**Abstract**

We report the use of balloon sinuplasty in a 22 year old male who sustained a frontal sinus fracture. Preoperative thin-cut maxillofacial CT demonstrated a displaced and comminuted right anterior table frontal sinus fracture with a large fragment partially occluding the frontal sinus outflow tract. Using endoscopic and fluoroscopic guidance, a sinus balloon was introduced into the injured frontal sinus. Repeated adjustment and inflation of the balloon under fluoroscopy suggested that the fragment was reduced and the frontal sinus outflow tract was enlarged. The sinus was filled with Merogel injectable after the balloon was removed. Postoperative maxillofacial CT revealed reduction of the largest bony fragments and a patent frontal sinus outflow tract. At 7 month follow up the patient had no functional or cosmetic abnormalities. Balloon Sinuplasty should be considered in the treatment of selected internally displaced anterior table frontal sinus fractures involving the frontal sinus outflow tract. The technique and considerations for its use are described.

**Case Report**

A 22 year old male sustained a right anterior table frontal sinus fracture involving the frontal sinus outflow tract. A 3 cm right lower brow/upper nasal sidewall laceration was closed at an outside hospital. There was neither a cosmetic depression nor a step-off. A preoperative CT was obtained (Fig 1). Under general anesthesia, the Acclarent Balloon Sinuplasty™ system was utilized to internally reduce the fracture. Using endoscopic guidance, a Relieva® sinus guide catheter was placed in the right nasofrontal recess. The Relieva® sinus guidewire was then passed into the right nasofrontal tract into the frontal sinus under fluoroscopic guidance. The Relieva® sinus balloon catheter was deployed over the wire, positioned at the superior extent of the internally displaced fracture fragment, and was inflated to 10 atm. The balloon was deflated and, after repositioning it more proximally in the nasofrontal outflow tract, was once again inflated to a pressure of 10 atm. Fluoroscopy suggested that the largest fracture fragment was reduced and that the frontal sinus outflow tract was enlarged (See Fig 3). A syringe filled with Merogel injectable was then attached to the sinus guided catheter and injected into the frontal sinus outflow tract. A postoperative maxillofacial CT was obtained which revealed reduction of the largest of the comminuted, internally displaced bony fragments of the anterior table (see Fig 2). Frontal sinus outflow tract patency was reestablished. Broad-spectrum antibiotics were given for 4 weeks post-operatively. Follow-up at seven months post surgery revealed no cosmetic or functional abnormalities. CT scan obtained at this time revealed a healed right frontal sinus fracture with no evidence of frontal sinus disease (see Fig 4).

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**Discussion**

The management of frontal sinus fractures is a controversial and evolving topic. The treatment of an anterior table frontal sinus fracture (AFSF) involving the frontal sinus outflow tract (FSOT) is at the epicenter of the debate. The time-honored treatment is frontal sinus obliteration. Recent retrospective reviews support this treatment.

Chen et al, in their review of 78 cases, managed the 3 cases of AFSF involving the FSOT with obliteration. Wilson et al reported data on 66 patients who had sustained frontal sinus fractures. 30 patients had fractures involving the FSOT. 24 were FSOT fractures in combination with anterior and/or posterior wall fractures. Frontal sinus obliteration with fat was performed for 28/30 patients. Among those patients undergoing obliteration, three patients developed meningitis, one patient developed a brain abscess, and chronic frontal headache and forehead depression were common. It is unclear whether these patients had FSOT involvement.

Recent studies also endorse management protocols with methods other than frontal sinus obliteration. Gossman et al, in their review of 96 cases, performed obliteration in 8 patients. The patient who underwent obliteration with Norian bone cement developed a frontocutaneous fistula six months later. In their review of 158 cases, Gerbino et al had four patients with AFSF involving the FSOT. The anterior frontal sinus wall was reconstructed and a Portex stent was placed in all four cases. No complications were reported among these 4 patients at 3 year follow-up. Smith et al reported on a group of seven patients with AFSF involving the FSOT. Each was treated with open reduction and frontal sinus obliteration. Antibiotics were given post-operatively. A computed tomography scan was obtained 8 weeks post-injury. 2/7 had persistent FSOT obstruction with frontal sinusitis. Both underwent successful endoscopic management. At a mean follow-up of 17.8 months, no major complications had resulted.

This is the first known report of utilizing balloon sinuplasty to internally reduce an AFSF with FSOT involvement. Of the various techniques reviewed, this method most closely follows the management protocol of Smith et al. Smith et al explained that this management protocol was developed due to the risk in obliterating a traumatized sinus and the increased facility of endoscopic sinus surgery to successfully manage the frontal recess and sinus. In this protocol, initial management addresses the displaced anterior frontal sinus fracture. Similarly, this was accomplished in our patient but without fracture exposure and without internal fixation. As in the report by Smith et al, antibiotics were given post-operatively and the FSOT was managed expectantly. To date, the patient is without evidence of complication.

**Conclusions**

Balloon catheter dilation of paranasal sinus ostia is a new technique with preliminary data which suggest it is safe and feasible. We have shown that it has the ability to internally reduce an anterior frontal sinus fracture. It should be considered in the treatment of selected internally displaced anterior table frontal sinus fractures involving the frontal sinus outflow tract as part of a management protocol which involves expectant management of the FSOT in compliant patients likely to follow-up.

**Bibliography**