

# Type of Endoscopic Drill Shaft Does Not Predict Nasoseptal Flap Necrosis

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## ABSTRACT

**INTRODUCTION:** The nasoseptal flap (NSF) is the workhorse for reconstruction of complex skull base defects after endoscopic skull base surgery (ESBS), and flap necrosis increases the known risks of ESBS such as cerebrospinal fluid leak, meningitis, and death. Several factors have been identified that increase rates of NSF necrosis but surgical technique and choice of instrumentation are not often or easily studied. Pressure on or manipulation of the flap pedicle during the case is hypothesized to compromise that blood supply. We aimed to study whether switching from an endoscopic high speed rotating shaft drill to an endoscopic high speed non-rotating shaft drill for resection of skull base bone would lead to a change in risk of necrosis.

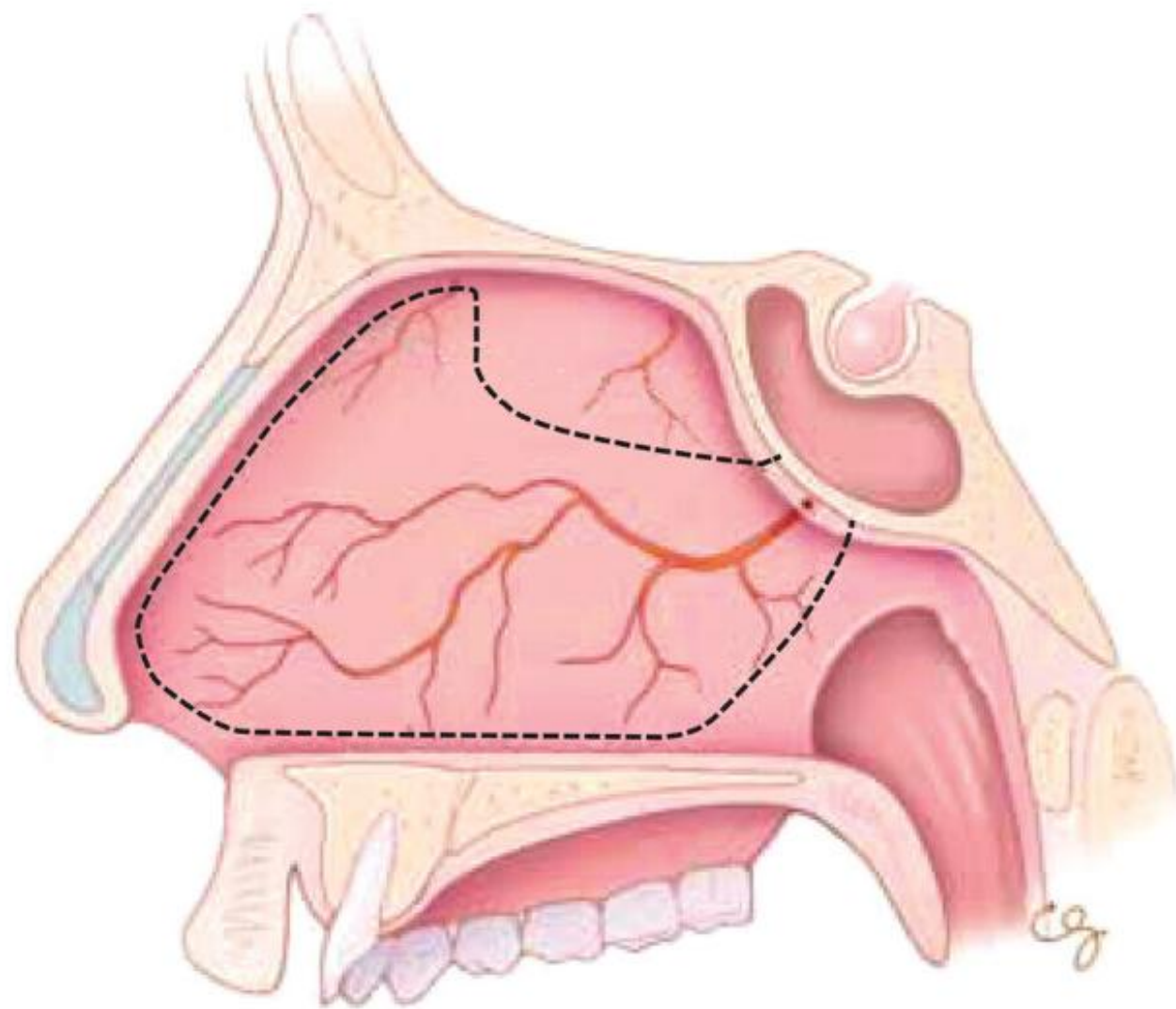
**METHODS:** We performed a retrospective review of all the ESBS cases with NSF reconstruction of a single skull base neurosurgeon and four different rhinologists at our institution over a 4-year period comparing rates of flap necrosis when using a rotating shaft vs a non-rotating shaft drill.

