

Pott's puffy tumor treated by endoscopic frontal sinusotomy*

Elimelech Deutsch, Ilan Hevron, Amos Eilon

Department of Otorhinolaryngology, Head & Neck Surgery, Bikur Cholim Hospital, Jerusalem, Israel

SUMMARY

Pott's puffy tumor is a serious extracranial complication of frontal sinusitis.

The formation of this entity is facilitated by the close anatomic relationship between the paranasal sinuses and the frontal bone. Furthermore, the rich diploic venous drainage of the region enhances the spread of the infection. We report on successful functional endoscopic frontal sinusotomy in a series of four cases of Pott's puffy tumor following acute frontal sinusitis, between the years 1994 and 1997.

We emphasize the advantages of this approach over the external approaches as follows: the technique treats the causative source of the disease, the morbidity is low, and it avoids facial cosmetic trauma and sequela.

Key words: frontal sinusotomy, sinusitis, Pott's puffy tumor

INTRODUCTION

Even with the advent of the antibiotic era, and the resultant improvement in events of acute and chronic sinusitis, suppurative complications following paranasal sinuses diseases do still occur, although probably in reduced severity and frequency. One of the most dangerous complications of frontal sinusitis is osteomyelitis and resulting subperiosteal abscess of the frontal bone - the so-called Pott's puffy tumor (Thomas et al., 1977). This entity, originally described by Sir Percivall Pott in 1775, (Ravitch, 1977) appears clinically as a purulent collection under the periosteum, causing swelling and pitting edema over the forehead. With the introduction of endonasal endoscopic surgery, the examination of the frontal recesses and the subsequent removal of obstructive ethmoid cells and/or diseased mucosa, became more feasible. The current report, presents a series of four cases of Pott's puffy tumor following acute frontal sinusitis, which were managed by endonasal endoscopic frontal sinusotomy.

MATERIALS AND METHODS

Patients

During the period between 1994 and 1997, four cases of patients with Pott's puffy tumor underwent surgery by endonasal endoscopic approach. Ages ranged from 12 to 38 (average 25.5 years). There were two males and two females. In three patients the event was the first episode of frontal sinus inflammation, and in one patient external frontal sinus surgery had been performed seven years previously. The presenting symptoms and signs in all of the patients were: a puffy forehead swelling, a large amount of purulent nasal discharge, and in one patient an orbi-

tal swelling was also noted on the same side as the forehead swelling. The main clinical symptomatologies noted were: systemic fever (38-39°C), severe headache, and photophobia. On admission all the patients had received intravenous antibiotic (amoxicillin clavulanate), which was continued orally for a total period of 6 weeks. The bacterial culture taken on admission, grew *Staphylococcus aureus*. Concomitantly, in the first hours after admission, a coronal and axial CT scans with contrast material of the sinuses and brain was performed. In three patients a unilateral pansinusitis was noted; in one patient a bilateral pansinusitis was noted; in one patient an anterior frontal bone plate dehiscence, with swelling of the corresponding soft overhead tissue, was also noted (Figure 2A). No associated intracranial pathology was noted.

Surgical technique

All the patients underwent endoscopic frontal sinusotomy, under general anesthesia. The approach followed the principles of endoscopic sinus surgery advocated by Messerklinger (Messerklinger, 1978) and Stammberger (Stammberger, 1986; Stammberger et al., 1990) and the principles advised by other authors (Schaefer et al., 1990; Loury, 1993; Metson, 1992; Har-El et al., 1995; Wigand et al., 1991; Draf, 1991; Hosemann, 2000) who employ the endoscopic frontal sinusotomy technique, to minimize the factors which predispose to occlusion of the frontal recess and ostium.

