

Combined Functional Endoscopic Sinus Surgery (FESS): a revisited approach*

D.M. El-Hennawi

Department of Otorhinolaryngology, Endoscopy Unit, The Medical School, Suez Canal University, Ismailia, Egypt.

SUMMARY

A technique of combined functional endoscopic sinus surgery (FESS) was carried out through the nose to clear up the ostiomeatal complex. A small window was then created in the canine fossa to remove the maxillary sinus pathology under endoscopic control. It aims at the complete removal of maxillary sinus pathology, which cannot be safely removed via the middle meatus while preserving the rest of the mucosa to ensure sinus rehabilitation. It also helps the surgeon in case of difficulty in locating the ostium during FESS. A series of 36 patients was studied over a period of two years, with a follow up, up to two years, post operatively. The present technique proved to be complementary to FESS with no serious complications. It is recommended for cases of recurrent antrochoanal polyps, oroantral fistula, sinusitis of dental origin or fungal infection of the nose and sinuses.

Key words: combined functional endoscopic sinus surgery, canine fossa, ostiomeatal complex, maxillary sinus rehabilitation, Caldwell Luc operation

INTRODUCTION

The advent of combined approach; multi-angled endoscopes and high resolution computed tomography (CT) scans has considerably enhanced the value of functional endoscopic sinus surgery (FESS) (Kaluskar and Patil, 1992). Based primarily on the concept developed by Wigand et al. (1978) and Messerklinger (1978), the technique has since then been adopted by several surgeons including Draf (1983), Kennedy et al. (1985) and Stammberger (1986). As Kennedy (Kennedy et al., 1985) and Stammberger (1986) has emphasised, the goal of FESS is to restore normal physiological function to the sinuses.

The surgical approach should be functional, not ablative or exenterative, and it should address the nose and sinuses physiologically. However, the procedure is not without danger, as the operating area abuts the cribriform plate and orbit (Kaluskar and Patil, 1992). Complications can be minimised by intimate knowledge of the surgical anatomy of the ostiomeatal complex and its variations, by cadaver dissection, adequate training and close supervision (Maran et al., 1993).

Under certain circumstances, FESS is not sufficient to deal adequately with extensive maxillary sinus pathology, through middle metal antrostomy due to anatomical, mechanical and pathological factors. Also, surgeons may have difficulties in identifying the maxillary sinus ostium during FESS in about 17% of the cases (Kennedy et al., 1987).

Thus combined FESS was developed to manage difficulties in locating the maxillary sinus ostium, or when the maxillary sinus pathology cannot be safely removed via the middle meatus.

MATERIALS AND METHODS

Patients of this series were presented or referred to the ENT clinic of Suez Canal University Hospital at Ismailia, Egypt, over a period of 2 years from December 1994 to November 1996 with nasal symptoms.

For the present technique patients were selected in whom chronic sinusitis was thought preoperatively to be extensive and of primary antral origin. From the start it was determined to select 30 patients for the combined FESS technique. In 6 other patients, the decision to perform combined FESS was made preoperatively. All patients were adults above 16 years old. Symptoms were graded mild, moderate and severe. All patients with mild symptoms were not included as they were treated conservatively. Preoperative diagnosis and cause of chronicity were the following:

1. Antrochoanal polyp, especially the recurrent cases either after simple polypectomy (15 cases) or after FESS (2 cases).
2. Oroantral fistula (5 cases) or sinusitis of dental origin (6 cases). Root canal treatment caused sinusitis of dental origin either due to perforation of the sinus floor or displaced foreign material into the sinus. While oroantral fistula was

due to tooth extraction, forming a communication between the antrum and the oral cavity.

3. Fungal infection of the nose involving the maxillary sinus extensively (2 cases). One case had bilateral huge concha bullosa obstructing the nose completely. The other one had chronic sinusitis of long duration. The underlying cause for his sinusitis was marked septal deviation narrowing the middle meatus together with polypoidal pathology of the uncinate process.
4. Diffuse polyposis: The potential candidates for these technique were the patients with diffuse polyposis (6 cases) owing to extensive bleeding or polypi obscuring the natural ostium, for identification or widening.

