Sinus Preservation Management for Frontal Sinus Fractures in the Modern Era: A Systematic Review

Kenny B. Carter Jr., MD1,2; David M. Poetker, MD, MA1,2; John S. Rhee, MD, MPH1,2

1Department of Otolaryngology and Communication Sciences, Medical College of Wisconsin, Milwaukee, Wisconsin and the 2Zablocki Veteran Affairs Medical Center, Milwaukee, Wisconsin

Abstract

Objective
To systematically review the existing literature supporting the efficacy and safety of sinus preservation management for frontal sinus fractures in the modern era of endoscopic frontal sinus surgery.

Study Design
A systematic review of the English literature for the targeted objective was conducted using the PubMed database between January 1995 and August 2008.

Methods
The PubMed database was queried using two major search terms of frontal sinus fracture or frontal sinus injury along with manual review of citations within bibliographies. Citations acquired from the primary search were filtered and irrelevant abstracts were identified that merited full review. Articles were identified that included any cohort of patients with frontal sinus fractures involving the frontal sinus outflow tract or posterior wall with sinus preservation management.

Results
A total of 231 citations were generated and 56 abstracts were identified as potentially relevant articles. Sixteen abstracts merited full review, with 7 articles meeting inclusion criteria for sinus preservation management. Similar short-term complications and effectiveness were found between fractures managed with sinus preservation and those with traditional management.

Conclusions
Sinus preservation appears to be a safe and effective management strategy for select frontal sinus fractures. Many of the complications encountered with sinus preservation can be successfully managed with endoscopic frontal sinus surgery. More transparent reporting of management strategies for individual cases or cohorts is needed. A standardized algorithm and categorization framework for future studies are proposed. Longer-term follow-up and larger prospective studies are necessary to assess the safety and efficacy of sinus preservation protocols.

Introduction

The incidence of frontal sinus fractures ranges from 5-15% of all facial fractures.1,2 Motor vehicle crashes are the most common cause of frontal sinus fractures and often result in concomitant orbital, nasal, and midfacial fractures. Several options for management of frontal sinus fractures have been described in the literature based on fracture pattern and associated injuries. The degree of fracture displacement, status of the frontal sinus outflow tract (FSOT), and any associated intracranial injuries may dictate management by observation, open reduction and internal fixation (ORIF) of the anterior table, obliteration, or cranialization. Management of isolated anterior table fractures without FSOT involvement has generally led to consensus in the literature.3,4 However, there is still controversy over the management of fractures with suspected involvement of the FSOT or posterior table. Fractures involving the FSOT have traditionally been obliterated or cranialized.5,6 Posterior table fractures associated with brain injury and persistent cerebrospinal fluid leak often require dural repair and sinus cranialization.7,8

The goal of this study was to systematically review the literature to identify the effectiveness and safety of sinus preservation for management of frontal sinus fractures. Specifically, we narrowed our study to address the question: ‘In the modern era of endoscopic frontal sinus surgery, what is the role of sinus preservation in the management of frontal sinus fractures?’ In the last 15 years, endoscopic technology has become standard in the management of frontal sinus disease including sinusitis, mucoceles, and cerebrospinal fluid leaks, all of which are common complications encountered with frontal sinus fractures.9,10 More recently, endoscopic approaches have even been utilized in facial fractures repair.11-13 We limited our literature search to articles published from January 1995 to the present, which we arbitrarily defined as the "endoscopic sinus surgery era."

In addition, we propose a reporting system that may help standardize classification of frontal sinus fractures based on degree of anterior table, posterior table, and FSOT involvement. Ultimately, patient outcomes should include any complications with specific management, as well as information about frontal sinus ventilation. This reporting system may help standardize patient reporting and outcomes which will facilitate comparison of patient cohorts across institutions and the development of a uniform treatment algorithm for management of frontal sinus fractures.

Methods

Article Selection Process
A multi-step search of the PubMed database was performed using the major search terms of frontal sinus fracture or frontal sinus injury along with the initial search was limited to include articles published between January 1995 and September 2008. Citations acquired from the primary search were filtered; all non-English and non-relevant articles were excluded at this time. Citations that did not appear to focus on the management of frontal sinus fractures were deemed non-relevant and excluded if they did not address the question or did not contain patient data. Articles were included if they reported patients with FSOT or posterior table fractures managed with sinus preservation. “Sinus preservation” included all fractures managed by observation, endoscopic or open reduction of the anterior and/or posterior table, and ORIF of the anterior table.