After an anterior ethmoidectomy procedure was completed, the skull base and the anterior ethmoid artery identification was performed, since it provides an important landmark for

* Received for publication February 2, 2000; accepted June 15, 2000

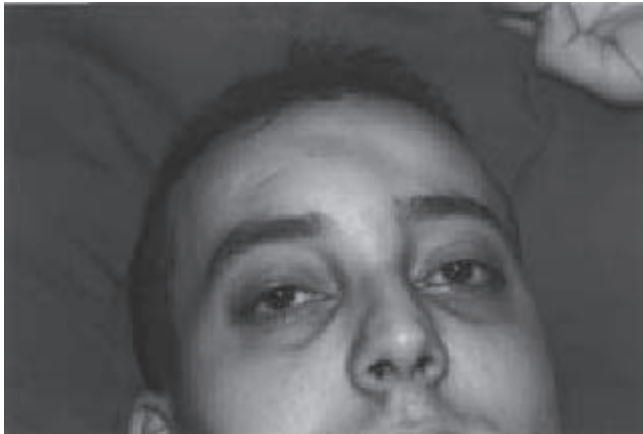


Figure 1A. Patient with preoperative rt. frontal soft tissue swelling.



Figure 1B. The same patient post-operative view picture (AP view).

enhancing the safety of the procedure. An attempt to preserve the superior portion of the ethmoid bulla makes this step feasible, because the integrity of this part of the bulla provides a landmark for the posterior margin of the frontal sinus opening. Soft tissue and bony lamellae were also removed from the frontal recess, taking care to remove only the overlying mucosa anteriorly to the side bone. After the bony overhang had been removed, the opening of the frontal sinus ostium was visible at this point, with 45° and 30° wide angle endoscopes, and was probed by a curved suction canula tip.

The procedure was continued, for removal of the thin bony layer from the anterior rim, avoiding excision of circumferential mucosa.

A maximal effort was made to avoid fracture of the middle turbinates superior attachment, in order to prevent consequent frontal recess restenosis. At the moment of the frontal sinus ostium being satisfactorily enlarged and well visualised, the procedure was considered completed, and Meroce[®] nasal packing was inserted for duration of one day. Stents or drains were not placed into the frontal recess, as a wide frontal recess and open frontal ostium had been established. One week postoperatively,

we commenced careful cleaning of the surgical site for a minimum of twice weekly, until 6 weeks from the intervention.

RESULTS

There were no intraoperative complications. In all the patients significant purulent discharge was drained out from the frontal recess and sinus. During the procedure *Staphylococcus aureus* developed in the culture taken in all the patients, moreover, in one patient *Staphylococcus epidermidis* was also noted. The main surgical finding was polypoid tissue which had occluded the frontal recess pathway. The length of the procedure varied between 45-60 minutes. The interval between surgery and disappearance of the main clinical symptoms, varied between 2 to 8 days (Figure 1A and 1B).

The CT scan and endoscopic examination performed a few months after the surgical procedures, showed normal findings in the operated frontal sinus region, in comparison to the pre-operative observation (Figure 2A and 2B).

Repeated office endoscopic examinations over a 24 to 36 months period have verified continuous patency of the frontal ostium. All the patients have continued these endoscopic examinations to the present day.

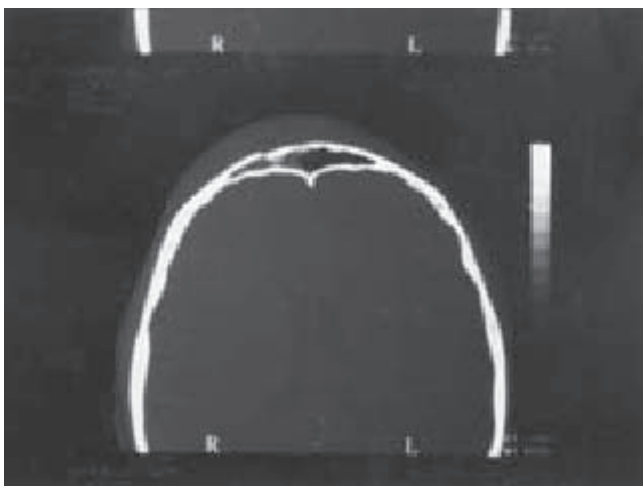


Figure 2A. Coronal CT image showing right anterior frontal bone dehiscence with overhead soft tissue swelling.