All selected patients were subjected to the following:

1. Careful history taking;
2. Thorough ENT examination;
3. Nasal endoscopy as described by Messerklinger (1978);
4. CT scan of nose and paranasal sinuses;
5. General examination and fitness for general anaesthesia (GA);
6. Necessary laboratory investigations.

Technique of combined FESS

All procedures were done under general hypotensive anaesthesia. Patients awaiting operation received a nasal decongestant spray several times. After administration of GA, the nose was injected following the technique of Stammberger (1986) with a local anaesthetic and a vasoconstrictor (xylocaine with epinephrine 1/80.000) using dental Carpule, with 27 gauge, 1,5 inch long needle. This dental Carpule facilitates accurate placement of the medication for excellent haemostasis. The nose was then packed for 10 minutes, with neurosurgical cottonoids pledges soaked in saline adrenaline solution 1/20.000. The canine fossa on the operated side was infiltrated similarly and then left for 10 minutes. A routine Messerklinger technique as described by Stammberger (1986) was used to perform surgery in the ostiomeatal complex through the intranasal approach.

After adequate retraction of the lip, an incision is made down to the bone in the gum margin, 3 mm above and parallel to gingivolabial fold from the posterior edge of the lateral incisor for 2-3 cm laterally. A mucoperiosteal flap is dissected superiorly, defining the canine fossa which lies lateral to the canine tooth, and extends cranially into a pointed or rounded arch (Draf, 1983). The exit of the infra-orbital nerve lies about 1 cm further cranially (Draf, 1983). The anterior wall of the antrum is opened in the canine fossa, where the bone is relatively thin (Draf, 1983), using a 5 mm drill. A 1 x 1 cm window is created allowing a 4-mm endoscope and any other instrument to be introduced parallel to each other in the maxillary sinus lumen. By the use of 30° or 70° endoscopes the entire maxillary sinus is inspected thoroughly and its ostium is identified easily.

Cysts, polyps or fungal masses were only removed while the rest of the mucosa, even when thickened or polypoidal, was left to heal after achieving good aeration and drainage through widening the maxillary sinus ostium. In case of failure to widen or identify the ostium during FESS from the nose, it was identified

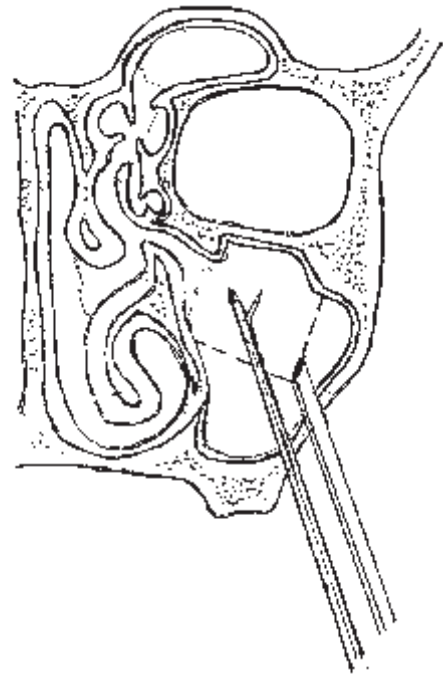


Figure 1. Schematic diagram of combined FESS technique.

and widened from within the maxillary sinus using backward cutting forceps. Schematic drawing of the technique of combined FESS is shown in Figure 1.

At the end of the procedure haemostasis was obtained by electrocoagulation, followed by repeated irrigation with saline to clear sinus lumen; H₂O₂ may also be used to wash the sinus, until bleeding has stopped completely. No antral packs were required in the sinus. The buccal incision was closed with absorbable suture material.

Postoperatively, the patients were placed in a semi-sitting position in bed and an ice pack was applied to the operated side for the next 24 hours. Analgesics, anti-inflammatory, and antibiotics were prescribed.

