

The canine fossa puncture technique in chronic odontogenic maxillary sinusitis

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ABSTRACT

Background: Endoscopic sinus surgery (ESS) including middle meatus antrostomy (MMA) has been advocated as the technique of choice in the treatment of maxillary chronic odontogenic sinusitis (COS). However, recently the endoscopic canine fossa puncture (CFP) has been proposed as an alternative surgical technique of accessing the entire antrum when pathology is limited only to the maxillary sinus. This study was designed to assess the outcomes of the CFP approach versus ESS (comprising MMA) in the management of COS.

Methods: A prospective study was performed on patients with COS produced by odontogenic infections (periapical granulomas or small inflammatory cysts of the molars or bicuspsids), oroantral fistula (OAF), large odontogenic cysts, and maxillary foreign bodies (dental fillings, teeth roots, and implants). Patients were randomly allocated into two groups: 56 patients underwent CFP and in 54 patients the maxillary sinus was approached through MMA. After a mean follow-up of 18.5 months, recurrence rates were compared between the two groups.

Results: During the follow-up period, OAF recurred in 10 patients: 4 in the MMA group (7.4%) and 6 in the CFP group (10.7%). The difference is not statistically significant ($p = 0.39$, Fisher exact test).

Conclusion: In patients with COS a conservative approach with avoidance of endonasal surgery is suggested: in COS without a fistula, CFP at the time of dental treatment will be sufficient. In OAF cases, CFP yielded similar results with MMA. Nevertheless, additional study with a larger sample and a longer follow-up is required to validate these results.

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Chronic odontogenic sinusitis (COS) accounts for ~10–12% of maxillary chronic rhinosinusitis (CRS) cases.^{1–4} It is produced by periapical granulomas or small inflammatory cysts of the molars or bicuspsids, chronic oroantral fistula (OAF), large odontogenic cysts occupying a great part of the maxillary sinus, and foreign bodies (dental fillings, teeth roots, and implants) pressed throughout the root canal or fistula into the antrum.^{2,4}

Management of COS requires simultaneous treatment of the sinus disease as well as of the odontogenic source.^{4,5} The classic Caldwell-Luc approach was typically used, despite its significant morbidity. Even after such extensive surgery, required revisions because of recurrent inflammation approaches 9–15% of cases.^{1–4} Nevertheless, recently, less invasive endoscopic sinus surgery (ESS) techniques have been advocated for the COS treatment.^{4,5} The technique entails middle meatus antrostomy (MMA) and removal of only irreversibly diseased mucosa, polyps, and foreign bodies through the MMA. ESS was associated with less morbidity and fewer recurrences than the Caldwell-Luc approach.^{4,5} However, it is acknowledged that MMA offers only a limited exposure of both the maxillary anterior wall and the lacrimal recess.⁶ Moreover, as emphasized by Wormald *et al.*,^{6–8} the anterior wall of the maxillary sinus can not be accessed through the MMA. These are the grounds why Chobillon and Jankowsky⁹ advocated the endoscopic canine fossa technique as an alternative surgical approach in the treatment of isolated maxillary sinus disease such as aspergilloma. However, their study is a retrospective report and draws together only aspergilloma cases. The objectives of this article were to evaluate the outcomes of the canine fossa puncture (CFP) approach versus standard ESS (comprising MMA) in the treatment of COS, outlining not only the advantages of these procedures, but also their limitations.

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METHODS

This is a prospective, randomized study and it was approved by the Institutional Review Board of the University of Medicine and Pharmacy Cluj-Napoca, in accordance with the Guidelines for Protection of Human Subjects. All of the patients, adults >18 years of age, were informed and consented to participate in the study. Included in the study were only patients suffering from maxillary COS, operated on between January 2004 and January 2010 and followed up for at least 6 months. Excluded from the investigation were patients suffering from rhinogenic CRS, patients with prior sinus surgery or facial trauma, patients with preexisting paresthesiae of the upper teeth, destructive lesions of the maxilla, and patients suffering from immunodeficiencies and ciliary abnormalities. Each patient had preoperative sinus CT to ascertain the sinus disease. Careful rigid nasal endoscopy was performed and the appearance was recorded. Before surgery all patients completed a questionnaire including factors endorsed by the Rhinosinusitis Initiative¹⁰: five symptoms (nasal blockage, facial pain, nasal discharge, postnasal drip, and dental pain) were assessed. Symptoms were unilateral corresponding to the diseased maxillary sinus. Symptoms were graded using a visual analog scale (VAS) where “0” means absence of the symptom and “10” is maximum severity.

