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Nasal Crust-Related Morbidity and Debridement After Endoscopic Skull Base Surgery

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Abstract

Introduction: Nasal crust after endoscopic skull base surgery can cause nasal congestion, obstruction, and pain, which can affect quality of life. The use of debridement aims to provide symptomatic relief and improve quality of life. Generally, most adult patients tolerate office-based debridement, except in a few select patients that require further sedation in the operating room for a debridement. The study sought to determine the rate of symptomatic crust-related morbidity and the rate of debridement in both the office and the operating room.

Methods: Premorbid, operative, and postoperative data of adult patients who had endoscopic skull base surgery in our institution from 2014 to 2018 were reviewed retrospectively. The characteristics of nasal symptoms in the postoperative period were determined and the number of debridements in the office and the operating room were analyzed.

Results: Two hundred and thirty-four (234) patients with 244 surgeries were included in the study. The majority, 68.9%, had a sellar lesion and a free mucosa graft (FMG) was the most common skull base reconstruction at 53.5%. One hundred and twenty (49.0%) had crust-related symptoms during the postoperative period and 11 patients (4.5%) required the operating room for debridement. The use of a pedicled flap, anxiety, and preoperative radiotherapy were significantly associated with intolerance to in-office debridement (p-value=0.05).

Conclusions: The use of a pedicled flap or anxiety may predispose patients to require an OR debridement. Previous radiotherapy also influenced the tolerance to the in-office debridement.

Keywords
- Nasal crusting
- endoscopic skull base surgery
- nasal congestion
- debridement
- anxiety

Introduction

The formation of nasal crusting is a major source of nasal morbidity after endoscopic skull base surgery.[1,2] Excessive nasal crust can obstruct airflow and cause symptoms including nasal congestion, pain, and drainage, which may affect quality of life after surgery.[2–4] The use of nasal saline irrigation reduces the accumulation of crust and related symptoms.[5] In some patients, saline irrigation is insufficient and excessive crust persists, affecting overall quality of life. In these patients, mechanical crust removal with forceps may be required for symptomatic relief and minimize complications such as

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adhesions.[6,7] There is no current study in the literature regarding crust-related nasal morbidity after endoscopic skull base surgery.

Most patients usually tolerate office-based debridement with topical anesthesia, and multiple debridements may be required for complete symptomatic relief. However, some patients cannot tolerate the procedure and require general anesthetic or conscious sedation in the operating room (OR). The present study sought to determine the rate of OR debridement and to elucidate the factors associated with it. One of the main objectives of was to determine the rate of symptomatic crust-related morbidity after skull base surgery and its associated factors.

Methods

Our Institutional Review Board (IRB) at Albany Medical College Institutional Review Board approved the study. Adult patients who had endoscopic skull base surgery from January 2014 to December 2018 were analyzed. Preoperative data including age, gender, location of the lesion, current smoking status, prior radiation, diabetes, and psychiatric disorders were obtained. Operative data including the type of endoscopic approach, the type of flap reconstruction (none, free mucosa graft, and pedicled flap), the inclusion of septoplasty, and inferior turbinoplasty were recorded. The number of office-based debridements per patient was recorded, and the patients that required OR debridement were identified. Patients who did not undergo office-based debridements, such as pediatric and mentally-disabled patients, were excluded from the study. We performed comparative analyses based on categorical factors such as skull base reconstruction, smoking, radiation, psychiatric disorders, and diabetes. The Student *t*-test, the Chi-squared test, and the Fischer analysis were used to determine significance ($p < 0.05$).

The skull base was reconstructed according to cerebrospinal fluid (CSF) leakage. Skull base defects with low and high levels of CSF leaks were reconstructed with a free mucosal graft (FMG)[8] and a pedicled flap[9] respectively. A similar augmentation technique was used in the graft and the pedicled flap reconstruction. Surgicel pledgets (Ethicon, Bridgewater, NJ, United States) were placed over the edges of the reconstructed mucosa, and DuraSeal (Integra LifeSciences, Princeton, NJ, United States), a dural sealant, was applied over the pledgets. NasoPore (Stryker, Kalamazoo, MI, United States), a bioresorbable nasal packing was used to buttress the reconstruction, and a nasal splint was placed in each nostril to minimize nasal obstruction and maintain airflow throughout the nasal cavity. Patients received similar training to perform a copious volume of saline irrigation (approximately 240 mL) twice a day after the splints were removed. The postoperative follow-up evaluation was as follows: a week after surgery to remove the splints, a month later for nasal cavity inspection, and nasal debridement when applicable. Follow-up visits were held three months later or earlier if the patients developed excessive crust or new symptoms. Therefore, the patients included in the present study attended at least three follow up visits (one week, one month, and four months after surgery), and the average follow up was of six to nine months. Patients were excluded if they were lost to follow up.

