

The place of Riedel's procedure in contemporary sinus surgery

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Abstract

Many operative procedures have been described to treat frontal sinus disease with varying results. Obliteration of the frontal sinus is attempted when drainage procedures fail. Most large series of patients undergoing sinus obliteration have reported recurrent disease yet the management of these patients is rarely discussed. We believe Riedel's procedure has an important role in the management of these patients. Riedel's procedure can help eradicate frontal sinus disease and symptoms when drainage and obliteration have failed and where there is persistent disease involving the anterior wall of the frontal sinus or the sinus itself. Whilst cranialization has a role in the removal of the mucosa or contents of the frontal sinus in craniofacial resection, the morbidity associated with it make Riedel's procedure preferable for dealing with chronic infection or locally invasive disease. Riedel's procedure also maintains a barrier in the form of the posterior wall of the frontal sinus and the intracranial contents. Post-operative disfigurement, the main criticism of this procedure, can be reduced to some extent by chamfering the margins of the frontal sinus along with the supraorbital rims and reconstructing the anterior wall at a later date if necessary. The authors are aware that any report about frontal sinus surgery should be judged after several years follow-up, and whilst not all these cases have been asymptomatic for a decade, several have been reviewed for many years.

Key words: Frontal sinus; Infection; Surgical Procedures, Operative; Treatment Outcome

Introduction

In the pre-antibiotic era frontal sinusitis was a particularly dangerous infection as it could cause complications such as meningitis, intracranial abscess and osteomyelitis.¹ Before the availability of endoscopes, trephination and external approaches were used. Endoscopes have helped visibility and enabled drainage to be obtained at the same time as preserving the bony support around the frontal recess as well as preserving the mucosa that lines this area that is crucial in preventing stenosis. An external frontoethmoidectomy often resulted in a loss of the lateral bony support of the frontal recess as well as the mucosa in this area and results in a high incidence of stenosis. If there is stenosis of the frontal recess a median drainage procedure will often help, either performed endoscopically or by a combined approach. If there are lateral loculations within the frontal recess, or other pathology such as Paget's disease, an osteoma or new bone formation that prevents a median drainage procedure from working, then frontal sinus obliteration is the main alternative. Rarely, even after obliteration infection can occur and this has been reported in more than

3 per cent.^{2,3,4} Neoplasms of the paranasal sinuses are uncommon and constitute only 0.2 per cent to 0.8 per cent of all malignancies.² In the frontal sinus tumours are even rarer.⁵ If there is a tumour in the frontal sinus, radical clearance is often required. In these situations Riedel's procedure is one of the options that allow preservation of the posterior wall or bony boundary over the brain with radical removal of all sinus mucosa and the anterior wall of the sinus if this needs to be removed.

History of frontal sinus surgery

In the pre-endoscopic era the surgical treatment of frontal sinus infection depended on whether drainage of the frontal sinus could be maintained or not. The options were either an external frontoethmoidectomy with possible damage to the nasofrontal duct as described by Lynch⁶ or a more conservative external frontal sinusotomy with preservation of the nasofrontal duct as described by Walsh⁷ and Macbeth.⁸ In patients where drainage could not be obtained a more radical procedure such as obliteration⁹ or removal of the sinus mucosa and the anterior wall as described by Riedel¹⁰ were used.