Patients included were allocated using randomization blocks (using a combination of triple and quadruple randomization blocks) into two groups: one group included patients who underwent CFP as the surgical procedure addressing the antrum and the other group of patients included those whose maxillary sinuses were approached by means of MMA. All patients were provided with thorough explanations about both surgical techniques and signed an informed consent form before entering the study.

In the MMA group surgery was performed using the standard anterior to posterior approach. A partial middle turbinate resection was performed in cases that exhibited a concha bullosa, a paradoxical middle turbinate, or polypoid middle turbinate. In general, surgery consisted of uncinctomy, anterior ethmoidectomy, and MMA. Removal of the pathological contents and granulations from the posterior, lateral, and upper parts of the maxillary sinus by means of the microdebrider (Hummer II; Stryker Corp., Santa Clara, CA) with curved cutting blades was performed under the guidance of the

angled 45 and 70° endoscopes. Foreign bodies and fungus balls were removed with a curved suction tip through the enlarged maxillary ostium. Only true polyps and cysts have to be removed by way of angled curettes and double spoon forceps; excessive stripping of all mucosa was avoided.

Dental pathology (either odontogenic cysts, periapical granulomas, foreign bodies within the sinus, or chronic OAF) was managed in the same surgical session. The cyst should be removed in a way that only the bone bed remains on the sinus wall at the implantation spot. In cases presenting with OAF the technique described by Lopatin *et al.*⁴ was used. After ESS, attention was turned to the oral cavity with the aim of deepithelialization and tensionless closure of the fistula tract. Using the straight microdebrider blade introduced through the oro-antral communication removal of polyps and granulations from the alveolar recess was accomplished. Because osteitis was found in COS, osteitic bone was drilled until we reached healthy bone. Manipulations inside the sinus cavity were controlled through the MMA using a 45 or 70° endoscope. The fistula mucosal flaps were inverted and sutured to provide a first layer of closure. Closure was completed in two layers, the second being either a vestibular advancement or palatal rotation flap. Vaseline gauze was used for nasal packing. Surgery was completed under general anesthesia in this group. Packing was removed on the second morning. Patients were discharged on general antibiotics for 12 days and topical corticoids for 6 weeks.

In the CFP group the anterior ethmoid was not addressed and maxillary pathology was dealt with only by accessing the anterior maxillary wall. The standard CFP technique described by Draf¹¹ was used at the start of the study: the tip of the trocar was positioned superior and lateral to the root of the upper canine, the trocar was rotated parallel to the sagittal plane to penetrate the maxillary sinus. Since 2005 we applied the new anatomic landmarks illustrated by Robinson and Wormald¹² to lessen the chance of nerve injury: the position of trocar entry corresponds to the point of intersection of a vertical line drawn through the pupil and a horizontal line through the floor of the nose. After trocar removal, secretions or pus were first aspirated through the sheath. Sinus diagnostic endoscopy was performed using the 30° endoscope. Depending on the pathology the surgical steps were diverse. In OAF cases, clearance of the alveolar recess and the fistula tract was performed with the microdebrider blade passed through the OAF canal. Manipulations inside the sinus were visualized with the angled endoscopes placed through the CFP. The rest of the surgical steps are identical with those previously described. If the floor of the maxillary sinus was intact, a second trocar was inserted through the anterior wall in close proximity to the first one—the “double barrel” approach (Mark May, Shadyside Hospital, Pittsburgh, PA, retired, personal communication; see Fig. 1). Under visual control, a biopsy forceps was introduced through the second sheath. The foreign body was grasped under control and removed by extracting the forceps together with the trocar cannula. In odontogenic cysts or COS, the trocar was withdrawn after it was felt to penetrate the sinus and the microdebrider blade was introduced through this puncture site into the sinus. The polyps or cysts were completely removed from the sinus under direct visualization. This visual control guarantees that the blade is within the sinus and not in the orbit or soft tissues.⁶⁻⁸ Once again, a mucosal sparing technique was used. Copious irrigation of the sinus by saline solution was performed to break up any remaining infective materials. In the cases with OAF it allowed verification of the effective closure of the OAF in the oral cavity. Under visual control osteitic bone from the alveolar recess was drilled away. The treatment of the odontogenic source was performed in the same surgical session. Local anesthesia with sedation was used in 75% of CFP patients; the remaining patients were operated on under general anesthesia. In this group placing ice over the cheek area postoperatively reduced the bruising and swelling associated with this approach. Patients were discharged on the same antibiotic and topic corticoid regimen.

