

Surgery for paranasal sinus mucocoeles: Efficacy of endonasal micro-endoscopic management and long-term results of 185 patients*

Ulrike Bockmühl¹, Barbara Kratzsch², Karin Benda¹, Wolfgang Draf¹

¹ Department of Otorhinolaryngology, Head and Neck and Facial Plastic Surgery, Klinikum Fulda gAG, Teaching Hospital of the Philipps-University Marburg, Germany

² University Department of Otorhinolaryngology, Friedrich-Schiller-University Jena, Germany

SUMMARY

This study evaluates the most extensive long-term treatment outcome of paranasal sinus mucocoeles with particular emphasis on the efficacy of endonasal micro-endoscopic management. It is a retrospective, consecutive case review of 255 patients with 290 mucocoeles including 125 frontal sinus, 23 frontoethmoid, 41 ethmoid, 72 maxillary sinus and 26 sphenoid mucocoeles. The median follow-up of the patients is 12 years (range 1 - 19 years). Sixty-six percent of the mucocoeles resulted after previous sinus surgery, whereas only 1.5% developed after endonasal micro-endoscopic surgery. The median period until mucocoele appearance was 10.8 years. Two hundred one mucocoeles (69.3%) were managed endonasally micro-endoscopically, 18.6% via the osteoplastic approach, 10% endoscopically in combination with an osteoplastic procedure, and 2% according to Lynch/Howarth. Thereafter, recurrence was found in 4 patients only (2.2%). In relation to the endonasal approach the recurrence rate was 1.6%. None of the patients treated endonasally had any complication. In view of these results this paper verifies endonasal micro-endoscopic surgery as a reliable treatment with favourable long-term outcome for paranasal sinus mucocoele management, but also describes contraindications for an endonasal procedure.

Key words: paranasal sinus mucocoele, endonasal micro-endoscopic sinus surgery, long term results

INTRODUCTION

A mucocoele is a slowly expanding epithelial-lined lesion containing inspissated mucus that fills a paranasal sinus cavity, erodes bone and therefore may extend intraorbitally or intracranially [1,2]. Paranasal sinus mucocoeles were clinically first described during the 19th century but the exact pathophysiological mechanisms responsible are still under debate. They are thought to arise as a result of obstruction of the sinus ostium secondary to previous surgery, inflammation and allergic reaction, trauma or a tumor mass [3-5]. Bone-resorbing substances, PGE2 and collagenases have been demonstrated in the lining of mucocoeles [6,7]. Paranasal sinus mucocoeles are reported to be found most commonly in the frontal sinus, with the ethmoid, sphenoid and maxillary sinus involved less frequently [8-10].

Although intranasal marsupialization of ethmoid sinus mucocoeles was first described in 1921 [11] mostly external approaches for radical exenteration of the mucocoele were used until the 1980's. In 1989, Kennedy et al. [9] first presented a 0% recurrence rate after treating frontal, ethmoid and sphenoid mucocoeles exclusively with an endoscopical approach. Today the endonasal approach using the endoscope and/or

microscope has emerged as the first choice for mucocoele surgery, with minimal morbidity and low recurrence rates [4,9,10,12-16].

During the last decade our experience with the endonasal approach has subsequently expanded to include most mucocoeles. However, there are still contraindications for this modality. Based on our surgical experience comprising a long-term postoperative follow-up, this paper evaluates the efficacy of endonasal micro-endoscopic surgery, describes its limits and defines the indication for an external approach.

MATERIALS AND METHODS

This is a retrospective, consecutive study of all paranasal sinus mucocoeles undergoing sinus surgery at the Department of Otorhinolaryngology of the Klinikum Fulda gAG (Teaching Hospital of the Philipps-University Marburg, Germany) over the 18-year period between 1983 and 2001.

