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Endoscopic-Modified Medial Maxillectomy for the Nonfunctioning Maxillary Sinus

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Abstract

Background: Middle meatal antrostomy (MMA) is the traditional intervention for chronic maxillary sinusitis but often fails to correct a nonfunctioning maxillary sinus that has lost its capability for mucociliary clearance. Endoscopic-modified medial maxillectomy (EMMM) can reshape the maxillary sinus and avoid a “sumping” effect, preventing secondary bacterial colonization, encouraging dependent drainage, and promoting effective nasal irrigation.

Objectives: We describe a modification of the EMMM surgical technique in patients with recalcitrant maxillary sinusitis and perioperative outcomes.

Methods: Consecutive adult patients with nonfunctioning maxillary sinuses managed with EMMM were assessed. Primary outcomes were the resolution of the presenting symptom and the absence of mucostasis. Secondary outcomes were early (<90 days) and late (>90 days) morbidity.

Results: Fifty-seven patients (51.7 ± 17.5 years, 56.1% female) were assessed. Fifty-two patients had complete resolution of their presenting symptom (91.2% [95% CI: 80.7–97.1]) and 52 patients had an absence of mucostasis (91.2% [95% CI: 80.7–97.1]). Those with persistent crusting were also those with symptoms. Early morbidities included temporary dysesthesia (3.2%), bleeding (1.1%), and pain (3.2%), with no late morbidities.

Conclusion: EMMM is a robust approach for salvaging a nonfunctioning maxillary sinus. The procedure enhances nasal irrigation, supplants mucociliary clearance, and discourages dependent mucus retention.

Keywords

endoscopic nasal and sinus surgery, endoscopic endonasal surgery, maxillary sinus, maxillary sinusitis, paranasal sinus diseases, modified medial maxillectomy, salvage sinus surgery, recalcitrant maxillary sinusitis, nonfunctioning maxillary sinus disease, chronic maxillary sinusitis

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Introduction

Middle meatal antrostomy (MMA) is the traditional operation for chronic maxillary sinusitis with the rationale for such surgery having historical roots in ventilatory concepts of disease. However, our understanding of pathophysiology has matured and failure of mucociliary clearance is recognized as an important factor. Persistent mucus/crusting in the inferior aspect of the sinus results from failed function and is referred to as “sumping.” Endoscopic-modified medial maxillectomy (EMMM), originally used for tumor removal, is commonly utilized for recalcitrant or nonfunctioning maxillary sinus disease.^{1,2} This salvage surgery aims to maximize the mechanical lavage of topical therapies and increase dependent, passive drainage. We describe a modification of EMMM, that obliterates the sinus floor below the nasal floor and perioperative outcomes.

Materials and Methods

Appropriate IRB approval from (St Vincent’s hospital human research ethics committee—2019/PID13822) was obtained for this study. A retrospective review of consecutive adult patients with nonfunctioning maxillary sinuses managed with EMMM was performed.

Outcomes

Primary outcomes measured were (1) resolution of presenting symptom and (2) absence of crusting/mucus pooling on endoscopic examination. Secondary outcomes were surgical morbidity, defined as early (<90 days) or late (>90 days). Early morbidity included infection, temporary paresthesia, bleeding, pain, and adhesion. Late morbidity included epiphora, stenosis, and permanent paresthesia.

Preparation

Patients were prepared topically with 1% ropivacaine with 1:2000 adrenaline-soaked cotton pledgets. Endoscopically, nasal mucosa was injected with 1% ropivacaine with 1:100,000 adrenaline across the lateral wall, middle turbinate, inferior turbinate, and floor.

Surgical Technique

MMA and anterior ethmoidectomy is first performed, followed by curved artery clip compression of the inferior turbinate head, aiming toward the maxillary ostium. Iris scissors release the turbinate from the medial maxillary wall posterior to the compressed line, leaving a turbinate stump that is bipolar cauterized.