**RESULTS:** In the first two years of the study, there were 143 NSFs with 6 necrotic flaps (4.2% rate) with the rotating shaft drill. In the latter two years, the non-rotating shaft drill was utilized exclusively and there were 187 NSFs and 6 necrotic flaps (3.2% rate). Although the overall ratio of necrosis to flaps raised was higher with the rotating shaft, when evaluated via chi squared analysis for statistical significance, they were not significantly different (p=0.63). The demographics and past medical history of the 12 patients with necrotic flaps were analyzed in aggregate and their average age was 49, 50% male, had an average BMI of 30, 58% were revision cases with history of prior ESBS tumor resection, 25% had a history of radiation therapy, 25% had a history of diabetes mellitus, and 50% had a history of hypothyroidism. Additionally, the pathology of these patients included 1 pituitary adenoma, 5 craniopharyngiomas, 2 chordomas, 1 chondrosarcoma, 2 meningiomas, and 1 trigeminal nerve schwannoma.

**CONCLUSIONS:** There are many perceived advantages to the non-rotating shaft high speed endoscopic drills, but their use does not appear to significantly alter rates of NSF necrosis. Ultimately, this study highlights that NSF necrosis rates are low but present when skull base centers are doing extensive endoscopic dural openings. This is true even with robust otolaryngology and neurosurgery residency and fellowship programs. Higher powered studies are needed to differentiate what specific surgical technique and instrumentation risk factors may predispose to NSF necrosis, but are challenging to perform given the rapid evolution of ESBS. In our cohort of NSF flap necrosis patients, the more likely causes have to do with 1) patient factors that affect viability of NSF pedicles (high rate of previous ESBS), 2) increased risk of poor wound healing (higher rates of obesity, radiation, diabetes, and hypothyroidism), and 3) more complex skull base pathology.

## INTRODUCTION

Postoperative Cerebrospinal fluid (CSF) leaks after Endoscopic Skull Base Surgery (ESBS) increase post-operative morbidity and mortality. There has been significant expansion and optimization of ESBS over the past 20-30 years and a major contributor to that growth and improvement is the increasing ability to endoscopically reconstruct skull base defects and prevent the mortality and morbidity associated with CSF leaks<sup>1</sup>. This decrease in CSF leak rates can be attributed, in part, to the development of regional vascularized tissue techniques for reconstruction<sup>2</sup>. The workhouse of regional vascularized tissue reconstruction is the nasoseptal flap (NSF) based off the posterior septal artery.