Patient profile data consisted of demographic details, past history of sinus surgery, trauma or inflammation, symptoms, the mucocoele site and expansion defined by computerized tomography (CT) and/or magnetic resonance imaging (MRI), and the type of sinus surgery performed. The patients were

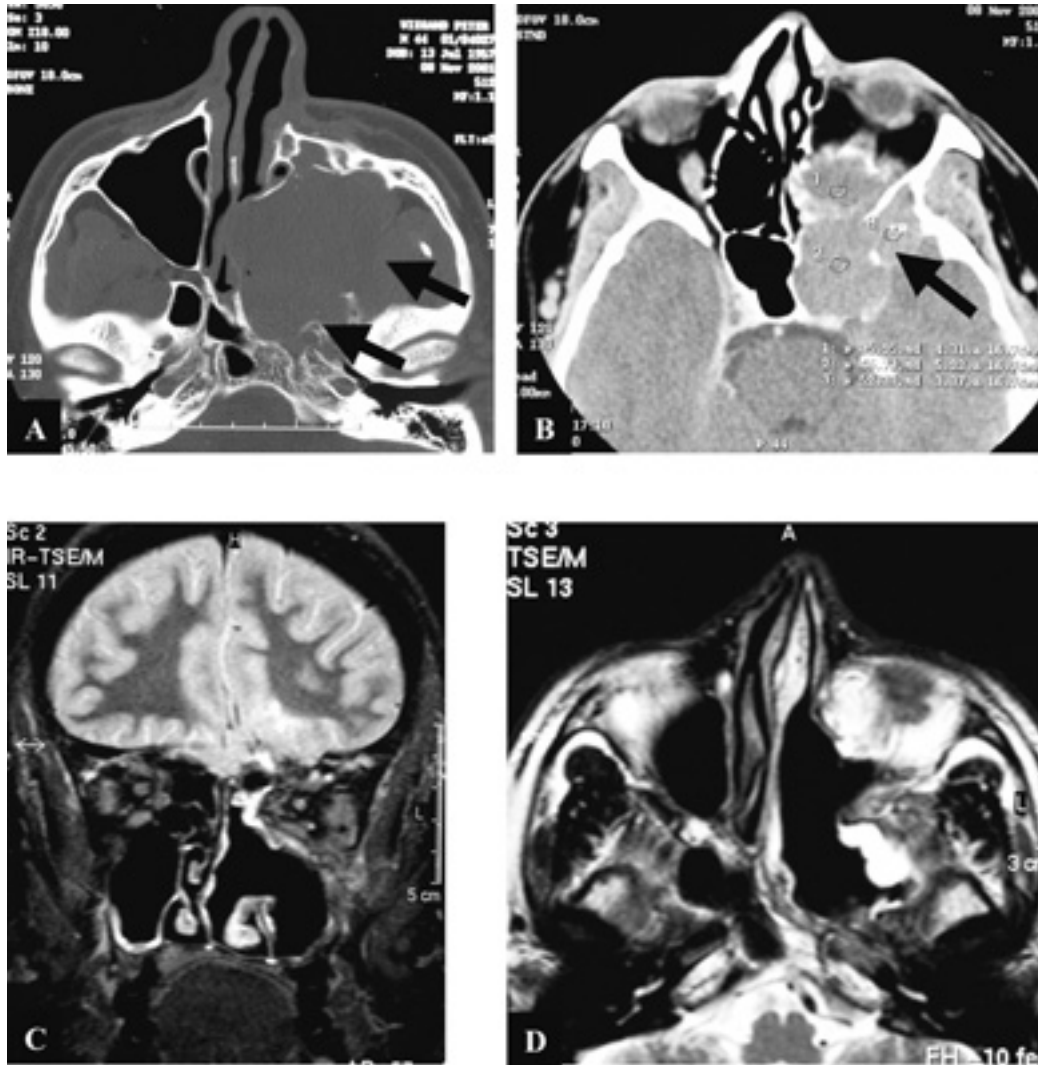


Figure 1. (A) Axial bony window computerized tomography image showing a chambered maxillary sinus mucocoele extend into the infratemporal fossa (arrows). (B) Axial soft tissue window computerized tomography image showing the intracranial mucocoele extension (arrow). (C) T2 weighted coronal and (D) axial magnetic resonance image 4 years after endonasal micro-endoscopic marsupialization of the mucocoele.

operated using the same surgical concept including endonasal micro-endoscopic sinus surgery (especially frontal sinus drainage type I - III according to Draf) and osteoplastic frontal and maxillary sinus surgery always using a microscope and/or endoscope [17,18]. The surgical procedure of the osteoplastic frontal sinus operation was described in detail by Bockmühl et al. [19] and Weber et al. [20]. The osteoplastic maxillary sinus operation means the temporary removal of the anterior bony wall of the sinus that will be replaced and fixed at the end of the operation [21].