Although surgery is of primary importance, the administration of antibiotics is essential in the management of COS.¹ According to

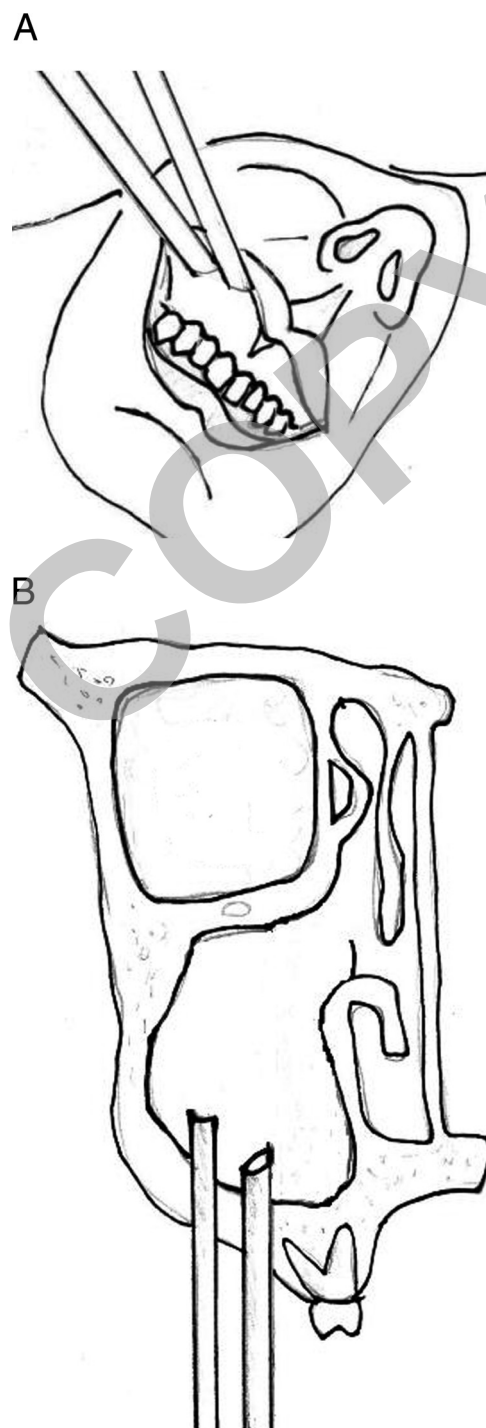


Figure 1. The double barrel approach: (A) two trocar sleeves are inserted through the anterior wall of the maxillary sinus. (B) The technique depicted in a coronal diagram.

current recommendations,¹ the combination of amoxicillin and clavulanate was administered for 28 days, and metronidazole (active against anaerobes) was delivered for 10 days.

Patients were actively followed in the outpatient clinic every 3 months after the operation and then on a yearly basis. The patients were recalled for endoscopic examination and interview concerning postoperative symptoms. During the follow-up the same VAS questionnaire was applied.

Table 1 Baseline characteristics of the two patient groups

	MMA Group <i>n</i> = 54	CFP Group <i>n</i> = 56	Statistics	<i>p</i> Value
Age (yr)	36.6 ± 12.8	40.7 ± 15.4	Student's <i>t</i> -test	0.12
Mean ± SD				
Male/female	29/25	36/20	χ ² -test	0.25
Oroantral fistula	22	23	χ ² -test	0.98
Foreign bodies	6	3	Fisher's exact test	0.22
Odontogenic cysts	13	16	χ ² -test	0.68
Periapical granulomas	13	14	χ ² -test	0.93

MMA = middle meatus antrostomy; CFP = canine fossa puncture.