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The first report of a frontal sinus surgery is by Vega who removed an osteoma from the frontal sinus in 1586.¹ Jurasz was the first surgeon to describe an intranasal approach to the frontal sinus.¹ In the late 1880s Ogston and later Luc described trephination and widening of frontonasal duct through the anterior ethmoid sinuses.^{1,11} Schonborn and Breiger first described the osteoplastic operation in 1890s.¹¹ Riedel described a technique in 1889 where he removed the anterior and inferior wall.^{1,11} It resulted in cosmetic deformity and required a second operation to improve cosmesis.¹¹ Killian modified this technique¹¹ and suggested leaving a bar of bone in the supraorbital region to improve appearance.¹ In 1908 Knapp advocated an extensive ethmoidectomy through the medial orbital wall, leaving the anterior wall of frontal sinus intact but removing the diseased mucosa and enlarging the frontonasal duct.¹ Lothrop in 1914 resected the frontal floor between the frontal recesses and the intersinus septum along with the upper aspect of nasal septum after an ethmoidectomy via an external approach as described by Lynch.^{1,12} By 1921 Lynch and later Howarth entered the frontal sinus through an external approach, approaching it via the medial orbital wall and like Knapp, removed sinus mucosa and left a stent to try and maintain a patent duct.¹ Obliteration with fat was described by Beugara, Itoiz and Tato *et al.*¹ The osteoplastic flap with fat obliteration has become popular for the treatment for persistent frontal sinus disease in the United States.¹² Macbeth and Bosley later postulated that fat obliteration is not necessary as they claimed that the cavity is filled by osteoneogenesis.¹ However, the senior author and others have found that unless the frontal sinus is obliterated¹³ then loculated areas within the sinuses are more likely to form and these can become infected. Walsh reported that it is important to remove the mucosa from the frontal recess as well as the sinus mucosa is removed otherwise the sinuses will not become obliterated.¹⁴ With the introduction of computerized tomography (CT) and endoscopes it became possible to open the frontal sinus to a greater or lesser extent with mucosal preservation dependent on the extent of disease and the skill of the operator.

The authors believe that Riedel's procedure still has a place in the management of frontal sinus diseases. They present five patients who underwent Riedel's procedure to control their frontal sinus disease.

Materials and method

Case 1

A thirty-five-year old Caucasian male had had a submucous resection of the nasal septum and an inferior meatal antrostomy five years previously in another hospital. His symptoms could not be controlled by medical treatment and endoscopic sinus surgery was performed to help drain pus in both his maxillary and ethmoid sinuses. Later he developed a polyp and infection in the right frontal recess, which failed to respond to medical treatment and for which he had an external ethmoidectomy.



FIG. 1

Oblique view of *Case 1* after a Riedel's procedure.

However, his symptoms persisted and he had an exploration via a bicoronal flap, the intersinus septum was removed and his sinuses were obliterated. He then presented with a swelling around the right medial canthus for which he had a right external frontoethmoidectomy. The patient was never free of pain or discharge and complained of a bilateral frontal headache and recurrent frontal swelling. A CT scan showed bilaterally opaque frontal sinuses and the post-operative changes of loss of bone lateral to the frontal recesses. An endoscopic median

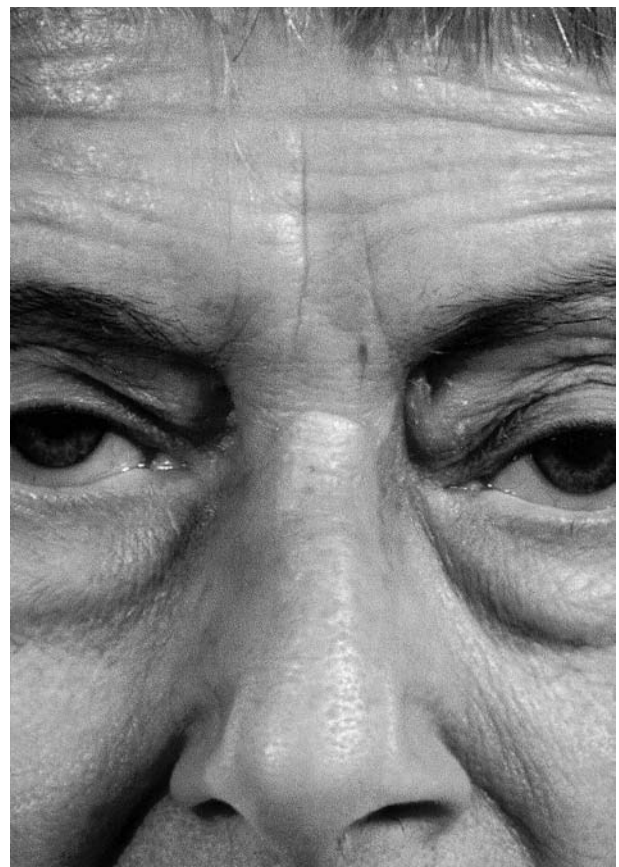


FIG. 2

Frontal view showing bilateral discharging sinuses through old external ethmoidectomy incisions in *Case 3*.