Combined FESS was the sole procedure for 18 patients. While the rest of the patients (18) required other procedures as shown in Table 1.

In two patients with fungal infection of the nose and paranasal sinuses, total sphenoidectomy was done (Wigand, 1981), in addition to combined FESS in order to clear up all the sinuses properly.

Two patients had had previous endoscopic ethmoidectomy. One of them had a recurrent antrochoanal polyp for the 3rd time, after simple polypectomy and FESS respectively. During the operation, the enlarged ostium was obstructed by the recurrent polyp with adhesions between middle turbinate and the lateral nasal wall. The polyp was originating from the inferior angle in the vicinity of a root of a projecting premolar tooth. The other patient had a recurrent antrochoanal polyp for the 2nd time after FESS. The polyp was found on the nasal floor extending to the nasopharynx with excessive mucopurulent discharge. The middle meatus was narrowed with adhesions between middle turbinate and the lateral nasal wall. The steno-

sed ostium could only be detected from within the maxillary sinus during combined FESS. The antrochoanal polyp was originating from the medial wall. Both cases required enlarging the ostium to a size of about 1.5 × 1.5 cm, removing the pedicle of the polyp properly together with the affected mucosa and clearing up the ethmoids properly.

Table 1. Concurrent surgery done with combined FESS.

Type of surgery	No. of procedures
Closure of oroantral fistula	5
Septoplasty	7
Middle turbinate partial resection	5
Inferior turbinectomy (ant. end)	1
Endoscopic total sphenoidectomy	2

RESULTS

The patients pool consisted of 26 males (72%) and 10 females (28%), with a mean age of 32 years. Only 6 patients had bilateral afflictions.

Anterior rhinoscopy revealed a significant deviation of nasal septum in 7 cases, solitary polyp in 10 cases (antrochoanal polyp), bilateral diffuse polyposis in 6 cases, mucopurulent discharge in 5 cases and synachia from previous operations in 2 cases.

Nasal endoscopy revealed a polyp or its pedicle in the ostiomeatal complex in additional 7 cases, where polyps were either too small to be seen by the naked eye, or the ostiomeatal complex was too narrow. The anterior end of the middle turbinate were polypoidal in 2 of these cases. Endoscopy revealed huge ethmoidal bulla in 4 cases, partial ethmoidectomy from previous surgery in 2 cases, and huge concha bullosa in 1 case. Deformity of the uncinate process was found in a total of 13 cases in the form of medially bent, bulging or polypoidal pathology.

CT scan was done for all patients prior to surgery. Findings were graded from “mild” (12 cases, only one sinus involved) to “moderate” (15 cases, two sinuses were involved), and severe in 9 cases (more than two sinuses were affected on the same side); two of these cases showed dense radio opaque shadows. The presence of the latter in absence of foreign body history denoting aspergillosis of the nose and sinuses (Stammerger et al., 1984). Diagnosis was confirmed by biopsy of sinus mucosa and fresh nasal scrapings. Intra-operatively the most characteristic feature was the presence of green brown sludge filling the antrum (Weir and Golding-Wood, 1997).

The majority of the patients was discharged from the hospital on the second day, except for four patients. Three of the latter group developed unilateral marked cheek swelling and one showed orbital ecchymosis in addition. These patients were discharged on the third day. Only one patient had severe post-operative bleeding from the maxillary sinus on the first post-operative day which required re-opening the sublabial wound and suction of blood from the sinus, electrocautery was applied to the bleeding points, then repeated wash out with saline and H₂O₂ till bleeding stopped and no antral packing was required. This patient stayed in the hospital for 3 days.

The patients were followed up twice per week for about 4 weeks and after that on a monthly basis. The follow-up period ranged from 6 to 26 months with a mean follow-up of 14.8 months. Only 4 patients (11%) were missed during the first 6 months of follow-up. The other patients showed various degrees of improvement, 28 patients (86%) lost their symptoms after 3 months and they had patent maxillary sinus ostia, a clean healthy ethmoid cavity and a nicely epithelialized maxillary sinus with no pathology.