A



B



Figure 2. (A) Sagittal CT scan showing maxillary sinusitis caused by chronic oroantral fistula. (B) Coronal CT scan of the same patient. Relevant is the normal appearance of the ipsilateral anterior ethmoid.

According to our previous results, the ESS failure rate in COS is roughly 9%.¹³ Because the anterior ethmoid has not been addressed in the CFP group, we assumed at least a 14% recurrence rate in the latter group. Based on 80% power to detect a statistically significant difference ($p = 0.05$), it was calculated that at least 53 patients would be required for both samples. Statistical analysis was performed by use of SPSS Version 10.0 (SPSS, Inc., Chicago, IL). Data were expressed as mean ± SD. The values of $p < 0.05$ were considered significant. A parametric test such as the two sample Student's *t*-test was useful for data that followed a normal distribution. A nonparametric test such as the Mann-Whitney *U* test was applied for data that did not follow a normal distribution.

RESULTS

Working as a team with the maxillofacial colleagues allowed us to pull together 110 COS cases. The MMA group included 54 cases and CFP group comprised 56 patients. The baseline characteristics comparing both groups are presented in Table 1. We detected that both



Figure 3. Coronal CT scan presenting odontogenic cyst with maxillary sinusitis.

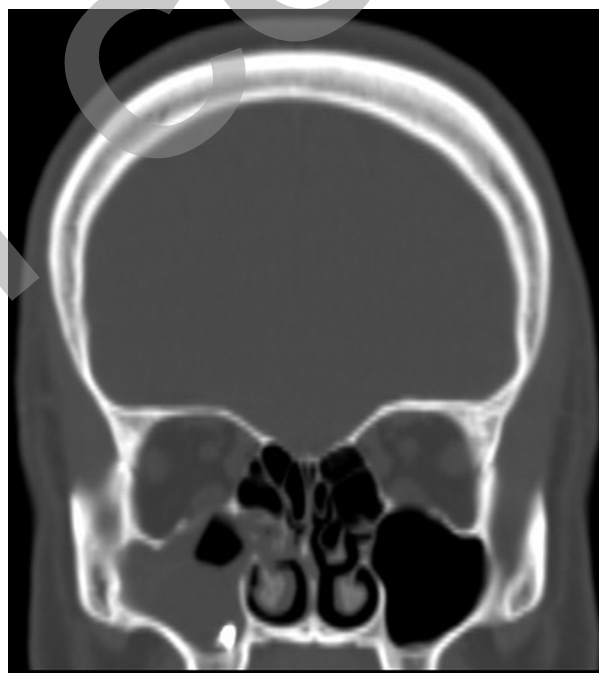


Figure 4. Coronal CT scan presenting a displaced dental filling into the right maxillary sinus eliciting sinusitis.

groups were matched for age, gender, and pathology causing COS: chronic OAF (Fig. 2), odontogenic cysts (Fig. 3), sinus foreign bodies (Fig. 4), or inflammatory reactions. Baseline VAS scores are outlined in Table 2 and no statistical difference are indicated. Despite the marked inflammatory changes within the maxillary sinus, CT opacification of the anterior ethmoid was noticed only in 33 patients (30% of COS cases).

Mean follow-up was 18.5 months, ranging from 6 to 38 months. Table 2 presents postoperative VAS symptoms. After surgery, there was a noteworthy improvement in both arms: VAS for all five symptoms decreased statistically significantly ($p < 0.0001$, Mann-Whitney *U* test). There was no difference in postoperative scores between the two groups (see Table 2). In cases with persisting symptoms, nasal endoscopy and CT scan were used to document recurrent disease (see Fig. 5).