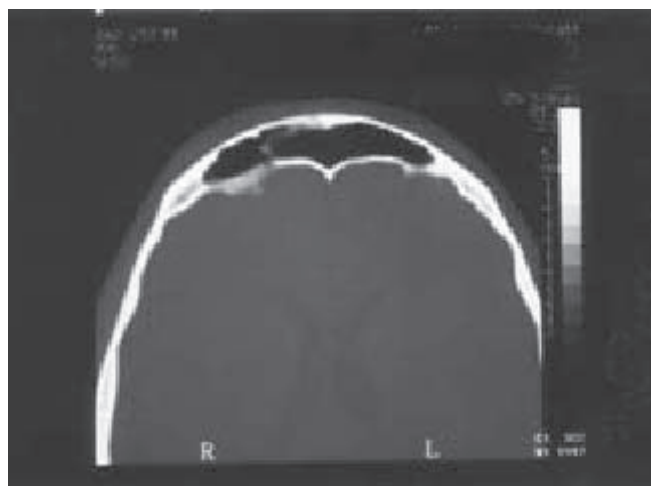


Figure 2B. Post-operative CT image (3 months) showing disappearance of soft tissue swelling and bony dehiscence.

DISCUSSION

The incidence of extracranial complications following acute paranasal sinusitis has been decreased significantly in the past decades following the use of broad spectrum antibiotics, but they still can occur with dangerous consequences. Pott's puffy tumor is a subperiosteal abscess of the frontal bone associated with frontal osteomyelitis, and is one of the extracranial complications that can develop following acute sinusitis, like subperiosteal orbital abscess (SPA) or orbital abscess (Altman et al., 1997). A number of cases have been reported since the original description by Percival Pott in 1775 (Ravitch, 1977), but fewer since the antibiotic era (Verbon et al., 1996).

All the four cases of Pott's puffy tumor in our report followed an event of acute frontal sinusitis. Anatomically the paranasal sinuses and especially the frontal sinus are intimately related to the anterior skull base. The frontal sinus originates from the anterior pneumatization of the frontal recess into the frontal bone, the frontal recess being the most anterior part of the anterior ethmoid cells. This process starts at about one year of age, and continues until 16-18 years of age, at which the average volume of 6-7cc is found (Altman et al., 1997). The thin inner plate of the frontal sinus is almost all compact bone while the outer plate is composed of both cancellous and compact bone. Free patency of the frontal recess is the key to understanding the formation of the various pathologies of the frontal sinus.

There are a number of anatomical factors which either separately, or in combination, may narrow the recess until complete obstruction results, increasing the chances of frontal sinus infections. These include over-pneumatized ethmoid bulla, enlargement of agger nasi cells, large supraorbital ethmoid cells and the way in which the uncinat process is inserted. Therefore, sinus obstruction by anatomical anomalies and/or inflamed mucosa or thick secretions, leads to mucus stagnation that ultimately results in an anaerobic environment in the obstructed sinus. The low oxygen tension contributes to ciliary dysfunction that aggravates the cycle.

Spread of infection is usually effected by one of the following:

- progressive thrombophlebitis through valveless diploic veins;
- hematogenously through septic microemboli;
- direct extension through focal osteitis and retrograde septic thrombophlebitis.

Basically there are two pathological types of osteomyelitis of the frontal bone:

- a. *focal type* that can progress to periosteal abscess and sinocutaneous fistula.
- b. *spreading type* that may develop to subperiosteal abscess with soft tissue swelling and pitting edema, -the Pott's puffy tumor.

The clinical consequences of frontal bone osteomyelitis are:

- a. *extracranial complications* such as: Pott's puffy tumor, sinocutaneous fistula, subperiosteal orbital abscess, and orbital abscess.
- b. *intracranial complications* such as: meningitis, epidural abscess, subdural abscess, brain abscess and cavernous sinus thrombosis.