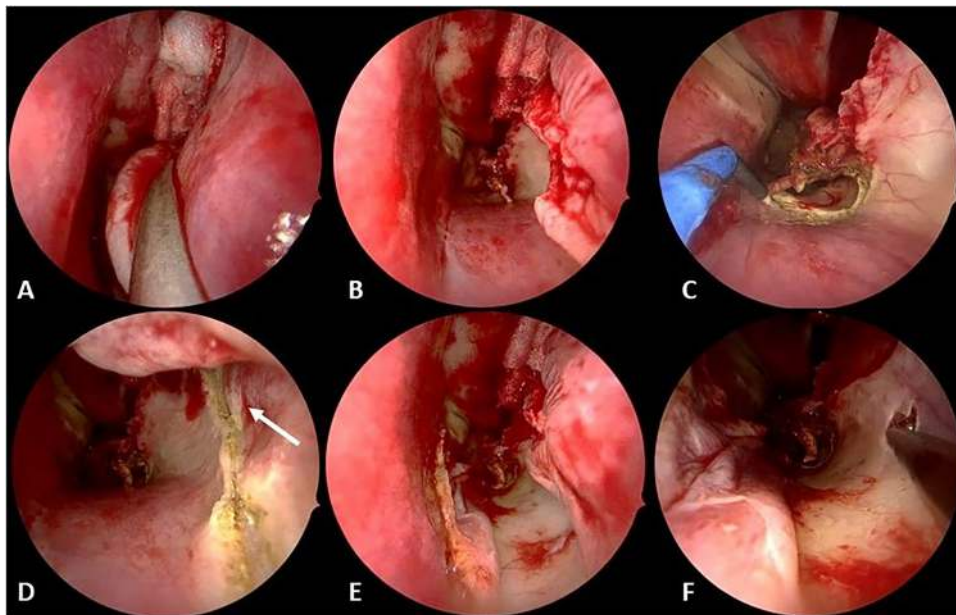


Figure 1. Inferior meatal flap creation. Representative intraoperative endoscopic imaging of the left nasal cavity. (A) The inferior turbinate’s head is compressed toward the maxillary ostium. (B) The inferior turbinate is divided from the medial maxillary wall with a preserved posterior stump. (C) The posterior incision is perpendicular to the nasal cavity and extends from the posterior maxillary sinus wall to the mid-hard palate/nasal floor using needle-point diathermy. (D) The anterior incision runs at a 45-degree angle from the anterior margin of the antrostomy, posterior and under Hasner’s valve (arrow), to the anterior limit of the nasal floor in the midline. (E) The inferiorly based mucosal flap is elevated subperiosteally from the nasal floor to the medial maxillary wall. (F) The medial maxillary wall is punctured with an ethmoid curette (Jessica’s punch).

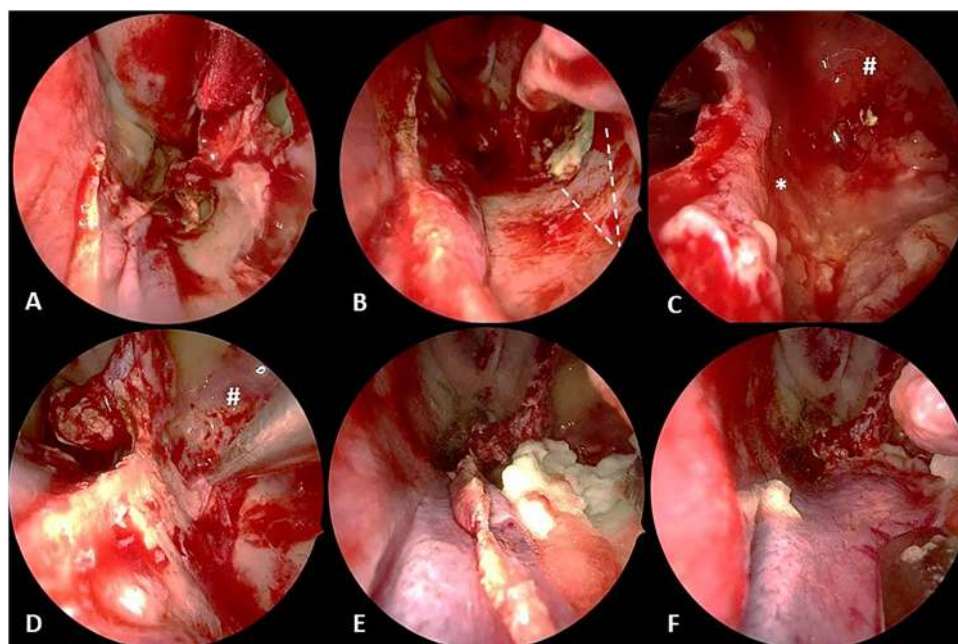


Figure 2. Medial wall of the maxillary sinus and nonfunctional mucosa removal with flap replacement steps. Representative intraoperative endoscopic imaging of the left nasal cavity. (A) The medial wall is divided upward and downward from the “punch.” (B) The triangular bone wedge represents the “prelacrimal” anterior extension of the maxillary sinus (Snidvongs’ wedge—Dash line area). (C) The nonfunctional hyperplastic mucosa in the inferior maxillary sinus. (D) The nonfunctional hyperplastic mucosa in the inferior maxillary sinus is removed. (E) The hemostatic matrix with thrombin is filled to the bottom of maxillary sinus until the level of nasal floor. (F) The inferior meatal flap is unfolded on the top of the matrix. Posterior wall of maxillary sinus (number sign), Medial wall of maxillary sinus (asterisk sign).

