Rhinology, 43, 230-235, 2004

What are the advantages of the endoscopic canine fossa approach in treating maxillary sinus aspergillomas?*

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SUMMARY

Aspergilloma of the maxillary sinus is a non-invasive mycotic infection of the immunocompetent host. Nowadays its treatment remains surgical removal, and endoscopic endonasal middle meatus antrostomy is retained as the most popular approach. In our experience, a complementary endoscopic canine fossa approach is often needed to achieve a complete resection of the fungus ball. This fact led us to ask ourselves if an isolated endoscopic canine fossa approach had any advantages over the endonasal middle meatus antrostomy. In this paper we retrospectively analyse the results of the surgical treatment of 31 patients presenting maxillary sinus aspergillomas. These patients were all operated between January 1997 and January 2003 in our Otolaryngology Department. They were divided in three groups. Group A included 10 patients operated through an endonasal middle meatotomy only, group B included 9 patients who were operated through a combined approach (endonasal middle meatus antrostomy and endoscopic canine fossa approach), and group C included 12 patients who were operated through an endoscopic canine fossa approach alone. No recurrences were noted in any group, but in group B three patients presented mild complications like persistent purulent discharge through the meatotomy and nasal crusting. The endoscopic canine fossa approach offers several advantages over other techniques. These include an optimal visualization of all maxillary sinus walls and recesses, the possibility of performing the procedure under local anaesthesia and on an outpatient basis, the preservation of the anatomy and physiology of the natural maxillary ostium and an easy removal of the eventual foreign bodies of dental origin in the sinusal cavity that could favourite the development of an aspergilloma.

Key words: aspergilloma, maxillary sinus, endoscopic, canine fossa, middle meatotomy.

INTRODUCTION

Mycotic infections of the maxillary sinus like the aspergilloma have been classically treated in the same way as chronic sinusitis. It was in 1651 when Dr. Highmore made the first registered description of a case of suppurative disease of the maxillary sinus (Woodham, 1995). Dr. William Cowper (1666-1709) described an operation in which the maxillary antrum could be approached through the alveolus after first having removed a tooth. In France, Louis Lamorier (1696-1777) described for the first time an external approach through the anterior wall of the maxillary sinus. Later on in 1771, John Hunter (1728-1793) published a method of intranasal approach of the maxillary sinus through an inferior or middle meatus antrostomy. The latest two decades of the 19th century saw the birth of modern rhinology, and authors like Mikulicz-Radecki (1850-1905) and Hermann Krause (1848-1921) introduced thick trocars for puncturing the inferior meatus very similar to those used today. In 1893, George Walter Caldwell (1866-1918) from New York described a technique in which an enlarged canine fossa opening was created in order to achieve a complete removal of the sinus mucosa. This procedure was combined with an inferior or middle meatus antrostomy that facilitated gravitational drainage of secretions and daily antral lavages. The same technique was described independently by Robert Henry Scanes Spicer (1857-1926) from London and by Henry Paul Luc (1855-19??) from Paris, in 1894 and 1897 respectively (Tange, 1991). This Caldwell-Luc technique remained one of the most employed in modern rhinology until the advent of new endoscopic sinus surgery. In fact, the Caldwell-Luc operation has been replaced in the treatment of sinusitis by endonasal endoscopic ethmoidectomy with middle meatal antrostomy. But some of its indications remain, like multiseptate maxillary sinus mucocele, oroantral fistula closure, revision surgery, transantral sphenoethmoidectomy, orbital decompression,

*Received for publication: February 20, 2004; accepted: July 6, 2004

pterygomaxillary fossa approach and mycotic maxillary sinusitis or aspergillomas (Gustafson and Bansberg, 2000).