Radiologic imaging is mandatory for confirming the extension of the frontal sinus disease and for exact planning of the surgery, and therefore coronal CT scan in high resolution mode is the imaging method of choice. CT scan is superior to MRI in its depiction of bone and in particular the air-bone and air-soft tissue interface, which are necessary to the surgeon.

The treatment recommended for frontal subperiosteal abscess should be a prompt approach and therefore in addition to broad spectrum intravenous antibiotics, it is mandatory to drain the sinus by the quickest and most effective way possible. The various surgical approaches to frontal sinus disease over the past century have varied between external and intranasal approaches. The external radical procedures (Jacobs, 1997) include removal of portions of the anterior frontal bone table and have tried to create a secondary drainage point, or to neutralize the sinus from the nose by obliterative or osteoplastic procedures of the sinus itself and of the recess.

The intranasal procedures (Stammberger, 1991) attempt to re-establish patency of the frontonasal passage by establishing a nasofrontal communication, and creation of adequate drainage and ventilation. The optimal surgical management of frontal sinus disease involves the selection of the least invasive operation, but also the one that is most able to treat the factors that induced the original infection, and the infection itself. Therefore, with the introduction and the development of endoscopic sinus surgery, an intranasal endoscopic procedure capable of restoring the normal nasal-frontal sinus communication in acute and chronic sinusitis, has become a feasible alternative to the previous, more conventional, radical approaches.

Presently, the endoscopic nasal surgery offers the opportunity of completely changing the existing approaches to the frontal sinus, to that of surgical procedure directed to the frontal recess, so that many secondary manifestations will regress spontaneously when the basic pathologic problem has been removed. Endoscopic exploration of the frontal recess presents one of the greatest challenges an ENT surgeon is likely to encounter. El-Silimy (1996) described a combined approach by endonasal and external percutaneous drainage but there are relatively very few reports regarding the exclusive use of the endoscopic intranasal approach in Pott's puff tumor.

Other authors (Schaefer, 1990; Loury, 1993; Metson, 1992; Har-el et al., 1995; Wigand et al., 1991; Draf, 1991; Hosemann, 2000) used the endoscopic frontal sinusotomy approach in acute cases of frontal sinusitis with relatively good results. It is important to emphasize our efforts to perform the endonasal endoscopic approach to the frontal sinus the most conservative way possible, with the minimal necessary trauma to the frontal recess and ostium, according to the technique reported by Stammberger (Stammberger, 1991).

In the case of an immediate failure it is always possible to perform external drainage. In our series, all four patients made rapid improvement clinically within the first 48 hours following the intervention. The efficacy of the use of stents after endoscopic frontal sinusotomy is often questioned, and remains a controversial issue. Reviewing the recent literature on this topic shows that stents have a patency rate ranging from 50%-90%

(Cullen et al., 1998). The reasons for the failures could be attributable to pressure from the stent damaging mucociliary flow by circumferential scarring or following inadequate creation of a sufficiently-sized ostium (Cullen et al., 1998). Schaefer (Schaefer, 1990), mentioned that the surface of the mucosa of the neo-ostium must communicate with nasal cavity air after surgery, to produce reversal of mucosal disease.

Metson (Metson, 1992), established that with wide exposure, but conservative tissue removal, postoperative obstruction can be kept to a minimum.

CONCLUSIONS

Pott's puffy tumor is a rare extracranial complication of frontal sinusitis in this post-antibiotic era. The four patients in this report have been treated concomitantly with massive intravenous antibiotics, and surgically by endoscopic frontal sinusotomy, with successful results; progress was followed up for 24 to 36 months. The wide use of endoscopic frontal sinusotomy approach, in both chronic and acute frontal sinusitis, in recent years, has become feasible with increase in the knowledge of the delicate regional anatomy and progress in the technical experience and skills of the various surgeons. As previously mentioned, the main purpose of endoscopic frontal sinusotomy is to create sufficiently wide and adequately patent frontonasal communication in order to obtain maximal drainage, subsequent good ventilation, resolution of local inflammation and relief of symptoms. The operative and postoperative procedures (repeat endoscopic examination and cleaning of the frontal recess) facilitate preservation of the route already opened and thereby, forestall the necessity of introducing drainage stents. However, for a definitive judgment of this type of surgery, a long follow-up period is required. The major advantage of the endoscopic approach is in that it offers a safe and effective alternative to the various external techniques, and the results are at least as good as those obtainable by the external techniques. In addition it avoids facial and forehead incision and subsequent distorting scars. In any case, when deciding how to approach the frontal sinus during endoscopic surgery, it is best to keep in mind the statement: do as little as possible and much as necessary (Mosher, 1912).