Table 1. Baseline Characteristics of Endoscopic-Modified Medial Maxillectomy Case Series.

	EMMM (N = 57)
Gender, N (%)	
Male	25 (43.9)
Female	32 (56.1)
Age (years), mean $\pm$ SD	51.7 $\pm$ 17.5
Prior maxillary surgery, N (%)	36 (63.2)
Diagnosis, N (%)	
Chronic rhinosinusitis without nasal polyps	19 (33.3)
Chronic rhinosinusitis with nasal polyps	19 (33.3)
Fungal ball	10 (17.5)
Cystic fibrosis	7 (12.3)
Primary ciliary dyskinesia	1 (1.8)
Granulomatosis with polyangiitis	1 (1.8)

EMMM = endoscopic-modified medial maxillectomy, N = number, SD = standard deviation.

An inferior meatal flap is created, with the posterior incision placed anterior to the soft palate junction. This incision extends from the posterior maxillary sinus wall to the mid-hard palate/nasal floor using needle-point diathermy (0016AM Megadyne, NJ, USA). Anteriorly, the incision runs at a 45-degree angle from the anterior margin of the antrostomy, posterior, and under Hasner’s valve, to the

Table 2. Overall Morbidities of Endoscopic-Modified Medial Maxillectomy Case Series.

	EMMM (N = 95) N (%)
Surgical morbidity	
Early (<90 days)	
Infection (require additional antibiotics)	0 (0)
Temporary paraesthesia	3 (3.2)
Bleeding (require intervention)	1 (1.1)
Pain (require additional pain treatment)	3 (3.2)
Adhesion (require additional postoperative visits)	0 (0)
Late (>90 days)	
Epiphora	0 (0)
Nasal cavity stenosis	0 (0)
Permanent paraesthesia	0 (0)

EMMM = endoscopic-modified medial maxillectomy, N = number.

anterior limit of the nasal floor in the midline. These incisions are to the bone and the inferiorly based mucosal flap is elevated subperiosteally (Figure 1).

The medial maxillary wall is punctured with an ethmoid curette (Jessica’s punch) and extended supero-inferiorly from the “punch” with a 2-mm angled Kerrison rongeur. Straight through-cutting forceps remove the medial wall posteriorly and backbiting forceps anteriorly. A 4.3-mm straight

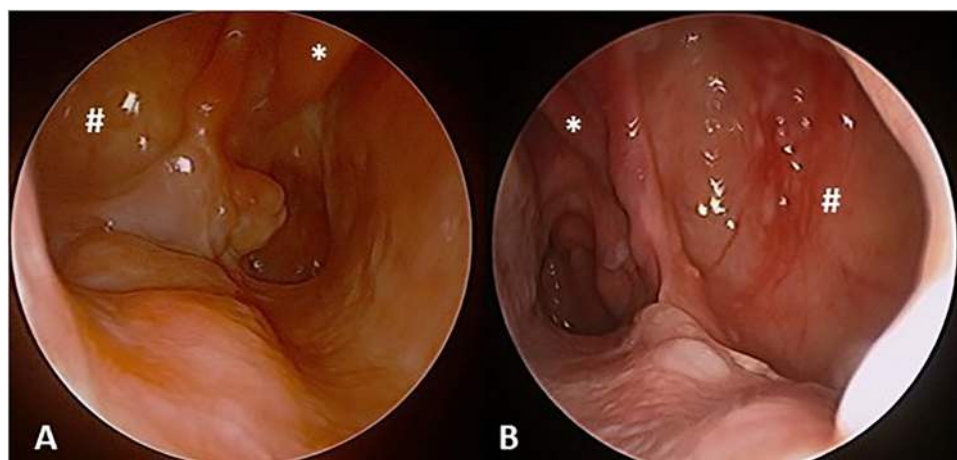


Figure 3. Postoperative view of the maxillary sinus. Representative postoperative endoscopic imaging of both nasal cavities. 3-month postoperative view of right (A) and left (B) maxillary sinuses after EMMM. Posterior wall of the maxillary sinus (number sign), Middle turbinate (asterisk sign).

microdebrider (Straightshot M5 Microdebrider, Medtronic, FL, USA) removes cut bone and mucosa. Drilling with a 4-mm 15° diamond burr removes the triangular bone wedge representing the “prelacrima” anterior extension of the maxillary sinus (Snidvongs’ wedge; see acknowledgement). Removing this wedge is essential for exposure and instrumentation of the sinus cavity. Any pneumatization of the sinus cavity that extends inferomedially is exposed by drilling. The greater palatine nerve and artery within their bony canal are posterior and should be preserved (Figure 2).