Only 4 patients (14%) felt the symptoms had not disappeared, two of them (7%) developed middle meatal stenosis and required revision surgery. The other two patients (7%) had no subjec-

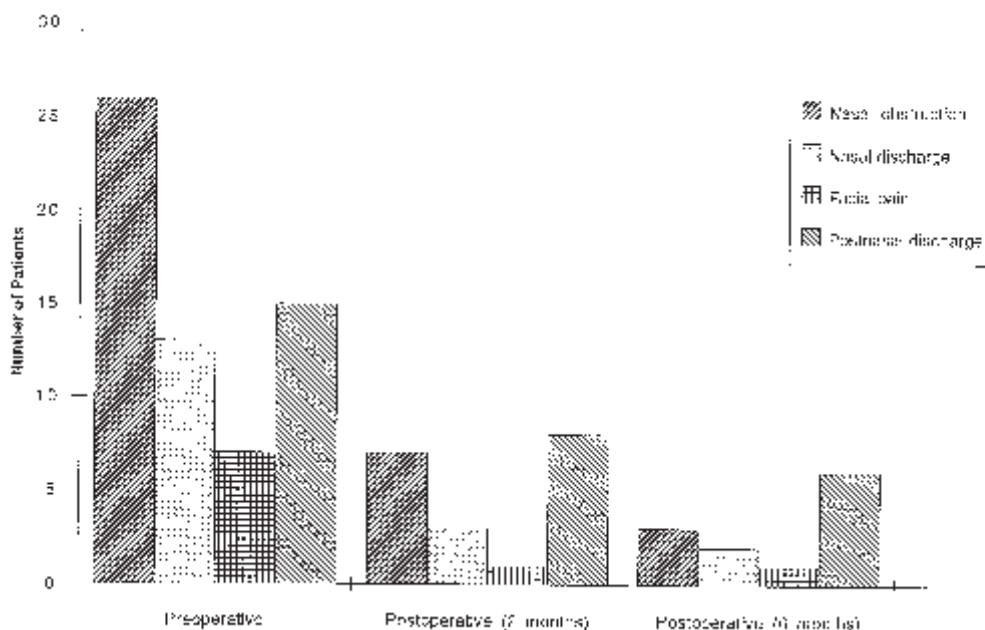


Figure 2. Symptoms profile in 32 patients with combined FESS.

tive improvement, in spite of patent ostia and healthy clean maxillary and ethmoid sinuses.

Analysis of the patients' postoperative symptoms is shown in Figure 2. It demonstrates that there were marked improvements at the end of the postoperative period as regards nasal obstruction (1%), nasal discharge (0.6%) and facial pain (0.3%). But the improvement in post nasal drip (16%) was slower, as mucous membrane might take a long time to settle down.

No serious complications were encountered in the present work. The intraoperative difficulties encountered during this technique of combined FESS were:

- Failure to identify and/or widening the natural ostium from the nose during FESS (6 cases) with extensive nasal polyposis. This problem was managed by shifting to the combined FESS technique.
- Scarring from previous surgery (2 cases) involving the middle meatus, which was stenosed in one case. Adhesions were cut, pathology was removed and ethmoidectomy was completed. Insertion of a thin Silastic roll in the middle meatus away from the ostium to avoid recurrence for about 3 weeks. Identification of the natural ostium from the nose was almost impossible and dangerous. Shift to the combined FESS was mandatory.
- Bleeding obscuring the field in the nose (2 cases with fungal infection), Merocel nasal pack was inserted overnight at the end of the procedure. Combined FESS made the location of the ostium easier.

DISCUSSION

FESS has become an acceptable technique for treatment of chronic sinus disease (Maniglia, 1991). Under certain circumstances, FESS is not sufficient to deal adequately with maxillary sinus pathology. Different surgeons advocate different endoscopic techniques to overcome this problem. Wigand et al., (1978) used the inferior meatal approach. This technique gives a limited view of the entire sinus, specially the ostium and the medial wall. Also, the radius of action is limited and hindered mechanically by the inferior turbinate and septum. By means of this technique one can hardly widen the maxillary sinus ostium and deal with the medial wall pathology. Moreover, the inferior meatal antrostomy is not physiologic as mucociliary clearance is directed toward the natural ostium. On the other hand, it may lead to spread of infection from the nose to the sinus (El Hennawi, 1989).