REFERENCES

1. Altman KW, Austin MB, Tom WC, Knox GW (1997) Complications of frontal sinusitis in adolescents: case presentations and treatment options. *Int J Pediatr Otorhinolaryngol* 41:9-20.
2. Cullen MM, Leopold DA (1998) Intranasal frontal sinusotomy. *Curr Opin Otolaryngol Head Neck Surg* 6:31-40.
3. Draf W (1991) Endonasal micro-endoscopic frontal sinus surgery: The Fulda concept. *Operative techniques in Otolaryngology, Head and Neck Surgery* 2:234-240.
4. El-Silimy O (1996) Combined endonasal and percutaneous endoscopic approach to Pott's puffy tumor. *Rhinology* 34:119-122.
5. Har-El G, Lucente FE (1995) Endoscopic intranasal frontal sinusotomy. *Laryngoscope* 105:440-443.
6. Hosemann WG, Weber RK, Keerl RE, Lund VJ (2000) Minimally invasive endonasal sinus surgery. Principle, techniques, results, complications, revision surgery. Thieme, Stuttgart, New York.
7. Jacobs JB (1997) 100 years of frontal sinus surgery. *Laryngoscope* 107 (suppl 83):1-36.
8. Lourry MC (1993) Endoscopic frontal recess and frontal sinus ostium dissection. *Laryngoscope* 103:455-458.
9. Messerklinger W (1978) *Endoscopy of the nose*. Baltimore: Urban and Schwarzenberg.
10. Metson R (1992) Endoscopic treatment of frontal sinusitis. *Laryngoscope* 102:712-716.
11. Montgomery WW, Cheney ML, Jacobs EE Jr (1989) Osteomyelitis of the frontal bone. *Ann Otol Rhinol Laryngol* 98:848-853.
12. Mosher HP (1912) The applied anatomy and the intranasal surgery of the ethmoidal labyrinth. *Trans Am Laryngol Assoc* 34:25-39.
13. Ravitch MM (1977) Surgery in 1776. *Ann Surg* 186:291-300.
14. Schaefer SD, Close LG (1990) Endoscopic management of frontal sinus disease. *Laryngoscope* 100:155-160.
15. Stammberger H (1986) Endoscopic endonasal surgery: new concepts in the treatment of recurring sinusitis. Part I and II. *Otolaryngol Head Neck Surg* 94:143-156.
16. Stammberger H, Posawetz W (1990) Functional endoscopic sinus surgery: concept, indications and results of the Messerklinger technique. *Eur Arch Otorhinolaryngol* 247:63-76.
17. Stammberger H (1991) *Functional Endoscopic Sinus Surgery*. Philadelphia, PA, BC Decker, pp 194-201.
18. Thomas JN, Nel JR (1977) Acute spreading osteomyelitis of the skull complicating frontal sinusitis. *J Laryngol Otol* 91:55-62.
19. Verbon A, Husni RN, Gordon SM, Lavertu P, Keys TF (1996) Pott's puffy tumor due to *Haemophilus influenzae*: case report and review. *Clin Inf Dis* 23:1305-1307.
20. Wigand ME, Hosemann WG (1991) Endoscopic surgery for frontal sinusitis and its complications. *Am J Rhinol* 5:85-89.

Deutsch E. M.D.
 Department of Otorhinolaryngology,
 Head & Neck Surgery,
 Bikur-Cholim Hospital,
 5 Strauss St. P.O.Box 492,
 Jerusalem,
 Israel
 Tel.: +972-2-6464106
 Fax: +972-2-6464384