

How I do it

Frontal sinus obliteration

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Abstract

This article highlights the indications for frontal sinus obliteration and suggests some intra-operative points to aid the surgeon in performing the operative procedure. It also reiterates the three principal points that need to be followed. There must be:

- (1) Meticulous removal of all visible mucosa and the inner bony cortex of the sinus wall.
- (2) Permanent occlusion of the nasofrontal duct.
- (3) The correct choice of material for the obliteration.

Key words: Frontal Sinus; Surgical Procedures, Operative

Introduction

Following the introduction of endoscopic sinus surgery and median drainage procedures the requirement for frontal sinus obliteration has decreased. However, we believe there still remains a group of patients who will benefit from this procedure.^{1,2} In this article we aim to highlight the indications for frontal sinus obliteration and describe some useful points in surgical technique.

Method

A coronal incision is normally made although it is possible to access this area with an eyebrow incision.³ In a patient with male pattern baldness the coronal incision may be made with zigzag lines to help disguise the scar and make it parallel to the hairline. We no longer raise the frontalis separate from the periosteum as this helps preserve the vascularity of the periosteum that will be needed to supply blood to the bone flap. Conventionally, the periosteum has been elevated with the bone of the anterior wall of the frontal sinus⁴ but we have found that by the time the bone of the supraorbital margin has been divided to mobilize the anterior wall of the frontal sinus there is little useful periosteum remaining. To add to this, trying to drill the mucosa off the posterior wall of the anterior bony plate whilst it is attached to periosteum makes this important task more difficult as well as negotiating the recesses of the frontal sinus itself. The periosteum is therefore raised with the frontalis. The frontalis and periosteum are replaced at the end of the procedure and a firm head bandage is used to reduce the chance of haematoma formation. This technique appears to provide as good as, if not better, a blood supply to the anterior bone flap because the periosteum is intact and unharmed.

A sterilized template of the frontal sinus is made from a pre-operative Caldwell view X-ray of the frontal sinus. A plain radiograph fails to account for some pneumatization so if a template alone is used to remove the anterior plate it will leave some overhang as areas of pneumatization often occur superiorly and laterally, even extending to the zygomatic process.⁵ Leaving an overhang makes removing the mucosa of the frontal sinus difficult and it is important to remove it all in order to avoid mucocele formation.⁶ The template is used to make an initial trephine into the sinus staying lateral to the midline (this avoids the dural lined intracranial venous sinuses should one drill outside the margins of the sinus). Once the sinus is entered a vein hook (Figure 1) is introduced and rotated to palpate the wall of the sinus. A Fissure burr is used to outline the bony plate, staying as near to the margin of the sinus as possible.

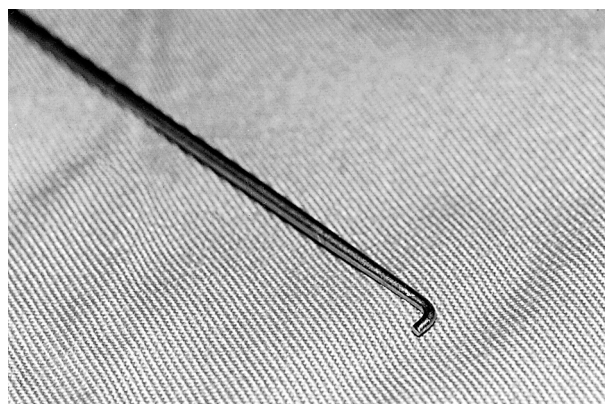


FIG. 1
A vein hook.

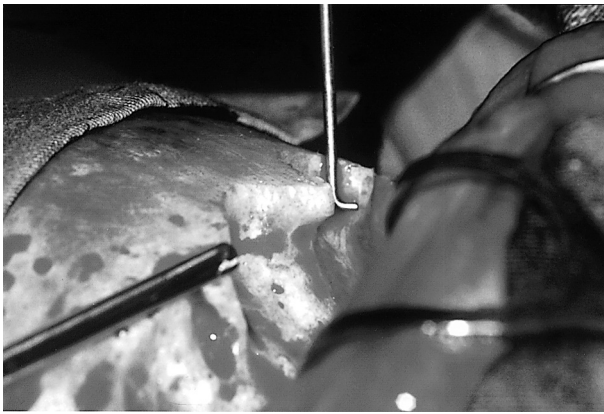


FIG. 2

A vein hook used to palpate the extent of the sinus.

Approximately 0.5 cm of bone is drilled until the vein hook is used to locate the margin of the sinus (Figure 2) before the direction of the drilling is continued. This reduces the overhang of the anterior wall of the sinus. Before the whole frontal plate is removed miniplates are positioned on it and burr holes made in the correct position for these on the cranium; this will help locate the plate quickly once the sinus has been obliterated (Figure 3).

It is vital to remove all the mucosa of the frontal sinuses before they are obliterated otherwise a mucocele will form, and a Mitchell's trimmer is an ideal shape for this. Donald⁶ has shown that mucosa follows the veins of Breschet into the posterior wall of the frontal sinus so these need to be cleared by drilling the posterior wall a fraction of a millimetre. The remaining bony walls, including the back wall of the anterior frontal plate, should be drilled with a diamond burr to ensure all the mucosa has been removed. Care needs to be taken not to enter the orbit as the floor of the frontal sinus can be very thin and if it is entered orbital fat prolapses upwards and makes it difficult to remove the mucosa around this area. If fat prolapses into the orbit it can be ablated with bipolar diathermy but it should not be pulled or pushed. Entering the orbit also causes a periorbital ecchymosis and the vision and orbital pressure need to be checked post-operatively to ensure that the vasculature of the optic nerve is not compromised by any bleeding into the post-septal compartment of the orbit.