Draf (1983) used the trocar and cannula through the canine fossa. Obviously, this technique is suitable for diagnosis and biopsy using the optical biopsy forceps.

Kaluskar and Patil (1992) described his technique to enlarge the maxillary sinus ostium by introducing the endoscope through the canine fossa and backward biting forceps through the nose. Thus, the latter technique is meant for widening the maxillary sinus ostium only, but not to deal with maxillary sinus pathology. Obviously, this technique offers a solution to a problem of non-visualisation of maxillary sinus ostium encountered during routine FESS.

The combined FESS is considered a continuation of the work carried out by several authors to avoid the drawbacks of a Cald-

well-Luc operation. The latter operation appears to be followed by several documented drawbacks. It is associated with high incidence of dysaesthesia and neuralgia (Pfeiffer and Schmitz, 1973). Also, it lacks magnification, and close inspection of the mucosa and different corners of the sinus by the endoscope. Kennedy et al. (1989) demonstrated that the mucosa which re-groups in the maxillary sinus is histologically and functionally abnormal. In addition, retention cysts of large size to fill or expand the sinus, have been described (Haesgawa et al., 1979). The most important drawback, is that the Caldwell-Luc operation does not deal with the pathology in the ostiomeatal complex. So symptoms will persist or will recur, soon after the operation due to re-infection of the sinus from the ethmoids (Kennedy et al., 1985; Stammberger, 1986).

Duncavage (1995) performed the Caldwell-Luc operation for cases of resistant maxillary sinusitis with removal of maxillary mucosa. An endoscopically placed middle meatus antrostomy was included in the procedure. Duncavage (1995) believes that, the irreversibly diseased maxillary mucosa and intrinsic chemical mediator may render the maxillary sinus non-functional. Thus, aggressive removal of the maxillary sinus lining results in contraction of the maxillary lumen and ingrowth of nondiseased nasal lining and resultant non-infected maxillary sinus. Contrary to Duncavage's (1995) postulation, the intraoperative appearance of the diseased mucosa does not supply any decisive information on its ability to recover specially after securing permanent drainage and ventilation (Wigand et al., 1978). Wigand et al. (1978) demonstrated in a huge series of 325 endonasal operations of the maxillary sinus in 239 consecutive patients without Caldwell-Luc intervention that 82% of the patients had lost their symptoms after 3 months and only 12 endonasal revisions were required. This is in accordance with the findings in the present work which showed patients' improvement with preservation of the antral mucosa and non-recurrence of the pathology. This confirms that the preservation of the lining mucosa is the safer way of maxillary sinus rehabilitation (Wigand et al., 1978). Also, regrowth of the mucosa in the sinus is unhealthy (Kennedy et al., 1987; Hasegawa et al., 1979). A recent study on the maxillary mucosa, in cases of chronic sinusitis with ostial obstruction, demonstrated ciliary loss, ciliary dyskinesia and changes in the character of the mucus. After FESS with restoration of normal drainage and ventilation, there was recovery of the mucociliary function with regeneration of the ciliary epithelium and production of mucus of normal chemistry (Elwany et al., 1997). These findings are firmly supporting the concept of combined FESS.

Combined FESS has many advantages. It offers an excellent view of the entire sinus, especially the ostium. In the present technique the radius of action for therapeutic measures is enhanced, as it works against a single fixed point in the anterior wall of the sinus, allowing the surgeon to reach any point in the sinus cavity with no blind spots. Also, there is no mechanical hindrance to the operator (e.g. septum or inferior turbinate). Functionally, the important mucosa of the nose is preserved. Only pathologic phenomena, such as cysts, polyps, abscesses or fungal masses within the sinus, are removed under endoscopic

control. Thus combined FESS follows the principle of preserving sinus mucosa, as it is the safest way of rehabilitation of the maxillary sinus rather than its radical eradication (Wigand et al., 1978; Elwany et al., 1997). It also emphasises the dominant role of the ethmoid in the pathophysiology of recurring rhinosinusitis (Stammberger, 1986).