Proposed Management Algorithm

- Sinus preservation option
- Sinus Ventilation: Is there any ventilation of the sinus sufficiently preserved?
- Observation
- Surgical Management
- Fracture Characteristics

What was the complication? How was it managed, and what was the outcome?

Conclusions

The goals of frontal sinus fracture repair include restoration of frontal contour and cosmesis, establishment of normal sinus ventilation, integrity of intracranial contents, and most importantly, prevention of the numerous complications that can arise in the setting of frontal sinus injury.11,12 With the widespread acceptance of endoscopic management of sinus disease, endoscopic techniques directed at the frontal sinus have gained acceptance. Procedures such as the Draf type III or frontal sinus deroofing have been well established and accepted.13 These techniques have been proven effective in management of frontal sinus mucocelles and chronic sinusalis, both known complications of frontal sinus fractures. These techniques have also been effectively used to manage complications from failed attempts at frontal sinus obliteration.

The establishment of these procedures and their application for management of frontal sinus fractures allows for more conservative management and sinus preservation in these patients.

Sinus preservation offers several advantages over traditional management with obliteration or cranialization:
1. Shorter operative time and exposure to anesthesia.
2. Negates need for wide exposure to remove all sinus mucosa and risk of bone devitalization.
3. Complications that arise in the setting of a preserved sinus would be more apparent on imaging studies and potentially identified sooner. In addition, the status of the frontal sinus can be evaluated in the clinic with endoscopic examination.

Sinus preservation may be considered in patients with frontal sinus fractures and the following characteristics:
1. Non-displaced or minimally displaced fractures of the anterior wall
2. Non-displaced or minimally displaced posterior wall fractures without significant intracranial injury or persistent CSF leak (traditionally cranialized)
3. Displaced anterior wall fractures with suspected FSOT involvement (traditionally obliterated)
4. Displaced anterior and minimally displaced posterior wall fractures without significant intracranial injury or persistent CSF leak (traditionally obliterated or cranialized)

Discussion

Sinus preservation appears to be a safe and effective management strategy for select frontal sinus fractures. Several recent studies have proposed sinus preservation protocols using endoscopic management of the FSOT as a viable alternative to frontal sinus obliteration. Additionally, complications arising from frontal sinus preservation may be managed endoscopically. As more centers begin incorporating sinus preservation protocols into management of frontal sinus fractures, more data will be available for comparative analysis. More transparent reporting of management strategies and longer-term follow-up are necessary to assess the safety and efficacy of sinus preservation protocols.

References


Frontal Sinus Fracture Classification

Study Fracture Classification Cases
Isolated Anterior Table Anterior Table + FSOT Anterior Table + Posterior Table Posterior Table + FSOT Isolated Posterior Table
Bell 2007 184 85 34 12 77 63 34 9
Steiger 2006 187 89 46 48 48 0 1
McRae 2009 18 22 18 3 56 28 20 0
Sills 2002 26 24 12 0 0 0 0
De Menezes 2009 15 24 74 24 26 71 62 12
Krier 2006 6

Excluded (n=175)
Non-relevant to frontal sinus fracture management or non-English articles

Excluded (n=40)
Studies with only non-Patient Data

Excluded (n=15)
Non-Review Article without Patient Data

Excluded (n=3)
No Sinus Preservation Protocol

PubMed Search: 231 citations

Published Search Results

21 Citations (n=56)

Potential relevant abstracts (n=56)

Full length articles retrieved for review (n=15)

Studies meeting criteria (n=7)

Excluded (n=40)
Non-relevant to frontal sinus fracture management or non-English articles

Excluded (n=15)
Non-Review Article without Patient Data

Excluded (n=3)
No Sinus Preservation Protocol

Excluded (n=17)
Non-relevant to frontal sinus fracture management or non-English articles

Excluded (n=40)
Studies with only non-Patient Data

Excluded (n=15)
Non-Review Article without Patient Data

Excluded (n=3)
No Sinus Preservation Protocol

Excluded (n=17)
Non-relevant to frontal sinus fracture management or non-English articles