After splint removal, the symptoms that presented during the postoperative period were classified into the following: asymptomatic, congestion, pain, drainage, and epistaxis. Patients who presented with expected crust discharge were classified as asymptomatic. Office-based debridement was performed for symptomatic patients with nasal crust. Debridement was performed in asymptomatic patients, mostly for visualization of the skull base. Patients received 2 sprays per nostril of 4% atomized lidocaine in normal saline at least 1 to 2 minutes before the nasal endoscopy. A rigid 0° or 30° endoscope with forceps was used for nasal debridement. The patients who failed to tolerate the first debridement were reanesthetized with an additional 2 sprays per nostril of 4% atomized lidocaine in normal saline. Mupirocin rinses and additional in-office anesthetics, including lidocaine soaked pledgets, were utilized as well. Another attempt at debridement was made after a five-minute waiting interval. Symptomatic patients with obstructing crust who failed these attempts were recommended for debridement with general anesthetic or conscious sedation.

Results

►**Table 1** shows the demographics and operative data of the study sample. The postoperative symptoms were classified as indicated in the methods section. In total, 81 cases presented with no nasal complaints, while 43 (65% and 35%) cases presented with very minimal nasal crust discharge as visualized on the endoscopic exam and described subjectively by the patients. Altogether, these presentations were classified as asymptomatic. The 43 cases that presented with very minimal nasal crust discharge were deemed 'asymptomatic' because some nasal crusting is expected postoperatively. Additionally, their nasal crusting did not produce any symptoms such as nasal congestion or excessive bleeding. A total of 50.8% of the patients (124 cases) were in the asymptomatic group. The average number of office-based debridements in the group without nasal complaints was of 0.1, and of 1.7 in the group with very minimal nasal crusting. Thus, the average number of office-based debridements in the asymptomatic group was of 1.2 ►**Table 2**.

Crust-related symptoms were present in 120 patients (49.0%). Nasal congestion was the most common symptom, with 74 cases, followed by nasal drainage, with 40 cases. Nasal pain and epistaxis were complaints in 17 and 4 (61.7%, 33.3%, 14.2%, 3.3%) cases respectively. The average number of debridements in symptomatic patients was of 2.2. Overall, more office-based debridements were performed for symptomatic patients than for asymptomatic patients (2.2 versus 1.2 debridements; $p < 0.05$) ►**Table 2**.

A comparative analysis was performed between the symptomatic and asymptomatic patients. The use of a pedicled flap (31.7% versus 13.7%) and anxiety (11.7% versus 4.0%) (39 versus 17 patients, 15 versus 5 patients) were

Table 1 Demographics and operative data of the study sample

Demographics		
Age		
Range (years)	18-87	
Mean (years)	55.2	
Standard deviation (years)	15.4	
	N	%
Gender		
Male	100	43.2
Female	134	57.3
Currently smoking	32	13.7
Diabetes	51	21.7
Preoperative radiation	10	4.10
Mood and anxiety disorder	63	26.9
Anxiety	19	30.2
Depression	27	42.9
Anxiety and depression	17	27.0
Operative data		
Location	N	%
Sellar/Suprasellar	168	68.9
Anterior cranial base	33	13.5
Middle cranial fossa	9	3.7
Clival/craniocervical junction	5	2.0
Extradural skull base	30	12.3
Skull base flap reconstruction		%
No flap	58	23.7
Pedicled flap	56	22.9
Nasoseptal	53	94.6
Pericranial	3	5.4
Free mucosa graft	131	53.5
Additional surgery	58	23.8
Septoplasty	26	10.7
Inferior turbinoplasty	7	2.9
Septoplasty and inferior turbinoplasty	25	10.2

significantly associated with postoperative nasal symptoms ($p < 0.05$), while diabetes was significantly associated with no nasal symptoms (15.0% versus 26.6%; $p<0.05$). (18 versus 32 patients). There was no correlation between current smoking and symptomatic presentation ►**Table 3**.