Combined FESS is ideal for dealing with, antrochoanal polyps, especially the recurrent cases, as this technique enables the surgeon to deal with the pedicle wherever it is in the antrum, widen the ostium, and clear up the ethmoids thus greatly reducing the recurrence rate.

Another indication for combined FESS is in oroantral fistula and/or sinusitis of dental origin as they are accompanied by extensive changes within the maxillary sinus, which usually extends at least to the ethmoids (9 cases), or even as a pansinusitis (2 cases). In oroantral fistula a tract by epithelialized oedematous mucosa is forming a true fistula which will not close spontaneously (Myers, 1987). Osteitis occurs in the bone of the tooth socket, the necrotic bone acts as a foreign body, preventing spontaneous closure. Complete removal of the tooth socket together with the fistulas track and the diseased bone is a must (Myers, 1987). Endoscopic control guarantees successful fistula closure. Clearing the maxillary and the ethmoids sinuses will prevent recurrence allowing the antral mucosa to cover the fistula from inside. Nothing less than combined FESS will provide this facility to the surgeon.

A third indication is aspergillosis which is the commonest fungal infection of the nose and sinuses (Stammberger et al., 1984). According to Rowe-Jones' (1993) classification, aspergillosis in the present study was of the non-invasive type (aspergilloma) which requires surgical debridement and sinus ventilation, perfectly offered by combined FESS which was extended to total sphenoidectomy. Stammberger et al. (1984) advocate performance of a conservative Caldwell-Luc operation via the canine fossa to clear the antrum adequately, removing only polyps and hyperplastic mucosa and the rest of the mucosa is left intact. Combined FESS follows the same principle, but performs the same task under endoscopic control, through a small window in the canine fossa. Widening the maxillary ostium was done also safely from within the sinus, as heavy bleeding (Stammberger et al., 1984) in the nose may obscure the field.

A further extension of the indications for the present technique is, while performing routine FESS, failure to identify and/or difficulties in widening the natural maxillary ostium in about 17% of the cases (Kennedy et al., 1987). May and Schaitkin (1995) described their technique to locate the ostium if it is obscured by scars or polypoidal disease either by pushing the posterior fontanel forcing the air bubbles to come through a patent but hidden ostium. The place where the bubbles arise can then be used as a focus of a wide maxillary sinus antrostomy. Alternatively, the posterior fontanels can be located safely by identifying the soft mobile membrane that lies just superiorly to the inferior turbinate. Once entered the sinus can be opened widely to include the natural ostium. But May and Schaitkin (1995) mentioned that in more difficult cases, the location of the natural ostium may be confirmed directly via the maxillary sinus

sinuscopy through the canine fossa. Failure to identify and inclusion of the main maxillary ostium or any accessory ostium with the middle meatus may result in a circular flow between the ostium and the meatus leading to incomplete clearance, if some mucous constantly recycled. The recycled mucous becomes overgrown with bacteria, usually *Staphylococcus* or *Pseudomonas* organisms resulting to resistance of symptoms and the need for revision surgery (Duncavage, 1995). This shows the importance of performing middle meatal antrostomy precisely and including the maxillary ostium and any accessory ostium which can be done safely from the antrum by the combined FESS technique, in case the surgeon encounters any difficulties through the nasal approach.

CONCLUSION

Combined FESS is a simple technique that might be performed by the endoscopist in recurrent or extensive maxillary sinus pathology. It should be attempted in cases of failure to identify the maxillary sinus ostium during FESS. The combined FESS gives an excellent view of the entire sinus, especially the ostium. Moreover, the radius of action for therapeutic measures is enhanced, with no mechanical hindrance. This technique is the safest way of maxillary sinus rehabilitation. It deals with distinct pathology within the sinus, preserving the healthy sinus mucosa. It is also securing normal aeration and drainage from widened sinus ostium after clearing the ostiomeatal complex.