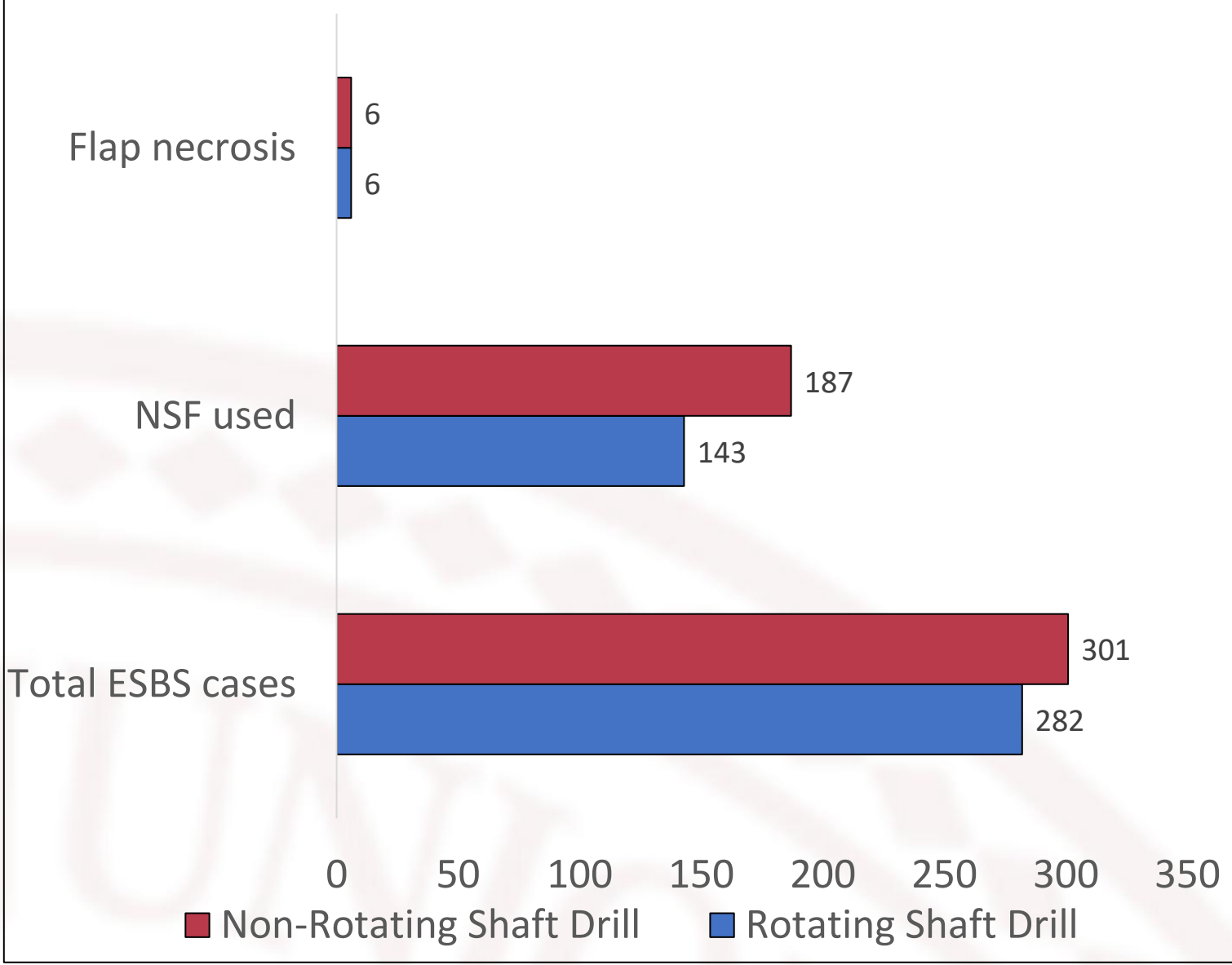
**Figure 1.** Outline of incisions of a Nasoseptal flap based off the posterior septal artery pedicle<sup>3</sup>.

The anatomy of the posterior septal artery has been studied extensively since the inception of the NSF and its path is well-understood and highly preserved<sup>4</sup>. The pedicle runs just inferior to the natural ostium of the sphenoid sinus and supplies the mucosa of the entire septum and nasal floor (Fig 1). For the Otolaryngologist and Neurosurgeon alike, preservation and protection of this pedicle is critical to any endoscopic skull base surgery such as standard (e.g. pituitary adenomas) and expanded (suprasellar, clival, and cavernous sinus disease) middle cranial fossa approaches and tumor resections. Patient factors that cause NSF necrosis have been studied extensively but surgical technique and choice of instrumentation are not as easily investigated. Pressure on or manipulation of the flap pedicle during the case is hypothesized to compromise that blood supply. We aimed to study whether switching from an endoscopic high speed rotating shaft drill to an endoscopic high speed non-rotating shaft drill for resection of skull base bone would lead to a change in risk of necrosis.