For this study 185 patients agreed to undergo a special postoperative clinical evaluation with nasal endoscopy as well as radiological examination (i.e. CT or MRI). The follow-up period ranged from 2 to 19 years (median = 12 years).

Data were recorded on an Excel[®] spreadsheet and simple associations were evaluated.

RESULTS

Epidemiology

Between 1983 and 2001, 255 patients (170 men, 85 women) with 290 paranasal sinus muco- and/or pyoceles were treated surgically. The age of the patients ranged from 10 to 80 years (mean 52). Thirty-five patients have had two muco- and/or pyoceles each. Fourteen patients were under the age of 20, and eight of them younger than 16 years.

Location of the mucocoeles

One hundred eighty one of the 290 paranasal sinus lesions were mucocoeles and 109 of them pyoceles. They were located as follows: 125 within the frontal sinus, 72 in the maxillary sinus, 41 in the ethmoid cells, 29 in the sphenoid sinus and 23 within the frontoethmoid complex. Of the 35 patients with 2 simultaneous mucocoeles, the most frequent combination was ethmoid and frontal sinus mucocoeles (23 cases). In 5 patients,

simultaneous maxillary sinus and ethmoid mucocoeles were found, in 3 cases the combination of frontal and sphenoid sinus mucocoeles and in 4 patients simultaneous ethmoid and sphenoid sinus mucocoeles were detected. Dehiscence of the posterior table of the frontal sinus was present in 7 patients, one patient presented with intracranial extension, 13 with erosion of the lamina papyracea, and 3 patients presented with partial erosion of a sphenoid sinus wall.

Symptoms

The clinical presentation comprised mainly ophthalmological and/or rhinological signs and symptoms. Most of them could be subdivided according to their localization (Table 1). Three of the patients with sphenoid mucocoeles presented with visual loss up to amaurosis. In general, single symptoms as well as combinations of symptoms have been described.

Etiology

In total, 168 (66%) of the 255 patients evaluated had a history of previous paranasal sinus surgery for chronic rhinosinusitis and/or polyps. In 43 cases (17%) the mucocoeles developed spontaneously. A history of trauma was found in 37 patients (14%), chronic sinusitis without operation in 5 patients (2%), and in another 2 patients the mucocoeles were caused by a tumor.

In 29 of the 168 patients, two celes were diagnosed resulting in a total number of 197 mucocoeles that have arisen postoperatively. Table 2 shows the localization of the 197 mucocoeles in relation to the type of previous operation. Importantly, 78.7% of the mucocoeles were seen after Lynch-Howarth [22] or Caldwell-Luc [23] operation or combinations with both of them in contrast to 1.5% following endonasal and 4% after osteoplastic sinus surgery.

Interval of mucocoele development

The shortest interval until muco- or pyocoele presentation was 1 year, the longest 19 years. The median interval for the development of a mucocoele was found to depend on the localization as follows: in the maxillary sinus after 15 years, in the frontoethmoid complex after 13 years, in the ethmoid after 10 years, and after 8 years in the frontal and sphenoid sinus, respectively.

Type of surgery for the mucocoele management

Most of the mucocoeles (69.3%) including all frontoethmoid, ethmoid as well as sphenoid lesions were managed by an endonasal micro-endoscopic sinus operation. Even extensive mucocoeles as shown in Figure 1 and 2 can be masupialized via the endonasal approach. In cases of far lateral located maxillary and frontal sinus mucocoeles as shown in Figure 3 they

Table 1. Frequency of signs and symptoms of the 255 patients according to the localization of their mucocoeles (n=290).

	Maxillary sinus	Ethmoid sinus (n=72)	Frontal sinus (n=41)	Frontoethmoid complex (n=125)	Sphenoid sinus (n=23)	(n=29)
Headaches		46.8%	69.2%	37.7%	85.7%	76.2%
Palpebral edema		42.6%	26.9%	31.2%	35.7%	
Pressure/Pain		55.3%		33.8%	2.7%	
Nasal obstruction		19.2%	26.9%	18.2%		
Exophthalmus		8.5%	23.1%	3.9%	2.6%	
Diplopia			2.7%	13.0%	14.3%	
Hyp-/ Anosmia			11.5%	3.9%		
Asymptomatic			11.5%		7.8%	4.8%

Table 2. Localization of the 197 mucocoeles subdivided into the previous operations the cele was caused by.

