM

- Frontal or sphenoid surgery

- Wide middle meatal antrostomy