FIG. 3

Oblique view of *Case 3* after a Riedel's procedure.



FIG. 4

Lateral view of *Case 3* after a Riedel's procedure.

drainage procedure was performed but a month later he presented with pain and swelling above his right eye. A CT scan showed loculated pus within the right frontal sinus. Once again the frontal sinuses were obliterated with fat along with antibiotics. Two weeks later he developed a swelling over his frontal sinuses from which pus was aspirated. He then underwent a Riedel's procedure with the supraorbital margins chamfered to reduce the cosmetic deformity and a culture of pus from within the sinuses grew *Pseudomonas* sp. and ciprofloxacin was prescribed (Figure 1). He remains symptom free after two and a half years. The cosmetic result is acceptable to the patient and he has declined reconstruction with a split calvarial bone graft.

Case 2

A sixty-four-year old Caucasian man developed frontal pain and swelling above the left eye. Pus was seen in the middle meatus. He had previously had a left external frontoethmoidectomy. As the symptoms recurred, a CT scan was performed that showed bilateral frontal mucocoeles and signs consistent with a pansinusitis. He underwent a revision left frontoethmoidectomy and both mucocoeles were drained. The dura was found exposed and a large area of frontal bone was eroded. After the operation he developed a recurrent left frontal swelling and discharge through the scar. He went on to have two

endoscopic frontal drainage procedures but as lateral areas of loculated infection persisted he underwent frontal sinus obliteration. A few months later he presented with a discharge from above the right upper eyelid and a CT scan revealed two areas of loculated mucopus in this area. A Riedel's procedure was undertaken through a 'seagull' forehead incision and interestingly no residual mucosa was found. His supraorbital ridges were chamfered. He remained well for six and a half years whilst he was followed up.

Case 3

A sixty-four-year old lady had a left frontal mucocoele for which she had an external exploration of her left frontal sinus. Six months later her symptoms recurred and she had another exploration of her left frontal sinus. She then developed a discharging right frontal sinus fistula and the reason for the other side becoming infected is unclear. The left sinus was explored externally on two further occasions. As symptoms continued she was referred to this centre. A CT scan showed a persistent right mucocoele and pansinusitis. An endoscopic right frontosphenoidectomy and polypectomy were performed. A few days later she developed a left periorbital swelling and diplopia on looking down. A left external frontoethmoidectomy was done a month later. She was then referred to our unit. Lateral areas

of loculated mucopus were found and both frontal recesses were severely stenosed. She had discharging fistula through her bilateral external ethmoidectomy scars (Figure 2). In spite of further drainage procedures infection recurred and a bilateral frontal sinus obliteration was done. She developed a staphylococcal infection. A CT scan of this region supported a diagnosis of osteomyelitis of the bone flap and pus grew methicillin-resistant *Staphylococcus aureus* (MRSA) for which she was given antibiotics with the appropriate spectrum of sensitivity. Her symptoms did not settle and a Riedel's procedure was performed and parenteral antibiotics were administered for a further four weeks. She remains trouble-free after five and a half years follow up (Figures 3 and 4).