The aspergilloma of the maxillary sinus, or mycetoma (fungus ball), is a non-invasive or extra-mucosal mycotic infection. It mostly affects immunocompetent patients, is almost exclusively of adults, and characterized by a female predominance. The infection is generally indolent until bacterial contamination produces a more typical chronic or acute recurrent sinusitis-like episode (Coste et al., 2003). The most frequent microorganism involved in Europe is Aspergillus fumigatus, but Aspergillus flavus or Aspergillus niger may be involved in some cases. The infection tends to be unilateral and is often limited to the maxillary sinus. The scannographic findings are quite characteristic (Krenmair, 1994, 1995), and include a unilateral heterogeneous opacification of the sinus, frequently accompanied with a thickening of the bony walls and the presence of typical metalic-like macro-or micro calcifications (De Gaudemar et al., 1993). On magnetic resonance imaging, aspergilloma is hypo intense in both sequences T1 and T2 because of the lack of water and the high content of proteins of the fungus ball (Gustafson and Bansberg, 2000).
The cause of aspergillomas remains obscure, and the role of dental filling material is controversial. It is true that this material is rich in zinc oxide and could eventually create a favourable environment for fungal growth; and it is also true that most of the aspergillomas develop in the maxillary sinus (89%; Klossek et al., 2001), but some other aspergillomas develop in other paranasal sinuses without this "favourable" milieu (Barry et al., 2002). The fact that aspergillomas are more frequent in females also suggests a hormonal influence. It is probable that other unknown factors (climatic, environmental, anatomical and physiological) predispose to this mycotic infection.

Nowadays, the therapeutically strategies for treating aspergillomas are mainly surgical, and without any doubt, most of the authors today favour the endoscopic endonasal middle meatus antrostomy approach. The Caldwell-Luc procedure is not the gold standard technique anymore, and is only indicated by some authors (Kennedy, 1985; Klossek, 1997) as a complementary step when the complete removal of the fungal ball is impossible through a middle meatal antrostomy approach alone.

In our experience, endoscopic intranasal middle meatus antrostomy frequently offers only a limited exposure of the anterior wall of the maxillary sinus, and often does not permit to fully visualize the lachrymal recess. This is an important inconvenience because of the possibility of leaving residual fragments of the aspergilloma. The present consensus is that a complete removal is the key point to avoid a recurrence. This has forced us to combine this endonasal procedure with an external endoscopic canine fossa approach of the maxillary sinus, which offers a complete exposure of all the sinus walls. After being developed, this latest technique has been used as the only surgical approach in the treatment of isolated maxillary sinus aspergillomas with good results. The objectives of this paper are to present our experience with the endoscopic canine fossa approach in the treatment of maxillary sinus aspergilloma and to compare this technique with middle meatal endoscopic antrostomy and combined techniques, outlining not only the advantages of the different techniques, but also their limitations. We will also discuss a few aspects of the main surgical steps of the endoscopic canine fossa approach.

PATIENTS AND METHODS

We performed a retrospective study on the charts of all patients who were operated of a maxillary sinus aspergilloma between January 1997 and January 2003 in our Otolaryngology and Head and Neck Surgery department. All the patients who presented a clinically and surgically confirmed aspergilloma limited to one maxillary sinus during that period were included. Patients who presented other naso-sinusal pathologies or opacification of other sinusal cavities on CT-scan were excluded. We also eliminated all incomplete patient files.
After selection of the files, patients were divided into three groups depending on the surgical technique used for the removal of the aspergilloma:

All patients that had only an endonasal endoscopic middle meatal antrostomy composed group A. The technique was started with an uncinectomy, which permitted to identify and enlarge the maxillary sinus ostium in a posterior direction. The limits of the antrostomy were the orbital floor superiorly, the vertical process of the palatine bone posteriorly, the insertion of the inferior turbinate inferiorly and the natural ostium and nasolacrymal duct anteriorly. Aspergilloma extraction was performed with curved suction tips and forceps. After removal of the fungus ball, lavages were done with an iodine solution. All the surgical steps were realized under 0°, 30° and sometimes 70° endoscope visualization.

Group B included those patients who were submitted to a combined approach (endonasal middle meatus antrostomy and endoscopic canine fossa approach). The middle meatal antrostomy was performed as described above, and then a vertical incision was made in the gingivolabial mucosa over the canine fossa, the bone of the anterior wall of the maxillary sinus was exposed and a small fenestration (approx. 1x1cm) was created with a chisel in order to enter into the sinus cavity and extract the aspergilloma under endoscope visualization. Lavages with an iodine solution were also performed.

Finally group C included all patients who were treated by endoscopic canine fossa approach only. The technique was the same as described above.

All antecedents of prior sinus surgery, complications in the

peri-and postoperative period and the presence or absence of recurrence were noted for all patients in each group.