Operation	Localization	Maxillary sinus n=42	Ethmoid sinus n=24	Frontal sinus n=72	Frontoethmoid complex n=13	Sphenoid sinus n=17	Multiple celes n=29	Σ = 197
Polypectomy		9	5	5	2	8	-	29
Caldwell-Luc (CL)		23	9	11	1	-	4	48
Lynch-Howarth (LH)		-	1	30	5	-	3	39
CL + LH		4	-	7	1	3	11	26
CL + LH + endonasal		2	-	3	2	-	4	11
CL + endonasal		2	4	5	-	2	4	17
LH + endonasal		-	2	5	2	3	2	14
Endonasal		-	-	3	-	-	-	3
Osteoplastic		2	-	1	-	-	-	3
Endonasal + osteoplastic		-	2	2	-	-	1	5
Septoplasty		-	1	-	-	1	-	2

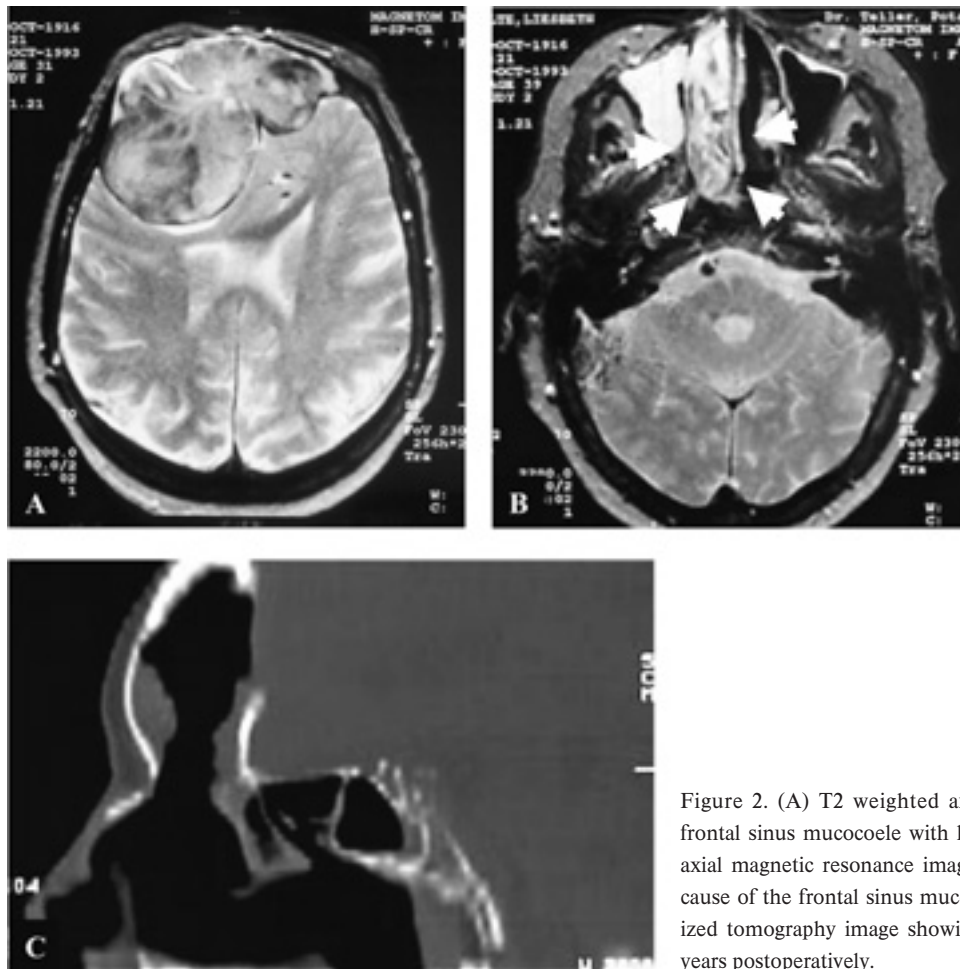


Figure 2. (A) T2 weighted axial magnetic resonance image showing a frontal sinus mucocoele with large intracranial extension. (B) T2 weighted axial magnetic resonance image showing an inverted papilloma to be the cause of the frontal sinus mucocoele. (C) Sagittal bony window computerized tomography image showing inconspicuous frontal sinus conditions 6 years postoperatively.