REFERENCES

1. Duncavage Y (1995) Maxillary sinus revision surgery In: Y Stankiewicz (ed) *Advanced Endoscopic Sinus Surgery*. Mosby, St. Louis, pp 7-11
2. Draf, W (1983) *Endoscopy of the Paranasal Sinuses*. Springer-Verlag, New York
3. El Hennawi D (1989) The role of radiology, bacteriology and sinuscopy in the evaluation of chronic maxillary sinusitis. MD Thesis. Alexandria University, Egypt
4. Elwany S, Hesham M, Gemae R (1997) Mucociliary clearance in chronic sinusitis: The effect of endoscopic sinus surgery. *Proc 16th World Congress of Otorhinolaryngology Head and Neck Surgery*, Sydney, pp 1487- 1491
5. Hasegawa M, Saito Y, Watanabe I and Kern B (1979) Postoperative mucocoeles in the maxillary sinus. *Rhinology* 17, 253-256
6. Kaluskar HK, Patil NP (1992) Combined approach middle meatal antrostomy. *Laryngoscope* 102: 709- 811
7. Kennedy DW, Zinreich J, Rosenbaum AE, Johns ME (1985) Functional endoscopic sinus surgery. *Arch Otolaryngol* 111: 576-582
8. Kennedy D, Zineruch S, Kuhn F, Shaalan H, Naclerio R, Loch E (1987) Endoscopic middle meatal antrostomy: theory, technique and potency. *Laryngoscope* 97 (supp 43) 1-9
9. Maniglia A (1991) Fatal and other major complications of endoscopic sinus surgery. *Laryngoscope* 101: 349-354
10. Maran D, Lund V, Mackay I, Wilson Y (1993) Endoscopic sinus surgery. Report of Royal College of Surgeons, Edinburgh, 15th January
11. May M, Schaitkin B (1995) Revision endoscopic sinus surgery. In: Y Stankiewicz (ed) *Advanced Endoscopic Sinus Surgery*. Mosby, St. Louis: pp 1-6
12. Messerklinger W (1978) *Endoscopy of the Nose*. Urban and Schwarzenberg, Baltimore
13. Myers E (1987) Caldwell-Luc operation and extensions. In: Joseph Goldman (ed) *The Principles and Practice of Rhinology*. John Wiley and Sons, New York. pp. 455-474
14. Pfeifer GR, Schmitz (1973) Über Schmerzen im Oberkiefer nach Kieferhöhlenoperation. *Dtsch Zahnärztl Z* 28: 989-992

15. Rowe-Jones J (1993) Paranasal aspergillosis - a spectrum of disease. *J Laryngol Otol* 107: 773-774
16. Stammberger H (1986) Endoscopic endonasal surgery: New concepts in treatment of recurring rhinosinusitis. *Otolaryngol Head Neck Surg* 94, 2: 143-156
17. Stammberger H, Jakse R, Beaufort F (1984) Aspergillosis of the paranasal sinuses. *Ann Otol Rhinol Laryngol* 93, 3: 251 -256.
18. Weir N, Golding-Wood G (1997) Infective rhinitis and sinusitis. In: I Mackay, T Bull (eds.) *Scott Brown's Otolaryngology: vol. 4 Rhinology*. Butterworth Heinemann. London pp. 8; 1-45
19. Wigand E, Steiner W, Jaumann M (1978) Endonasal sinus surgery with endoscopic control: from radical operation to rehabilitation of the mucosa. *Endoscopy* 10: 255-260
20. Wigand ME (1981) Transnasal ethmoidectomy under endoscopic control. *Rhinology* 19: 7-15

Dr. Daa M. El-Hennawi
2 Kafr Abdou St., Rouchdy,
Alexandria,
Egypt
hen@cns.egypt.com

ANNOUNCEMENT