RESULTS

Thirty-one patients were finally included in our study. The mean age was 45.3 years (range 16 to 72) and there was a significant female predominance (25 females / 6 males).

Group A included ten patients who were treated by endonasal endoscopic middle meatus antrostomy only. One of them had already a middle meatus antrostomy and was treated for an aspergilloma recurrence. In three patients we noted mild complications that included persistent purulent discharge in two cases and nasal crusting in one. There were no clinical signs of recurrence after a follow-up of at least six months.

Group B included nine patients who were treated by a combined approach. Four of them had already been treated surgically for an aspergilloma (Three middle meatus antrostomies and one Caldwell-Luc) and were presenting a recurrence. It is important to note that seven of these patients were initially programmed for an endonasal endoscopic middle meatus antrostomy only but the canine fossa approach was required in order to complete the aspergilloma removal because of poor visualisation. One of the patients presented a severe epistaxis a few days after surgery and had to be reoperated for endoscopic cauterisation of the sphenopalatine artery. There were no clinical signs of recurrence of the aspergilloma after a follow-up of at least six months in this group.

Group C was treated by endoscopic canine fossa approach only and included 12 patients. Two of them had already a middle meatus antrostomy and were presenting a recurrence. No complications or recurrences were noted six months of minimum follow-up after the surgery.

DISCUSSION

When looking at our results, we can see that the recurrences in the surgical treatment of the aspergilloma are not as infrequent as we thougth. In fact seven of the thirty-one patients had had prior sinus surgery. Nevertheless, we can observe that none of the three groups treated by us presented any recurrence independently of the technique chosen. It is somehow true that in some patients the follow-up period is still too short, and more time is needed in our series to get a final conclusion.

The average age and sex ratio of our patients are similar to those reported in the literature. This is consistent with other results reported by different authors, most of them using actually the middle meatus antrostomy as the main surgical approach for the resection of the aspergilloma (Chevalier et al., 1992; Ragheb et al., 1992; Gilain et al., 1992; Klossek et al., 1997). In a study on twelve patients, Gilain et al. reported no recurrences after the removal of maxillary sinus aspergillomas through an enlarged middle meatus antrostomy. In their study, they describe a way to enlarge the middle meatus antrostomy by removing the superior border of the inferior turbinate, or sometimes by removing the whole inferior turbinate creating a large double meatotomy (Gilain et al., 1992). Lopatin also defends middle meatus antrostomy versus an external approach in cases of maxillary sinusitis of dental origin, and notably in the extraction of the causing foreign bodies. But he also recognizes the fact that this approach does not allow good exposure or manipulation when treating disease in the anteromedial part of the sinusal cavity, or in the alveolar recess (Lopatin, 2002).

There is no doubt when looking at the recent reports in the literature that, for most authors, endoscopic middle meatus antrostomy is nowadays the procedure of choice in the treatment of maxillary sinus aspergillomas. In our experience, this procedure does not always allow a complete visualization of the maxillary sinusal cavity, and this could be the first cause of aspergilloma recurrence. This led us to ask the following question: What are the advantages of a primary endoscopic canine fossa approach in treating maxillary sinus aspergillomas?

The first advantage is without any doubt the excellent exposure of all maxillary sinus walls. The anterior wall is indeed not exposed directly, but it can be fully visualized with 70°, 90° or 120° endoscopes at the end of the procedure. On the contrary, a middle meatus antrostomy does not allow to visualize the angle formed by the bony lacrimal duct and the anterior maxillary sinus wall (lacrimal recess of the maxillary sinus), or to identify bony septations that can divide the sinusal cavity. Feng (2000) reports in a study of 41 cases that the use of a combined approach (endonasal endoscopic middle meatus antrostomy and canine fossa approach) is “superior to that of a single pathway”. He states that even if a middle meatus antrostomy is a good approach for removing aspergillomas of the maxillary sinus, the canine fossa approach is necessary in most of the cases in order to assure a complete removal.

A second advantage is that an endoscopic canine fossa approach can be easily performed with local anaesthesia and on an outpatient basis (Whittet et al., 1989). The costs are then reduced, and so are the eventual risks and hazards of general anaesthesia, notably in elderly patients. It is nevertheless advised to perform the surgical procedure under general anaesthesia when the patients are anxious or will not cooperate during an intervention while being awake (e.g., mentally retarded patients).