A total of 14 patients underwent general anesthesia in the OR for their debridement, but 3 (11.3% and 2.4%) patients were excluded because they failed to meet the inclusion criteria, as their specific nasal symptoms and exam findings were not adequately documented pre- and postoperatively to enable a comparison with other patients. Therefore, 11 patients (4.5%) underwent OR debridement after they failed to tolerate the in-office debridement, 10 of whom for symptomatic relief, and all had obstructing nasal crusting. There was severe nasal congestion in 5 cases (as endorsed by the patient and the endoscopic examination), pain in 3 cases, and 5 (4.2%, 2.4%, 4.0%) cases had mucopurulent discharge with a concern for a sinus infection. One (81%) asymptomatic patient had a debridement for synechiae resection.

A comparative analysis was performed between the patients who did and did not tolerate the office-based debridement and eventually went to the OR ►**Table 4**. The use of a pedicled flap was significantly associated with going to the OR for debridement (54.5% versus 21.0%; $p < 0.05$). Anxiety, not depression, was significantly associated with intolerance of the in-office procedure and going to the OR (18.2% versus 10.7%; $p<0.05$) (68 versus 26 patients and 22 versus 13 patients). None of the 3 (0% and 50%) patients with anxiety in the OR debridement group were on anxiolytic medications, while 8 of the 16 patients (50%) with anxiety who tolerated the office-based debridement were on anxiolytic medications. Radiotherapy two years prior to surgery was significantly associated with intolerance to the office-based debridement and the need for OR debridement (27.3% versus 3.0% (34 versus 4 patients); $p < 0.05$).

Discussion

The postoperative management of the nasal cavity after endoscopic skull base surgery has the goal of minimizing nasal morbidity and improving quality of life. A patent nasal airway, minimal nasal pain, optimal wound healing, and reduced risk of infection are some of the factors that reduce morbidity and improve quality of life.[1–13] Lack of mucosa over an exposed bone and cartilage leads to excessive crust, which is a significant cause of nasal obstruction, pain, discomfort, and possibly infection. The definitive treatment to reduce excessive crust formation is the mucosalization of the nasal cavity, which usually takes 10 to 12 weeks, depending on the type of skull base reconstruction.[9,11] Pedicled flaps take longer to remucosalize in comparison to graft reconstruction over an exposed surface.[11]

The present study demonstrated that most patients did not develop symptoms from nasal crusting. In this group of patients, nasal saline irrigation was sufficient. Debridement was mainly performed in these patients for inspection of the nasal cavity during follow-up visits. In the remaining patients who developed crust-related symptoms, mechanical removal of the crust through debridement was performed to provide symptomatic relief. Debridement was more frequently performed in symptomatic patients than in asymptomatic patients. We believe that, without debridement, patients continue to experience crust-related symptoms until sinus mucosalization is completed. In addition, removal of excessive crust enhances the healing of the mucosal surfaces and enables the visualization of the skull base reconstruction during the follow-up. The present study showed that there were factors that may influence the development of symptoms, such as the use of flap reconstruction, anxiety, and diabetes mellitus. Interestingly, our study demonstrated that diabetic patients seemed to have fewer overall symptoms. This is contrary to common

Table 2 Average number of debridements in symptomatic and asymptomatic patients

	N	%	Average number of debridements
Symptomatic	120	49.2	
Congestion	74	30.3	2.2
Drainage	40	16.4	1.6
Pain	17	7.0	2.3
Epistaxis	4	1.6	2.5
Asymptomatic	124	50.8	1.2
Crust discharge	43	17.6	1.7
No symptoms	81	33.1	0.1

Table 3 Comparative analysis of symptomatic and asymptomatic patients

	Symptomatic		Asymptomatic		
Number of patients	120	%	124	%	
Average age (years)	55.2		55.2		
Smoking	14	11.7	18	14.5	
Diabetes	18	15.0	33	26.6	$p < 0.05$
Preoperative radiation	7	5.8	3	2.4	
Anxiety	14	11.7	5	4.0	$p < 0.05$
Depression	15	12.5	12	9.7	
Anxiety/depression	9	7.5	8	6.5	
No reconstruction	20	16.7	40	32.3	$p < 0.01$
Free mucosa graft	63	52.5	68	54.8	
Flap reconstruction	38	31.7	17	13.7	$p < 0.001$
Average number of in-office debridements	2.1		1.2		$p < 0.0001$
Operating room debridement	10	8.3	1	0.8	$p < 0.01$

Table 4 Comparative analysis of patients who required operating room (OR) debridement and those who did not

	OR debridement		Non-OR debridement		
		%		%	
Number	11		233		
Average age (years)	54		55		
Smoking	3	27.3	29	12.4	
Diabetes	4	36.4	47	20.2	
Preoperative radiation	3	27.3	7	3.0	$p < 0.001$
Anxiety	3	27.3	16	6.9	$p < 0.05$
Depression	2	18.2	25	10.7	
Anxiety/depression	1	9.1	16	6.9	
Skull base reconstruction					
None	0	0.0	59	25.3	
Free mucosa graft	5	45.5	126	54.1	
Flap	6	54.5	49	21.0	$p < 0.01$
Symptomatic	10	90.9	111	47.6	

knowledge, as diabetic patients are at risk of poorer wound healing. Additionally, the use of the pedicled flap reconstruction was associated with the presence of crust-related symptoms.