Table 3. Localization of the 290 mucocoeles and type of surgical approach performed.

Localization	Maxillary sinus	Ethmoid sinus	Frontal sinus	frontoethmoid	Sphenoid sinus
Operation	n=72	n=41	n=125	n=23	n=29
Endonasal	57	41	51	23	29
Osteoplastic frontal sinus op	-	-	43	-	-
Osteoplastic max. sinus op	11	-	-	-	-
Endonasal + osteoplastic frontal sinus op	-	-	25	-	-
Endonasal + osteoplastic max. sinus op	4	-	-	-	-
LH	-	-	6	-	-

were removed via an osteoplastic approach. The details of the surgical approach for each location are summarized in Table 3.

Long-term treatment outcome

Of the 185 patients who could be followed clinically, endoscopically as well as radiologically over this long-term period 4 patients (2.2%) presented with a recurrent mucocoele. In relation to the endonasal sinus surgery the recurrence rate was only 1.6% (3 cases). In 3 cases primary and recurrent mucocoele were located in the ethmoid, whereas 1 patient showed first a frontal sinus mucocoele and then a subsequent mucocoele in the sphenoid sinus. Three of the 4 recurrent mucocoeles developed during an interval of 25 – 30 months, but the

fourth mucocoele occurred after 68 months.

All 4 patients underwent endonasal revision surgery, and in 3 of them a type III frontal sinus drainage according to Draf was performed.

DISCUSSION

Advances in endoscopic and microscopic sinus techniques and instrumentation, as well as the introduction of intraoperative imaging and navigation systems have made the endonasal approach the first choice for treatment of paranasal sinus mucocoeles [10,13,14,24-27]. It is confirmed by our present study describing long-term follow-up results of the largest series of mucocoeles so far.



Figure 3. Far lateral located sinus mucocoeles (left circles) might be contraindications for an exclusively endonasal approach in contrast to medially lying celes (right circles).

The epidemiological and clinical aspects of our series of 255 patients generally correspond to those found in the literature [9,10,13,14,16,26,28]. However, mucocoeles of the fronto-ethmoid complex occurred in 65.2% which is in line with the findings of Serrano et al. [16] but less frequent compared to other studies [8,10,13,29]. In contrast, we and Serrano et al. [16] have seen proportional more frequent maxillary as well as sphenoid sinus mucocoeles.

The majority (66%) of our 255 patients presenting with mucocoeles had a history of previous paranasal sinus surgery for treatment of chronic rhinosinusitis, and/or nasal polyps. Importantly, 78.7% of these were seen after Lynch-Howarth [22] or Caldwell-Luc [23] operation or combinations of both procedures in contrast to 1.5% after endonasal and 4% after osteoplastic sinus surgery. These percentages clearly demonstrate the main disadvantage of the Lynch-Howarth operation consisting in the partial or complete removal of the lateral bony wall of the frontal recess which subsequently leads to soft tissue prolapse, i.e. disrupting the natural sinus drainage. It reveals the strong association between sinus obstruction and the development of a mucocoele. The major problem of the Caldwell-Luc operation is also scarring of the facial soft tissue, rather than the inferior antrostomy. Islands of laterally localized mucosa get separated finally causing the mucocoele formation. Thus, we feel that both procedures should no longer rank among modern concepts of paranasal sinus surgery [30,31].

Most of the mucocoeles (69.3%) including all frontoethmoid, ethmoid as well as sphenoid mucocoeles were managed by an endonasal micro-endoscopic sinus operation. Thereby, stripping of the mucocoele lining does not appear to be necessary since it has been shown that the mucocoele does not lose normal respiratory epithelium and postoperatively returns to its

normal appearance [27,28]. Depending on the individual anatomy, we performed type II up to type III frontal sinus drainages according to Draf [18]. In the cases of sphenoid mucocoeles successful marsupialization was achieved by removing the anterior bony wall (type II) or additionally the intersphenoidal as well as 1 cm of the posterior nasal septum (type III) [32]. In relation to the endonasal sinus surgery 98.4% of our patients were long-term disease free. Restenosis or a recurrent mucocoele were seen in only 3 of 185 cases (1.6%). This excellent long-term result complements the shorter follow-up outcomes described in the literature so far.