A third advantage would be the preservation of the integrity of the natural ostium of the maxillary sinus. Perko and Karin demonstrated in their study in rabbits that when the maxillary ostium is surgically disturbed, partially or totally, the normal drainage of the sinusal cavity is altered, and that this can lead to permanent purulent discharge through the antrostomy. The dissection of the ostium can also affect the normal irrigation and innervation of the sinus mucosa and facilitate contamina-

tion by allowing nasal secretions or external irritating agents to penetrate freely into the sinus (Perko and Karin, 1992). Although this study was performed in rabbits, any sinus surgeon can note that it is not unusual to observe similar findings in patients with middle meatal antrostomies who present persistent purulent discharge without any apparent infectious focus. Kennedy and Shaalan (1989) advocate for the systematic preservation of the natural ostium of the maxillary sinus, except when it is stenotic or closed. In our experience, even in such cases, we can suspect regression of the ostium inflammation after removal of the aspergilloma through a canine fossa approach, as these patients do not present pain or discomfort related to ostial dysfunction after surgery.

A final advantage would be that the endoscopic canine fossa approach is more suitable than any other endoscopic technique for the removal of foreign bodies, notably of dental origin, that can be trapped inside the sinusal cavity (Draf, 1983). As we discussed above, one of the favourizing factors for the growth of maxillary sinus aspergillomas could be the presence of dental filling material in the sinusal cavity. By extracting these foreign bodies, we eliminate the initial stimuli for the development of an aspergilloma.

Like any other surgical technique, the endoscopic canine fossa approach also has some disadvantages or limitations. The most important would be that this technique does not allow a direct control of the sinusal cavity in post-operative control consultations. The surgeon then has to rely on the patient's symptoms, a middle meatus endoscopic examination and control scanners in order to be sure of the absence of recurrence. Nevertheless, it is also known that the main factor for aspergilloma recurrence is the presence of residual fungi in the cavity after surgery. The endoscopic canine fossa approach offers an exceptional exposure that allows the surgeon to be sure of a complete aspergilloma removal. Sinus lavages with iodine solutions are recommended during the procedure, and should be performed immediately after the macroscopic removal of the fungus ball. These lavages theoretically should permit to eliminate any residual fragment of aspergilloma, hyphae or spores. In our series we still have not seen any recurrence in patients operated through a canine fossa approach, but we know that recurrences can occur long time after surgery. It is certain that a long-term follow-up is needed to confirm the absence of recurrence in any of the three study groups, but at this moment the results are quite satisfactory.

Another so-called disadvantage when performing an endoscopic canine fossa approach would be that this approach does not leave a nasoantral window that permits post-operative lavages of the sinusal cavity. Again, our experience has shown that by removing the inflammatory stimuli, and in this case the aspergilloma, the natural ostium seems to regain a normal function, and no lavages are needed in order to remove secretions or crusts from the antrum. We nevertheless strongly recommend the systematic prescription of proper antibiotics and systemic steroids when there is evidence of an associated bacterial infection, or when the maxillary sinus mucosa looks oedematous. Aspergillus is by definition an aerobic organism that thrives in well-ventilated sinuses; thus, we can suspect that the ostium function is normal when we find only the fungus ball within a normal maxillary sinus. On the other side, when observing retained purulent secretions in a sinusal cavity with inflammatory mucosal changes, it is likely that there is a concomitant bacterial infection that could be the cause of the ostial dysfunction.

It is important to note that the endoscopic canine fossa approach has clear indications, and it is not to be used as the sole surgical technique when there is clinical or scannographic suspicion of involvement of other paranasal sinuses. For instance, scanner oppacification of the anterior ethmoid cells would constitute a clear indication for performing an endonasal endoscopic functional ethmoidectomy with middle meatus antrostomy.

One last and obvious contraindication for the use of endoscopic canine fossa approach is when treating children with aspergillomas, and one should always be certain that full dentition is complete before proceeding to perform any canine fossa approach.