Successful in-office debridement of the crust was dependent on the patient's tolerance to the procedure. The present study indicated that some patients who had flap reconstruction, a history of anxiety, or radiation prior to surgery had reduced tolerance to the procedure and required an alternative approach, such as the use of a general anesthetic in the OR. Continued observation, which was an option, was associated with poor quality of life secondary to nasal symptoms. We believe that debridement under general anesthesia posed minimal risk to the patients, and it provided instant symptomatic relief and improved healing. In addition, the removal of any excessive crust enabled the visualization of the skull in the immediate postoperative period. Of note, one asymptomatic patient underwent debridement in the OR for synechiae resection after she failed to tolerate in-office resection. In this patient, observation was not an option, and resection in the OR was needed to minimize further morbidity.

Most patients (95.5% (118)) tolerated the in-office debridement. Pedicled flap reconstruction, anxiety, and a history of radiotherapy were associated with failure to tolerate the in-office debridement. The use of septal mucosa for pedicled flap reconstruction exposed the septal bone and cartilage, which increased crust formation and led to the need for debridement under general anesthesia. The level of tissue manipulation and damage involved in flap reconstruction compared to that of free mucosa grafts predisposed patients to develop excessive crust and symptoms. Only patients with flap reconstructions developed crust-related symptoms and required additional debridements.

Anxiety played a major role in symptomatic presentation and in the ability to tolerate the in-office debridement. Anxiety and depression are known to influence the perception of pain, and there is a well-established axis between these disorders and pain syndromes.[13,14] Only anxiety, not depression, was discovered to have a significant association with the symptomatic presentation. Though most patients with anxiety tolerated the office-based debridement, it was a significant factor in patients that required general anesthesia for debridement. This brought up an interesting question: Could premedicating these patients with anxiolytics minimize the development of symptoms? However, in the present study, we found that this was unlikely: 7 out of the 14 patients in the symptomatic group, and 1 out of the 5 (50% and 20%) patients in the asymptomatic group were being treated for their anxiety. Still, anxiolytic medication may play a role in the tolerance to the office-based debridement. None of the 3 patients (0%) with anxiety who failed to tolerate the in-office debridement were on anxiolytic medication. However, 8 out of the 16 patients (50%) being treated for anxiety tolerated the office-based debridement. This suggests that patients with anxiety would benefit from anxiolytic medication to help them tolerate the office-based debridement.

Radiotherapy can adversely affect wound healing.[15,16] Subjectively, we noted that patients who underwent radiotherapy presented with nasal crusting that was more adherent and difficult to debride. The present study showed that previous radiotherapy did not increase the rate of crust-related symptoms, but a higher proportion of patients submitted to radiotherapy did not tolerate the office-based debridement and required general anesthesia. Current smoking, another factor that interferes with optimal wound healing, especially in endoscopic sinus surgery, was shown to have a minimal effect on symptom presentation and tolerance to debridement.[17,18]

The treatment paradigm in the present study, including the type of skull base reconstruction, the use of a buttress and dural sealant, and the postoperative management, was institution-specific and may not be applicable to other institutions. However, the present study showed that the use of a buttress and dural sealant did not influence the rate of symptomatic presentation or the tolerance to the office-based debridement. The use of a pedicled flap was a major factor in determining symptomatic presentation and the tolerance to office-based debridement. All patients had a one-week, followed by a four-week, clinical evaluation. Based on the present study, frequent follow-up for patients with pedicled flap reconstruction and previous radiotherapy may reduce excessive crust formation and mitigate some of the symptoms, which may eliminate the need for OR debridements. In addition, a short course of anxiolytics for patients with anxiety would also help them tolerate the office-based nasal inspection.

Limitations

The present was a retrospective study, and it lacked an objective analysis to quantify the symptoms related to excessive crust formation. The categorization of symptoms was based on subjective clinical presentation, and the use of instruments that yield objective data such as the Sinonasal Outcome Test (SNOT-22) for each patient would provide a more standardized classification.[19] The analysis of symptoms in the present study may be overestimating or underestimating the severity of each patient's symptoms. Additionally, the lack of objective data may not provide a clear, replicable, and definitive indication for debridement. However, our clinical assessment of each patient who had excessive crusting, along with the understanding that alternative treatments such as observation would not provide adequate and quick relief, formed our basis to perform mechanical debridement in symptomatic patients.