- **Infection in the frontal sinus may prove to be refractory to surgical intervention**
- **This is a series of cases of five patients who had persistent infection in spite of conventional surgery and who were then treated by removal of the anterior and inferior walls of the frontal sinus (Riedel's procedure). These reports are accompanied by a precis of the history of frontal sinus surgery**
- **The authors suggest that this operation has a place in the management of recalcitrant infection and that, with careful surgical technique, undue cosmetic deformity can be avoided**

Case 4

A seventy-three-year old Caucasian lady developed a left frontal extradural abscess along with frontal sinusitis. The intracranial abscess was drained and a biopsy of friable white material within the frontal sinus proved to be verrucous carcinoma. She had an osteoplastic flap and resection of the tumour without sinus obliteration. A biopsy six months later from the left frontal recess was positive for transitional cell carcinoma. She developed a repeated right periorbital swelling which failed to respond to antibiotics and a discharging external fistula. She was referred to the senior surgeon and Riedel's procedure was carried out. Verrucous carcinoma was found in the right frontal sinus along with pus and the histology found no evidence of transitional cell carcinoma on this occasion. Her supraorbital ridges were chamfered and a pressure bandage was applied for four days after surgery to reduce the possibility of a haematoma collecting. The radiotherapists advised against any treatment as there was macroscopic removal of disease and the histology showed all the specimen of verrucous carcinoma to be very well differentiated. Some workers have advocated combined therapy but the evidence base for this in the paranasal sinuses is small. She remains symptom free after three years.

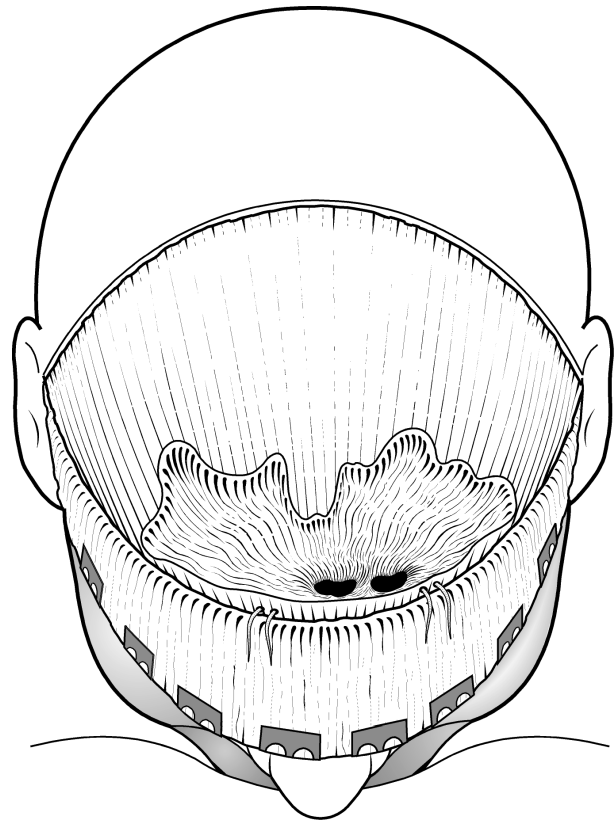


FIG. 5

Appearance after the anterior table of the frontal sinus has been removed.

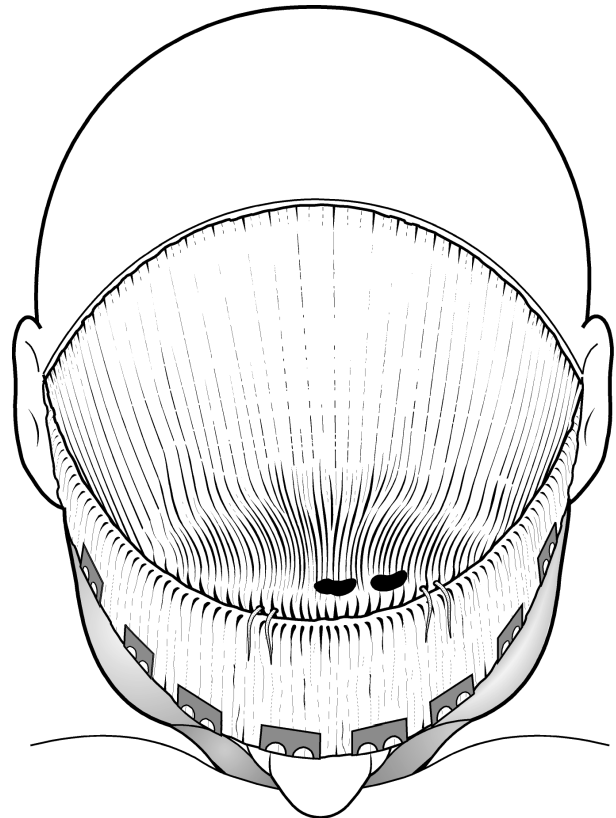


FIG. 6

After Riedel's procedure done to smooth the edges of the frontal sinus and chamfered the supraorbital margins and preserved the supraorbital and trochlea neurovascular leashes if possible.