Nevertheless, certain paranasal sinus mucocoeles are not suitable for an endonasal approach.

Contraindications for an endonasal approach in the management of mucocoeles:

1. Far laterally localized frontal or maxillary sinus mucocoeles as shown in Figure 3.
2. In cases of revision surgery where the previous operation was external according to Lynch-Howarth [11,22] or Caldwell-Luc [23] and has caused severe scars.
3. If maxillary sinus mucocoeles are located within the zygomatic bone.
4. In cases when the mucocoele is present with a cutaneous fistula that needs to be excised.
5. In cases of malignancy causing the mucocoele.

There will be some circumstances in which these contraindications may not apply, since they depend to a degree upon the experience of the surgeon. On this note Figures 1 and 2 show borderline cases. The chambered maxillary sinus mucocoeles with extension into the infratemporal fossa (Figure 1) could all be accessed endonasally. Similarly, the frontal sinus mucocoele with intracranial extension (Figure 2) could only be sufficiently drained by complete removal in the causing inverted papilloma of the right ethmoid sinus. However, if there is poor access to the mucocoele and the risk of damage to local structures or a stable drainage can not be established, an external osteoplastic or combined approach should be performed (possibly with obliteration) [30].

To conclude, the long-term results of this study add to the number of publications advocating endonasal sinus surgery as a safe and effective approach for mucocoele management and therefore as the first line treatment [10,13,14,16,26].

ACKNOWLEDGEMENTS

Dedicated to the 65th birthday of Prof. Dr. Wolfgang Draf.

REFERENCES

1. Delfini R, Missori P, Iannetti G, Ciappetta P, Cantore G (1993) Mucocoeles of the paranasal sinuses with intracranial and intraorbital extension: Report of 28 cases. *Neurosurgery* 32: 901-906.
2. Batsakis JG, Sciubba JJ (1991) Pathology. In: Blitzer A, Lawson W, Friedman WH, eds. *Surgery of the paranasal sinuses*. Saunders, Philadelphia, pp 127-128.