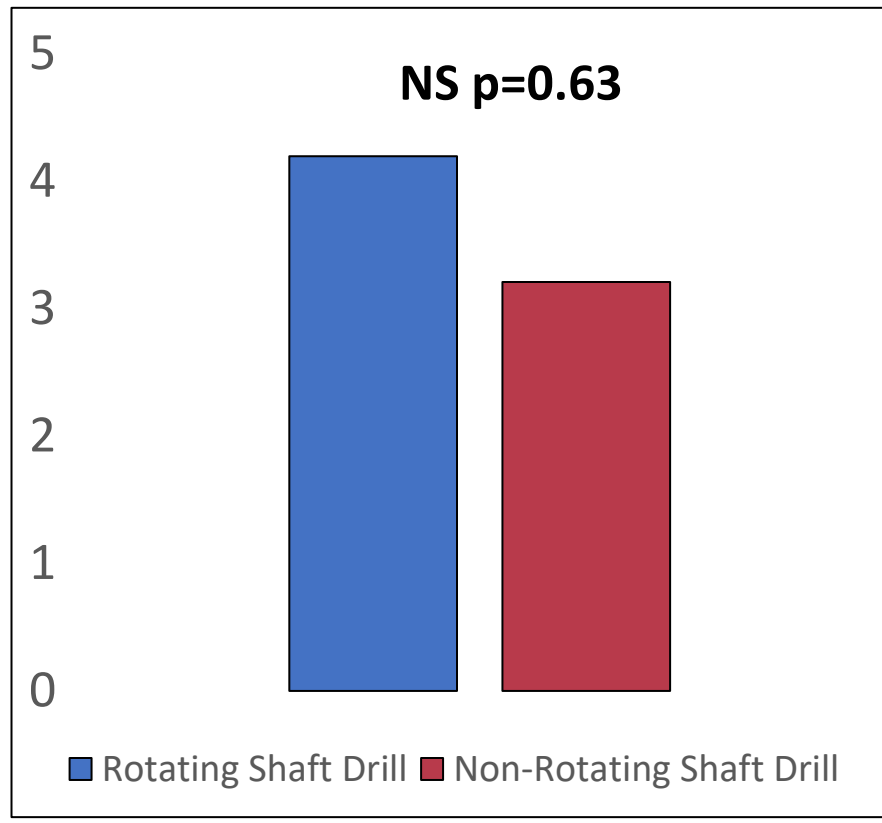
## METHODS AND MATERIALS

- Single institution retrospective review of all ESBS cases over 4-year period
  - Drill shaft type changed at the half-way point of the study from rotating shaft to non-rotating shaft.
  - Single high volume skull base Neurosurgeon and 4 high volume fellowship trained Rhinologists
- Cases with NSF reconstruction selected for chart review
  - Cases excluded if no follow up recorded
  - Chi squared analysis performed for flap necrosis rates.
- Cases with Flap necrosis selected for in-depth chart review.