Table 2 Symptomatic score at baseline and at the latest follow-up visit (mean, 18.5 mo) in patients undergoing surgery for odontogenic sinusitis

Symptom Mean $\pm$ SD	Baseline		<i>p</i> Value	Postoperative		<i>p</i> Value
	MMA <i>n</i> = 54	CFP <i>n</i> = 56		MMA <i>n</i> = 54	CFP <i>n</i> = 56	
Nasal obstruction	4.8 $\pm$ 0.7	5.2 $\pm$ 0.8	0.33*	0.4 $\pm$ 0.64	0.5 $\pm$ 0.85	0.18#
Facial pressure	4.1 $\pm$ 0.9	4.8 $\pm$ 1.1	0.14*	0.4 $\pm$ 0.62	0.6 $\pm$ 0.71	0.23#
Nasal discharge	5.1 $\pm$ 1.1	5.7 $\pm$ 1.3	0.22*	0.3 $\pm$ 0.48	0.4 $\pm$ 0.39	0.41#
Postnasal drip	5.5 $\pm$ 1.8	5.8 $\pm$ 1.5	0.18*	1.2 $\pm$ 0.55	1.2 $\pm$ 0.45	0.14*
Dental pain	5.7 $\pm$ 1.7	5.5 $\pm$ 1.6	0.65*	0.3 $\pm$ 0.34	0.2 $\pm$ 0.32	0.25#

*Student's *t*-test.
#Mann-Whitney *U* test.
MMA = middle meatus antrostomy; CFP = canine fossa puncture.



Figure 5. Recurrence in a patient previously operated on for chronic oro-antral fistula by means of the canine fossa puncture approach.

During the follow-up period, OAF recurred in 10 patients: 4 in the MMA group (7.4%) and 6 in the CFP group (10.7%). Nevertheless, the difference did not reach statistical significance ($p = 0.39$, Fisher's exact test). If we consider OAF a distinct group, recurrence rates are 18% for MMA and 26% for CFP; however, the difference is not significant ($p = 0.87$, Fisher's exact test). COS did not recur in those cases associated with odontogenic cysts, foreign bodies, or inflammatory reactions secondary to chronic periodontitis. Patients with recurrent OAF underwent a second attempt of the fistula closure after the same surgical technique. Once again, the anterior ethmoid was not addressed in CFP failures. After the second attempt there were no cases of recurrent disease.

There were no serious complications encountered. Neurological sequelae (facial paresthesia and pain and teeth numbness) were reported by 14 (25%) of the patients in the CFP group immediately after the operation. However, after 3 months paresthesia was reported by only 2 patients (3.5%). A telephone survey was conducted on these 14 patients asking them if in case of recurrence they would still undergo another CFP approach. ESS with MMA under general anesthesia was the alternative technique suggested. Despite the occurrence of paresthesia/pain, 13 of 14 patients decided for the CFP approach. A comparison of the two surgical approaches used in the management of COS is presented in Table 3.

Table 3 Comparison of the surgical approaches used in patients suffering from maxillary odontogenic sinusitis

Outcomes	MMA (%)	CFP (%)	Statistical Significance
Symptomatic improvement	93	90	0.87 (χ^2 -test)
Recurrence rate	7.4	10.7	0.39 (Fisher's exact test)
Foreign body extraction	100	100	
Healing of dental sinusitis	100	100	
Failures in oroantral fistula	18	26	0.87 (Fisher's exact test)
Complications	0	3	

MMA = middle meatus antrostomy; CFP = canine fossa puncture.

DISCUSSION

Because COS arises from the underlying dental pathology, it deserves special consideration because of some differences in pathology, microbiology, and management when compared with CRS.¹⁻³ An oral vestibular approach is recommended by maxillofacial surgeons in the treatment of maxillary cysts: in keeping with the law of gravity, it is reasonable to assume that the content can be drained easily into the oral cavity.¹⁴ However, we are more familiar with the endoscopic intranasal or CFP procedures, providing an alternative approach.

Inflammation within the anterior ethmoid is less common in COS: 25% in Lopatin's study⁴ and 30% in our study. Because CFP yielded high success rates, we presume that inflammation within the ethmoid is reversible as long as the patient is provided with adequate medical treatment.