3. Evans C (1981) Aetiology and treatment of fronto-ethmoidal mucocoele. *J Laryngol Otol* 95: 361-375.
4. Moriyama H, Nakajima T, Honda Y (1992) Studies on mucocoeles of the ethmoid and sphenoid sinuses: Analysis of 47 cases. *J Laryngol Otol* 106: 23-27.
5. Lund VJ (1987) Anatomical considerations in the aetiology of fronto-ethmoidal mucocoeles. *Rhinology* 25: 83-88.
6. Lund VJ, Harvey W, Meghji S, Harris M (1988) Prostaglandin synthesis in the pathogenesis of fronto-ethmoidal mucocoeles. *Acta Otolaryngol* 106: 145-151.
7. Lund VJ, Henderson B, Song Y (1993) Involvement of cytokines and vascular adhesion receptors in the pathology of fronto-ethmoidal mucocoeles. *Acta Otolaryngol* 113: 540-546.
8. Natvig K, Larsen TE (1978) Mucocoele of the paranasal sinuses. *J Laryngol Otol* 92: 1075-1082.
9. Kennedy DW, Josephson JS, Zinreich SJ, Mattox DE, Goldsmith MM (1989) Endoscopic sinus surgery for mucocoeles: a viable alternative. *Laryngoscope* 99: 885-895.
10. Lund VJ (1998) Endoscopic management of paranasal sinus mucocoeles. *J Laryngol Otol* 112: 36-40.
11. Howarth WG (1921) Mucocoele and pyocoele of the nasal accessory sinuses. *Lancet* 2: 744-746.
12. Har-El G (2001) Management of the paranasal sinus mucocoele. *J Oral Maxillofac Surg* 59: 246-247.
13. Beasley NJP, Jones NS (1995) Paranasal sinus mucocoeles: Modern management. *Am J Rhinol* 9: 251-256.
14. Khong JJ, Malhotra R, Selva D, Wormald PJ (2004) Efficacy of endoscopic sinus surgery for paranasal sinus mucocoele including modified endoscopic Lothrop procedure for frontal sinus mucocoele. *J Laryngol Otol* 118: 352-356.
15. Rubin JS, Lund VJ, Salmon B (1986) Frontoethmoidectomy in the treatment of mucocoeles. A neglected operation. *Arch Otolaryngol Head Neck Surg* 112: 434-436.
16. Serrano E, J.-M. K, Percodani J, Yardeni E, Dufour X (2004) Surgical management of paranasal sinus mucocoeles: A long-term study of 60 cases. *Otolaryngol Head Neck Surg* 131: 133-140.
17. Draf W (1991) Endonasal micro-endoscopic frontal sinus surgery: The Fulda concept. *Operative Techniques Otolaryngol Head Neck Surg* 2: 234-240.
18. Draf W (2005) Endonasal frontal sinus drainage type I-III according to Draf. In: Kountakis S, Senior B, Draf W, eds. *The frontal sinus*. Springer, Berlin Heidelberg New York, pp 219-232.
19. Bockmühl U (2005) Osteoplastic frontal sinusotomy and reconstruction of frontal defects. In: Kountakis S, Senior B, Draf W, eds. *The frontal sinus*. Springer, Berlin Heidelberg New York, pp 281-289.
20. Weber R, Draf W, Keerl R, Kahle G, Schinzel S, Thomann S, Lawson W (2000) Osteoplastic frontal sinus surgery with fat obliteration: technique and long-term results using magnetic resonance imaging in 82 operations. *Laryngoscope* 110: 1037-1044.
21. Feldmann H (1978) Osteoplastic operation of maxillary sinus. *Laryngol Rhinol Otol* 57: 373-378.
22. Lynch RC (1921) The technique of a radical frontal sinus operation which has given me the best results. *Laryngoscope* 31: 1-5.
23. MacBeth R (1971) Caldwell, Luc, and their operation. *Laryngoscope* 81: 1652-1657.
24. Hartley BE, Lund VJ (1999) Endoscopic drainage of pediatric paranasal sinus mucocoeles. *Int J Pediatr Otorhinolaryngol* 50: 109-111.
25. Busaba NY, Salman SD (1999) Maxillary sinus mucocoeles: Clinical presentation and long-term results of endoscopic surgical treatment. *Laryngoscope* 109: 1446-1449.
26. Har-El G (2001) Endoscopic management of 108 sinus mucocoeles. *Laryngoscope* 111: 2131-2134.
27. Ikeda K, Takahashi C, Oshima T, Suzuki H, Satake M, Hidaka H, Takasaka T (2000) Endonasal endoscopic marsupialization of paranasal sinus mucocoeles. *Am J Rhinol* 14: 107-111.
28. Lund VJ, Milroy CM (1991) Fronto-ethmoidal mucocoeles: A histopathological analysis. *J Laryngol Otol* 105: 921-923.
29. Lloyd G, Lund VJ, Savy L, Howard D (2000) Optimum imaging for mucocoeles. *J Laryngol Otol* 114: 233-236.
30. Weber R, Draf W, Kratzsch B, Hosemann W, Schaefer SD (2001) Modern concepts of frontal sinus surgery. *Laryngoscope* 111: 137-146.
31. Weber R, Keerl R, Draf W (2000) Endonasale endoskopische Chirurgie von Kieferhöhlenmukozelen nach Caldwell-Luc-Operation. *Laryngorhinootologie* 79: 532-535.
32. Draf W, Weber R (1992) Endonasale Chirurgie der Nasennebenhöhlen - Das Fuldaer mikro-endoskopische Konzept. In: Ganz H, Schätzle W, eds. *HNO Praxis* 12. Springer, Berlin Heidelberg New York, pp 59-80.

Ulrike Bockmühl, M.D., Ph.D.
 Dept. of Otorhinolaryngology
 Head and Neck and Facial Plastic Surgery
 Klinikum Fulda gAG
 Teaching Hospital of the Philipps-University Marburg
 Pacelliallee 4
 36043 Fulda
 Germany

Tel: +49-661-846007
 Fax: +49-661-846002
 E-mail: u.bockmuehl.hno@klinikum.fulda.de