FIG. 3

Titanium miniplates are placed before the anterior wall of the frontal sinus is removed.

The roof of the ethmoid sinuses and the frontal recess should not be instrumented unless there is a reason to do so as it is easy to open these up and create a large defect. The frontal recess is then separated from the nasal airway with a sheet of fascia lata, and fat is used to obliterate the sinuses. The bony plate with its attached miniplates is then secured and the pericranium and coronal flap sutured with 2/0 vicryl and skin staples. A relatively tight crepe bandage is placed to ensure no haematoma develops between the flap and the bony plate and this is kept in place for at least three days.

Discussion

Although frontal sinus obliteration remains an uncommon procedure the authors believe it is indicated for several different reasons:

- (1) if a median drainage procedure has failed to establish drainage of the lateral part of the frontal sinus;
- (2) a lateral mucocele;
- (3) osteomyelitis;
- (4) any sinus pathology not accessible endoscopically eg. osteoma, inverted papilloma or verrucous carcinoma;
- (5) an encephalocele or significant defect of the posterior wall of the frontal sinus that cannot be accessed endoscopically;
- (6) frequently after repeated external frontoethmoidectomies where loss of lateral support has led to collapse of the orbital contents, narrowing the drainage pathway or fibrous loculations that cannot be dealt with by a median drainage procedure;
- (7) when median drainage has failed because of narrow area/stenosis between the lateral and medial parts of the frontal sinus.

In order to perform the operation successfully certain principles need to be followed. There must be meticulous removal of all visible mucosa and the inner cortex of the sinus wall, permanent occlusion of the nasofrontal duct and the correct choice of material for the obliteration.⁷ The gold-standard material for obliteration seems to be the fat autograft, as reflected upon by Weber *et al.* this material has the largest experimental base.⁷⁻¹¹ Other autogenic materials, including muscle,¹² corticocancellous bone,^{13,14} and inorganic materials such as hydroxyapatite cement,¹⁵ bioactive glass¹⁶ and proplast,¹⁷ have also been used. The inorganic materials seem to have good experimental results on animal models but have yet to be proven on human models. However, in all the studies carried out, the success of the obliteration seemed to be determined by whether or not the main principles had been followed rather than by which material had been used.¹⁸ Not placing any material in the sinus after removal of the mucosa has been described but the senior author has seen several failures after this technique, with lateral loculated areas of infection and mucoceles developing, sometimes years after surgery.¹⁹

Several complications have been described following frontal sinus obliteration. Hardy and Montgomery⁸ found a complication rate in the abdominal wound of 5.2 per cent and Catalano *et al.*⁹ found a 1.7 per cent rate. The complications included haematoma, seroma and abscess formation. The complications for the operation site have been most comprehensively documented in the Hardy and Montgomery 1976 series (47 of 250 patients). In the frontal wound, six patients developed a haematoma or seroma and eight formed an abscess. Six of the latter cases required revision surgery. Bone cuts were made outside

the sinus in eight patients, the dura was incised in seven cases and skin necrosis occurred in two others. One patient had total anosmia, temporary ptosis and temporary loss of frontalis muscle function. Among 208 patients at follow-up, 93 per cent were asymptomatic. In 12 patients there was persistent frontal pain unrelieved by medical therapy; this may have been due to post-surgical neuropathic pain.²⁰ All patients initially complained of abnormal frontal sensation although at 12 months this had settled in 65 per cent of patients. The scar was considered poor in 12 per cent and six per cent were unhappy with the forehead contour. In 20 of 208 patients revision surgery was performed – four days to 14 years after primary surgery. Six early revisions were performed because of persistent purulent drainage through a fistula, five patients had fat necrosis and one had an unrecognized supraorbital pyocoele. Among 14 delayed revisions, there were four patients with negative findings on explorations because of chronic pain, seven patients with chronic sinusitis, two with osteomyelitis and one with infected bone in fibrous dysplasia.

Monitoring the sinuses post-operatively can be a problem with this obliterative procedure as when persistent symptoms occur it can be difficult to distinguish recurrent disease from neuropathic pain. The most helpful form of imaging appears to be the magnetic resonance imaging (MRI) scan which, although the most accurate, still has its limitations. The detection of a small recurrent mucocele and differentiating vital adipose tissue from fat necrosis in the form of oil cysts prove to be the major difficulties.²¹

Conclusion

Operative procedures for the management of chronic inflammatory conditions of the frontal sinus have been around since the late 19th century.²² Through the evolution of endoscopic drainage of the frontal sinus, the need for frontal sinus obliteration has been reduced, but it still has a role where removal of pathology within the sinus or drainage cannot be achieved endoscopically. Several points on surgical technique have been described that will hopefully allow this procedure to be performed with greater ease and fewer complications.

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Professor N. S. Jones takes responsibility for the integrity of the content of the paper.
Competing interests: None declared