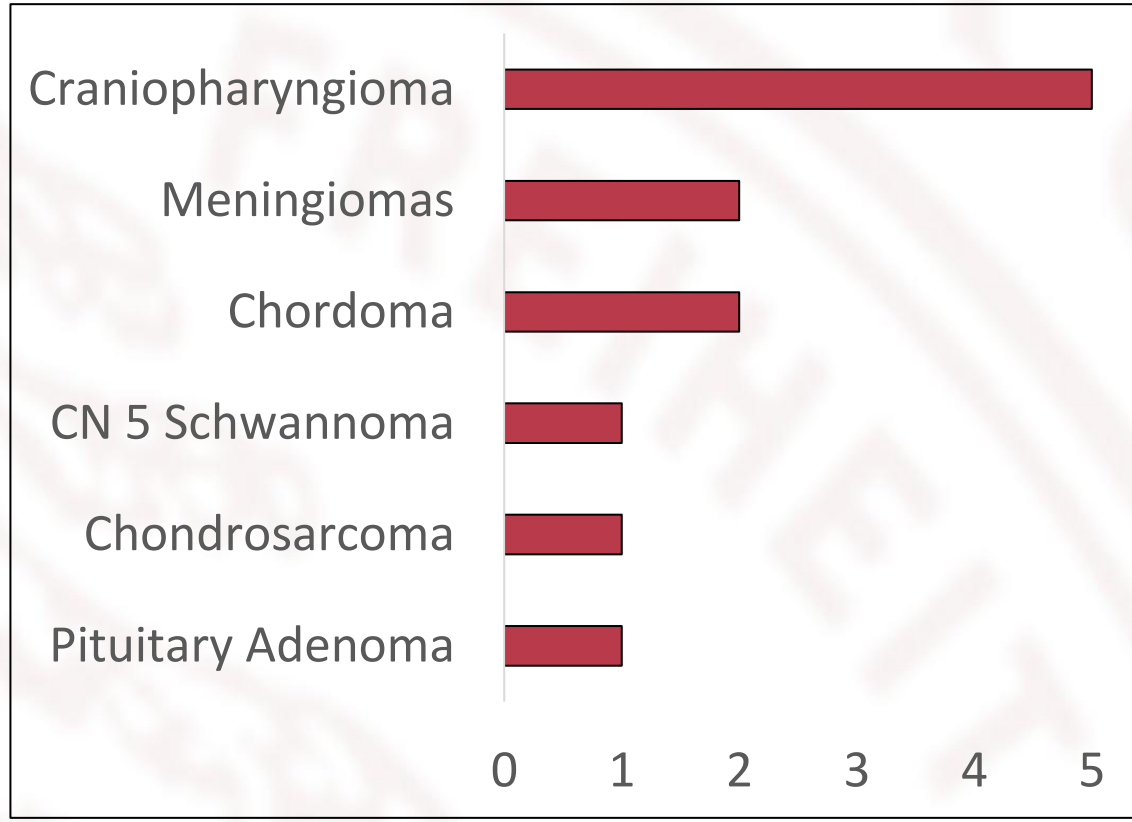
## RESULTS



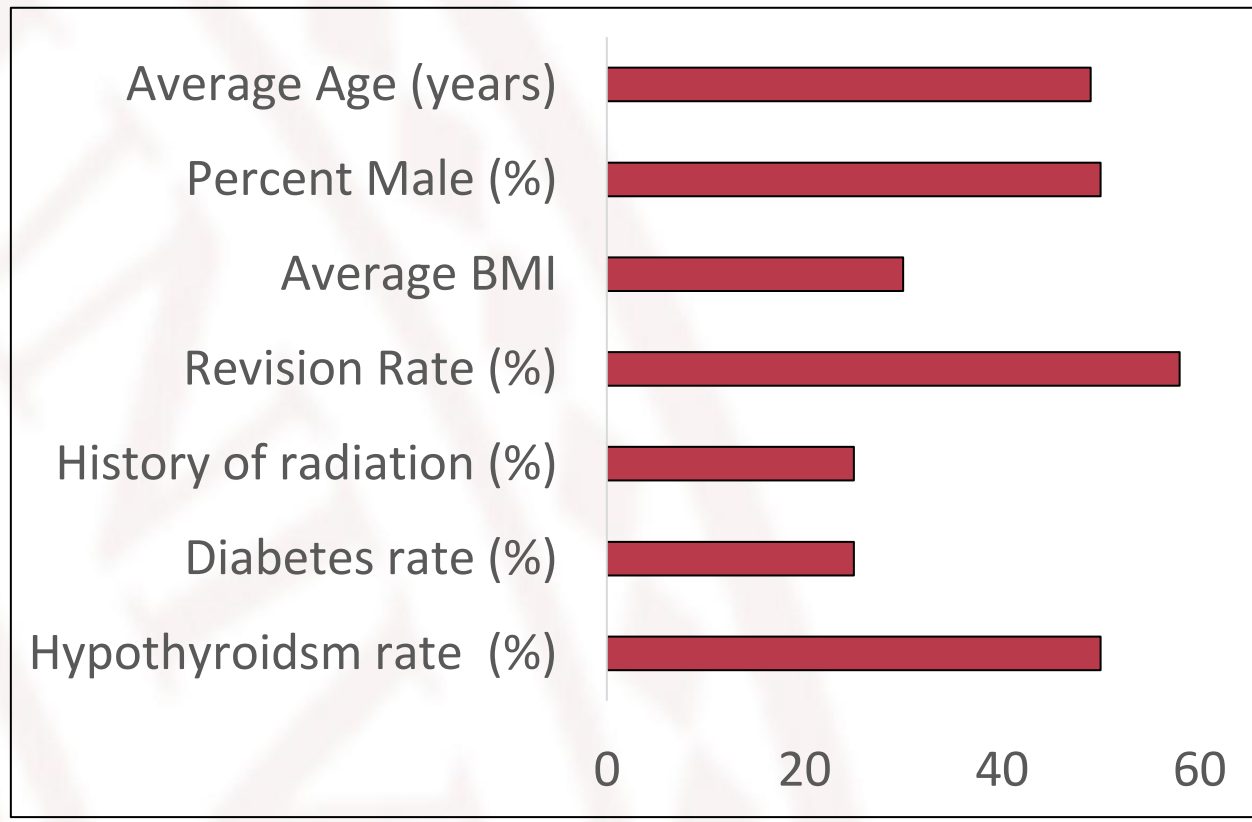
**Chart 1.** Number of Endoscopic Skull Base(ESBS) cases, Nasoseptal Flaps (NSF) used, and NSF necrosis events