Some readers could think that an endoscopic canine fossa approach is just a modified Caldwell-Luc technique. In fact we can say that they just have in common the route of access to the sinus cavity and differ in several aspects (Table 1).

Endoscopic canine fossa approach	Caldwell-Luc procedure
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

Table 1. Differences between endoscopic canine fossa approach and Caldwell-Luc procedure.

First, the incision made in the gingivolabial mucosa when performing an endoscopic canine fossa approach has a vertical direction following the direction of the mucosa vessels (Figure 1). This allows to reduce bleeding, improving comfort and visualization. This incision is also smaller (between 1 and 2 centimetres).

Figure 1. Vertical incision in the gingivolabial mucosa of the canine fossa.

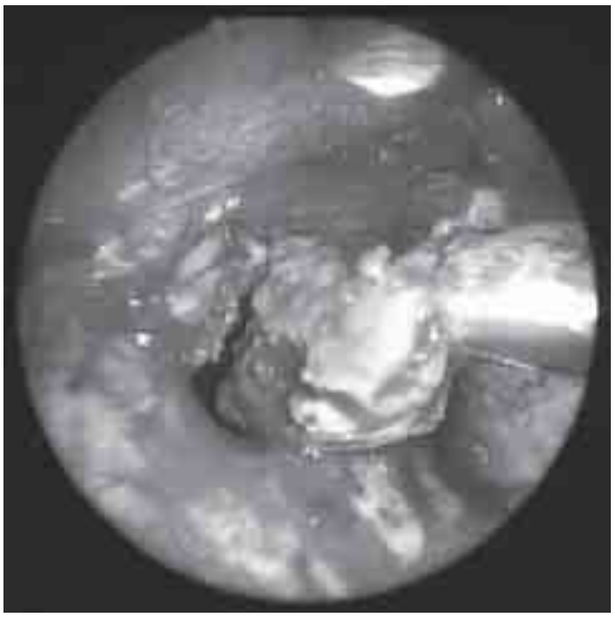

Figure 3. Aspergilloma extraction with a suction tip.

Figure 2. Anterior wall antrotomy. Note that the size of the bony window is limited to allow just the passage of the rigid endoscope and an instrument.

Figure 4. Final result. Note that the natural ostium is patent and anatomically intact.

Second, the window created at the anterior maxillary sinus wall is as small as possible, allowing just the passage of a 4mm rigid endoscope and a forceps or an aspirator (Figure 2). This window is also located as lateral as possible, far away from the infraorbital foramen and from the anterior maxillary neurovascular bundles, and near the root of the zygomatic process of the maxilla. This allows preserving the innervations and vascular supply of the superior dental apparatus, thus reducing the risk of post-operative paraesthesia or teeth discoloration. Ferekidis et al. (1996) have already described some of these modifications of the classic Caldwell-Luc operation, and have concluded that these permit to avoid post-operative sensitivity disorders. It is important to note that with the rigid endoscopes, the limited size of the anterior wall bone opening does not affect the full resection of the fungus ball, as visualization is excellent and this lesion is usually soft and easily fragmented

with the tip of a rigid aspirator for its further extraction (Draf, 1983) (Figure 3).

Third, when performing an endoscopic canine fossa approach, the sinus mucosa is left undisturbed. In a traditional Caldwell-Luc technique, the sinus mucosa is entirely resected.

And a fourth and last difference is that in an endoscopic canine fossa approach no nasoantral window is created and, as mentioned earlier, drainage of the maxillary sinus after surgery depends entirely on the natural ostium (Figure 4).

CONCLUSIONS

Despite of the short postoperative follow-up of some of our patients (6 months only), the endoscopic canine fossa approach seems to be an excellent surgical option when treating maxillary sinus aspergillomas. It is an easy to perform technique that offers the advantages of optimal cavity visualization, feasibility under local anaesthesia and on an outpatient basis, preservation of the natural ostial anatomy and physiology, and proper removal of foreign bodies of dental origin that could be the cause of the aspergilloma. It is important to avoid any canine fossa approach in children because of the potential of permanent dentition injury.

In conclusion, if an endoscopic canine fossa approach offers the possibility of complete extraction of a maxillary sinus aspergilloma without disturbing the natural ostium and its physiology, then why not using it as the first choice technique when the pathology is limited to the maxillary sinus?

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