Case 5

A thirty-eight-year-old Caucasian gentleman developed left periorbital cellulitis and frontal sinusitis. A left frontoethmoidectomy was performed and a Silastic drainage tube was placed in the frontal recess. Three months later he had another left frontal sinus infection for which a revision frontoethmoidectomy was done. Two months later he presented again with left frontal pain and swelling. Pus from the frontal recess grew MRSA and was treated with antibiotics. A few months later he developed a discharging sinus over his left ethmoid sinus and he was referred to this centre. A CT scan showed reactive changes in both cortical plates of the frontal sinus suggesting osteomyelitis. Endoscopy of his nose revealed tight stenosis of the frontonasal recess with fullness of the left lateral wall caused by a small mucocele. Riedel's procedure was carried out. Both frontal sinuses contained pus with hyperostosis blocking the frontal recesses. The supraorbital rims were chamfered down to, and around, the supraorbital nerves. Pus from the sinuses did not grow any organisms. At follow up nine months later the patient is well and is satisfied with the cosmetic result.

Discussion

Acute frontal sinusitis is usually an isolated event and if it does not respond to antibiotics then a trephine normally settles what is usually a 'one-off' infection. Recurrent or persistent frontal sinus infection is difficult to treat and often results from previous instrumentation of the frontal recess. Medical management with a minimum of six weeks of antibiotics and steroids have been recommended¹⁵ and only if this fails is surgical management required. An endoscopic or external frontoethmoidectomy are the initial surgical options and if these fail a median drainage procedure or obliteration of the frontal sinus should be considered. The larger series reporting oblitative procedures have found a 3 per cent recurrence of infection^{3,4} and Weber *et al.* have reported a 10 per cent chance of recurrent infection.² Other series have not reported any recurrent infections,^{16,17} but with any study of the frontal sinuses a long follow up is required as many problems recur at a later date. Kuhn¹⁵ reported recurrent mucoceles after frontal sinus obliteration but did not mention recurrent frontal sinus infection. The literature describing the management of recurrent frontal sinus infections after obliteration is notable by its sparseness. Procedures to deal with failed oblitative procedures are only mentioned in passing in the historical part of any discussion about the surgical management of frontal sinus disease. Riedel's procedure has always been discredited because of post-operative disfigurement and its modification by Killian has also failed to find favour with the surgeons.⁹

The authors believe Riedel's procedure has a useful role in the management of a small proportion of patients when drainage of the frontal sinus cannot be established, frontal sinus obliteration has failed,

or who have osteomyelitis of the anterior wall of the frontal sinus. The main criticism of disfigurement following Riedel's procedure can be overcome to a great extent by chamfering the supraorbital ridge and drilling the bones at the margins of the frontal sinus to make it a gentle curve rather than a sharp step. This also allows the thick soft tissue to fall in and line the vacated frontal sinus area (Figures 5 and 6). As the frontal sinus mucosa is completely removed, the chance of recurrent complications are few, and if it happens it can easily be recognized. The authors accept that this procedure causes a cosmetic defect, but after chamfering the margins of frontal sinus it is minimal.

Conclusion

Riedel's procedure has a place in eradicating frontal sinus disease when other drainage and obliteration methods have failed and where there is persistent disease of the anterior wall of the frontal sinus or the sinus itself. The post-operative disfigurement, which is the main criticism against this operation, can be overcome by chamfering the edges of the frontal sinus and the supraorbital ridge.

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