Recurrent disease developed only in OAF patients. It is acknowledged that the possibility of osteitis within the maxilla must be considered in COS patients. Thus, recurrences encountered may be caused by this finding or the particular microbiology of these cases. Unfortunately, no bacterial cultures were obtained. Nevertheless, long-term antibiotic treatment (including antianaerobic agents) was provided according to the guidelines.^{1,2} In all OAF revision cases, a nidus of osteitic bone was found. Furthermore, the existence of a learning curve is shown: 6 recurrences in the first 15 cases, and only 4 cases within the rest of the 30 patients. Although recurrence was more frequently encountered in the CFP group, the difference was not significant. A comparison of surgical approaches for the management of OAF is presented in Table 4, emphasizing the acceptability of CFP and its value in revision. CFP should be considered a minimal invasive surgical technique in the treatment of COS. However, consider-

Table 4 Surgical treatment techniques used for the treatment of chronic oroantral fistula

Surgical Approach and Benefits	Drawbacks	Success in Revision
Middle meatus antrostomy		
Familiar for the rhinologist	Incomplete access to all the recesses of the maxillary sinus	100%
High success rates	General anesthesia required (cost and hazards)	
Postoperative treatment and control through the MMA		
Canine fossa puncture		
Wide exposure of the maxillary sinus	Higher complication rate (no significance in the long term)	100%
High success rates		
Can be performed under local anesthesia on an outpatient basis	Postoperative treatments or inspection of the maxillary sinus impossible	

ing these results, we suggest that another study with a larger sample size and a longer follow-up is warranted.

It was considered that a blocked ostium is associated with OAF failure because the resultant high intrasinus pressure unlocks the fistula tract closure.³ Nonetheless, this concept has been recently disputed: Longhini *et al.*¹⁵ discovered that MMA will not lead to resolution of COS if the odontogenic source is left untreated.

ESS was advocated at the time of treatment of the odontogenic source.⁵ However, Bomeli *et al.*¹⁶ favor a conservative approach, suggesting that the dental provider should concentrate on the dental pathology and then to decide on ESS indication. Because recurrence rates did not increase in the CFP group, we support the latter position. We assume that in COS, ESS should be offered only for persistent symptoms after complete dental treatment. Another study comparing CFP versus observation only at the time of the dental treatment should solve this controversy.

According to Hosemann *et al.*,¹⁷ there are limitations during routine MMA. Although most of the maxillary sinus can be accessed through a generous MMA, angled endoscopes and instruments do not allow precise management of the entire antrum, especially in the areas of the alveolar recess, the anterior and medial walls. These authors as well as others suggest that an additional CFP may help.^{14,7}

Chobillon and Jankowsky⁹ described, initially, the endoscopic CFP technique: a small fenestration (~1 × 1 cm) was created with a chisel and aspergilloma was extracted under endoscope control.⁹ Instead of a chisel, we suggest the use of two trocars to minimize trauma.

The CFP approach in isolated maxillary sinusitis has several advantages: wide exposure of the whole sinus with clear visualization of the ostium⁹ and it can be easily performed under local anesthesia, on an outpatient basis. This leads to lower costs and fewer eventual risks and hazards of general anesthesia.⁹ CFP is the technique of choice for the removal of foreign bodies, notably of dental origin; using a single trocar, we extracted the foreign bodies without visual control.¹⁸ We consider this method cumbersome and thus we favor the "double barrel" approach.

However, there are some drawbacks of the CFP approach: postoperative sinus irrigations can not be performed and maxillary sinus can not be visualized on postoperative controls. In the past there have been concerns regarding the safety of the CFP approach in children. However, recently, Lee *et al.*¹⁹ have shown that CFP did not affect the maxillary sinus volume in pediatric patients and led to a successful surgical outcome. Recurrence is suggested by persisting symptoms, nasal endoscopy, and confirmed by CT scan. Nevertheless, because recurrence developed only in OAF cases, it was easily detected on clinical examination.

CONCLUSION

This study enabled us to draw the following conclusions: because COS is set apart by a different pathology, the anterior ethmoid is frequently untouched by the pronounced inflammatory changes involving the maxillary sinus. Thus, a conservative approach with avoidance of endonasal surgery is suggested; in COS without a fistula, CFP at the time of dental treatment will be sufficient. In OAF

cases, CFP yielded similar results with MMA. Nevertheless, a further study with a larger sample and a longer follow-up is required to validate these results.

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