Conclusions

Excessive nasal crusting may require debridement for symptomatic relief following endoscopic skull base surgery. The use of a pedicled flap or anxiety may predispose patients to require an OR debridement. Previous radiotherapy also influenced the tolerance to the in-office debridement.

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Conflict of Interests
The authors have no conflict of interests to declare.

References

1 de Almeida JR, Snyderman CH, Gardner PA, Carrau RL, Vescan AD. Nasal morbidity following endoscopic skull base surgery: a prospective cohort study. Head Neck 2011;33(04):547–551
2 Gallagher MJ, Durnford AJ, Wahab SS, Nair S, Rokade A, Mathad N. Patient-reported nasal morbidity following endoscopic endonasal skull base surgery. Br J Neurosurg 2014;28(05): 622–625
3 McCoul ED, Anand VK, Bedrosian JC, Schwartz TH. Endoscopic skull base surgery and its impact on sinonasal-related quality of life. Int Forum Allergy Rhinol 2012;2(02):174–181
4 McCoul ED, Anand VK, Schwartz TH. Improvements in site-specific quality of life 6 months after endoscopic anterior skull base surgery: a prospective study. J Neurosurg 2012;117(03): 498–506
5 Pynnonen MA, Mukerji SS, Kim HM, Adams ME, Terrell JE. Nasal saline for chronic sinonasal symptoms: a randomized controlled trial. Arch Otolaryngol Head Neck Surg 2007;133(11):1115–1120
6 Bugten V, Nordgård S, Steinsvåg S. The effects of debridement after endoscopic sinus surgery. Laryngoscope 2006;116(11): 2037–2043
7 Lee JY, Byun JY. Relationship between the frequency of postoperative debridement and patient discomfort, healing period, surgical outcomes, and compliance after endoscopic sinus surgery. Laryngoscope 2008;118(10):1868–1872
8 Suh JD, Ramakrishnan VR, DeConde AS. Nasal floor free mucosal graft for skull base reconstruction and cerebrospinal fluid leak repair. Ann Otol Rhinol Laryngol 2012;121(02):91–95
9 Kassam AB, Thomas A, Carrau RL, et al. Endoscopic reconstruction of the cranial base using a pedicled nasoseptal flap. Neurosurgery 2008;63(1, Suppl 1)ONS44 –ONS52, discussion ONS52–ONS53
10 Castelnuovo P, Lepera D, Turri-Zanoni M, et al. Quality of life following endoscopic endonasal resection of anterior skull base cancers. J Neurosurg 2013;119(06):1401–1409
11 Kimple AJ, Leight WD, Wheless SA, Zanation AM. Reducing nasal morbidity after skull base reconstruction with the nasoseptal flap: free middle turbinate mucosal grafts. Laryngoscope 2012; 122(09):1920–1924
12 Noorily AD, Noorily SH, Otto RA. Cocaine, lidocaine, tetracaine: which is best for topical nasal anesthesia? Anesth Analg 1995;81 (04):724–727
13 Adler G, Gattaz WF. Pain perception threshold in major depression. Biol Psychiatry 1993;34(10):687–689
14 Bär KJ, Brehm S, Boettger MK, Boettger S, Wagner G, Sauer H. Pain perception in major depression depends on pain modality. Pain 2005;117(1-2):97–103
15 Kunisada T, Ngan SY, Powell G, Choong PF. Wound complications following pre-operative radiotherapy for soft tissue sarcoma. Eur J Surg Oncol 2002;28(01):75–79
16 Tibbs MK. Wound healing following radiation therapy: a review. Radiother Oncol 1997;42(02):99–106
17 Briggs RD, Wright ST, Cordes S, Calhoun KH. Smoking in chronic rhinosinusitis: a predictor of poor long-term outcome after endoscopic sinus surgery. Laryngoscope 2004;114(01):126–128
18 Krzeski A, Galewicz A, Chmielewski R, Kisiel M. Influence of cigarette smoking on endoscopic sinus surgery long-term outcomes. Rhinology 2011;49(05):577–582
19 Hopkins C, Gillett S, Slack R, Lund VJ, Browne JP. Psychometric validity of the 22-item Sinonasal Outcome Test. Clin Otolaryngol 2009;34(05):447–454