**Chart 2.** Rate of Nasoseptal Flap Necrosis based on type of drill used. Not significant on Chi square analysis



**Chart 3.** Pathology of Nasoseptal flap Necrosis patients (n).



**Chart 4.** Aggregate demographics of all patients with Nasoseptal flap necrosis

## DISCUSSION

Until recent years, many of the drills used to resect skull base bone had elongated and modified drill heads connected to drill handpieces designed for non-endoscopic surgery. These drill heads had elongated rotating shafts that could potentially lead to increased risk of collateral damage from the proximal shaft while the surgeon is focused on the drill head. As ESBS has advanced, several vendors have now developed handpieces designed for endoscopic surgery with only the drill head that rotates (Figure 2). We hypothesized that the transition to a non-rotating shaft drill may lead to decreased pressure and manipulation of the NSF pedicle, thus decreasing the rates of NSF necrosis. While using an endoscopic high-speed drill with a rotating shaft, the rate of NSF necrosis was 4.2%. This rate decreased to 3.2% after switching to a non-rotating shaft drill but this was not a statistically significant different on chi-squared analysis, perhaps due to low incidence.



**Figure 2.** Example of Non-rotating shaft endoscopic high-speed drill

Ultimately, the data presented highlights that the rates of NSF necrosis are low in a high-volume endoscopic skull base center but much can be observed from these patient events. 11/12 of the NSF necrosis cases had skull base pathologies that traditionally require extended approaches (e.g. craniopharyngioma, meningioma, chordoma, and chondrosarcoma). This highlights that procedures with extensive skull base disease likely led to increased dissection, pressure, and manipulation of the flap pedicle compromising the blood supply. Additionally, NSF necrosis patients had high rates of known predisposing factors that lead to poor wound healing (E.g. hypothyroidism, previous radiation, and diabetes). Finally, the most common trait in all the NSF necrosis patients was revision surgery rates (60%) highlighting how altered anatomy or previous pedicle damage can lead to increased necrosis rates.

## CONCLUSIONS

- Changing drill shaft type from rotating to non-rotating did not change the rates of NSF necrosis, but low incidence rate underpowers the study
- The vast majority of NSF necrosis patients were extended approaches with complex skull base pathology
- Patient factors affecting wound healing and pedicle viability (revision surgery) are major contributors to NSF necrosis and overall rate is low.

## CONTACT

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