Hyperplastic, nonfunctional mucosa in the inferior maxillary sinus is removed subperiosteally with a ball probe/curette. Hemostatic matrix with thrombin (Ethicon, New Jersey, USA) is filled to the bottom of the maxillary sinus until the level of the nasal floor. The inferior meatal flap is unfolded on top of the matrix (Figure 2). Free mucosal grafts can be harvested from the inferior turbinate to cover any exposed bone. Finally, a Mersel (Medtronic, FL, USA) finger gloved spacer and hyaluronic acid gel (Bioregen, Changzhou, China) are used to pack the maxillary sinus. The surgical steps are illustrated in Video 1.

Postoperative Care

Patients were discharged on the same day with nasal irrigations commencing on the first postoperative day and spacers kept for 7–14 days. Amoxicillin/clavulanic acid was given for 10 days, and prednisone was given at 25 mg daily for 7–14 days.

Results

Fifty-seven patients (51.7 ± 17.5 years, 56.1% female) were assessed (Table 1). Fifty-two patients had complete resolution of their presenting symptom (91.2% [95% CI: 80.7–

97.1]) and 52 patients had absence of mucostasis (91.2% [95% CI: 80.7–97.1]). Those with persistent crusting were also those with symptoms. Follow-up was 47.0 ± 21.4 months. Early morbidities included temporary dysesthesia (3.2%), bleeding (1.1%), and pain (3.2%), with no late morbidities noted (Table 2).

Discussion

The EMMM technique described evolves from previous descriptions,^{1,2} with adding aggressive drilling of the triangular bone wedge, hyperplastic-nonfunctional mucosa removal, and obliteration of the inferior maxillary sinus with an inferior meatal flap laid across the gelatin matrix (Figure 3). The anterior incision that runs at a 45-degree angle creates a sizable flap that can cover the raw bone after drilling. Additionally, the triangular wedge of bone allows complete exposure of the “prelacrima” anterior extension of the maxillary sinus. The authors’ approach has changed over time as failures from traditional EMMM were mainly due to persistent crusting/sumping inferiorly. The nonfunctioning dependant mucosa that requires “uphill” mucociliary clearance is thought to be the main factor in the failure of standard MMA or traditional EMMM. The removal of this nonfunctioning mucosa and obliteration of the inferior (cf. nasal floor) space facilitates passive gravity dependant mucus clearance.

The authors’ EMMM techniques aim to reshape the maxillary sinus, avoid the sumping effect, and encourage dependant drainage and effective irrigation. Nasal irrigation can penetrate the maxillary sinus after EMMM better than standard MMA.³ Additionally, reducing mucostasis is likely to prevent secondary infection. Stagnant/dead biologic material likely predisposes to bacterial colonization. In this study, absence of mucostasis (91.2% [95% CI: 80.7–97.1]) was

observed at 12 months. In patients with treated maxillary fungal ball, the need for antibiotics was higher when mucostasis was observed (60% v 13%, $p = 0.05$).⁴ Therefore, preventing secondary infection is probable if mucostasis is reduced.

The modification of EMMM is applied to facilitate mucociliary failure in patients presenting with persistent mucus/crusting in the inferior aspect of the sinus or evidence of “sumping” from the CT scan, even if they have not had a history of previous surgery. This technique benefits patients with nonfunctioning maxillary sinuses, such as those with a long-standing maxillary fungal ball. Almost 20% of this group of patients still experiences persistent mucostasis despite adequate MMA.⁴ Patients with a fungal ball may have an underlying mucociliary clearance dysfunction, either preexisting or secondary to a long-standing fungal ball.⁴ EMMM modification is also helpful for patients with prior adhesions/scarring, mucus plugging in hypersecretory conditions (allergic fungal rhinosinusitis), cystic fibrosis, neoplasia associated with extensive mucosal removal, and/or radiotherapy. Outside these indications, the authors rarely perform EMMM as a primary intervention for chronic rhinosinusitis.

Conclusion

EMMM is a robust, low-morbidity salvage surgery addressing the nonfunctioning maxillary sinus. The procedure enhances nasal irrigation and discourages dependent mucus retention.

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Declaration of Conflicting Interests

The authors declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this

article: Richard J. Harvey is consultant/advisory board with Medtronic, Novartis, Glaxo-Smith-Kline and Meda pharmaceuticals. He has been on the speakers' bureau for Glaxo-Smith-Kline, Astra-zeneca, Meda Pharmaceuticals and Seqirus. Larry Kalish is on the speakers' bureau for Mylan and Seqirus Pharmaceuticals. Raewyn G. Campbell is on the speakers' bureau for Medtronic, Seqirus, GSK, and Viatris. All other authors have no personal, financial, or institutional interest in any drugs, materials, or devices described in this article.

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Supplemental Material

Supplemental material for this article is available online.

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