Article

Causative Factors for Complications in Transpalatal Advancement

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Abstract

Introduction: Transpalatal advancement (TPA) is a procedure that is used when modern variants of uvulopharyngopalatoplasty are unable to provide enough anterior traction. Although successful in reduction of obstructive sleep apnea (OSA) parameters, it also comes with procedure-specific risks. Formation of an oro-nasal fistula (ONF) is a complication that results in significant morbidity and a protracted treatment course.

Methods: After approval from the University of Wollongong Health Research Ethics Committee, a retrospective chart review of all cases undergoing TPA performed by a single surgeon over a 10-year period from 2008 to 2018 was performed. Patients underwent pre- and postoperative level 1 or 2 polysomnography. Factors potentially contributing to palatal complications, as well as pre- and postoperative polysomnographic parameters, subjective sleep questionnaires, and body mass index (BMI) were statistically analyzed where a P value $<.05$ was considered a significant result.

Results: A total of 59 patients were included. Overall palatal complication rate was 25.4% (15/59), with the most common being transient velo-palatal insufficiency (VPI) (8/59, 13.6%). ONF developed in 4/59 (6.8%) of patients. None of the analyzed contributing factors for palatal complications were statistically significant, except the presence of a high-arched palate and development of ONF. All analyzed sleep parameters, as well as BMI, were significantly different when comparing pre- to postoperative results.

Conclusion: This study suggests that TPA has a role in current sleep surgery paradigms and can significantly improve both objective and subjective outcome measures of OSA. Surgeons contemplating TPA on patients with high-arched hard palates should do so with caution.

Keywords

obstructive sleep apnea, sleep surgery, sleep apnea, snoring and sleep, complications, iatrogenic palatal perforation

Introduction

Transpalatal advancement (TPA) was first introduced by Woodson in 1993[1] and has since become integrated into the range of procedures that a sleep surgeon may employ for the treatment of obstructive sleep apnea (OSA).[2] It is utilized when there is a posteriorly positioned soft palate and a modern variant of modified uvulopharyngopalatoplasty (mUPPP) is insufficient to provide adequate anterior advancement. Formation of an oro-nasal fistula (ONF) (Figure 1) is a known complication that can result in significant morbidity and a protracted recovery course. The published English-language literature regarding TPA is limited, and provided by only a few authors.[1,3-7] None of these specifically address the factors that contribute to complications. A meta-analysis revealed an overall ONF rate of 10.2%.[8] This paper attempts to explore patient factors that may contribute to the ONF rate. It also aims to further report on the effect TPA has, as part of multilevel sleep surgery, on specified objective and subjective sleep parameters.

Method

Approval from the University of Wollongong Health Research Ethics Committee was obtained. A retrospective chart review of all cases of undergoing TPA via either a

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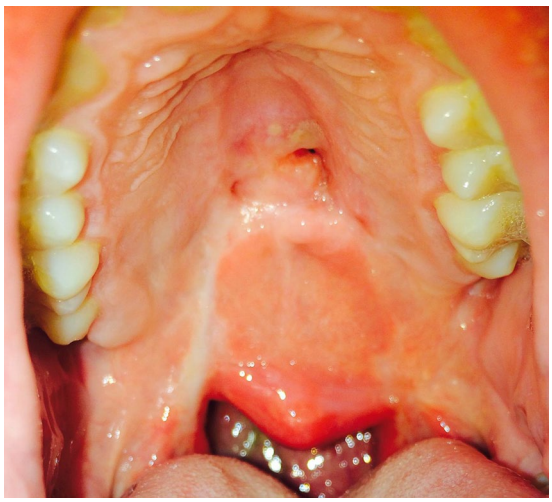

Figure 1. Oro-nasal fistula.

gothic arch or propeller incision performed by a single surgeon over a 10-year period from 2008 to 2018 was performed. The indication for performing a TPA was to facilitate multilevel upper airways reconstructive salvage surgery following CPAP failure/intolerance. All patients underwent mUPPP[9] in addition to TPA and surgical management of the nasal, retrolingual, or lower airway as appropriate. They also underwent a level 1 or 2 sleep study prior to surgery; this was repeated at least 3 months after surgery. Data collated included patient demographics, body mass index (BMI), apnea–hypopnea index (AHI), lowest oxygen saturation (LSAT), Epworth Sleepiness Scale (ESS) score, and snoring severity scale (SSS) score. An assessment of the improvement in snoring was also obtained from the patient's partner or relatives at the 3-month follow-up appointment. Potentially relevant risk factors for palatal complications, and specifically ONF, were tabulated. These included age older than 60 years, BMI greater than 30 kg/m^2, OSA severity, previous palatal surgery, smoking status, the presence of inflammatory nasal disease, gastroesophageal reflux, and a high-arched hard palate. The presence of a high-arched palate was clinically judged by the operating surgeon. Palate-related postoperative complications (wound dehiscence, long-term palatal numbness, velo-palatal insufficiency [VPI], and ONF) and the need for revision surgery were recorded.

Sleep parameter data sets were also analyzed. Patients with incomplete data sets were excluded. Pre- and postoperative AHI, LSAT, ESS score, SSS score, and BMI were statistically analyzed with a two-tailed paired *t*-test. Contributors to any palatal complications and ONF were subjected to the Fisher's exact test. A $P < .05$ was considered significant. All statistics were subjected to Bonferroni correction for multiple testing. Statistics were performed using SPSS software (IBM Corp. Released 2013. IBM SPSS Statistics for Mac, Version 22.0. IBM Corp., Armonk, New York, USA).

Table 1. Surgeries[a] Performed Concurrently with Transpalatal Advancement.

Procedure	No.
Modern variant uvulopharyngopalatoplasty	59
Coblation channeling of the tongue	40
Lingual tonsillectomy	23
Coblation-assisted Lewis and Mackay operation	18
Submucosal lingualplasty	1
Epiglottopexy	1
Submucosal coblation of inferior turbinates	8

[a]Patients have >1 other surgery in addition to transpalatal advancement.

Results

A total of 59 patients underwent TPA as part of multilevel upper airways surgery. All patients had a mUPPP and the tongue surgically addressed simultaneously (Table 1). The majority of patients were male (47/59, 79.7%). The average age of the patient at surgery was 50 years (range 24-70). All patients were included for analysis of factors contributing to palatal complications. The overall palatal complication rate was 25.4% (15/59). Of the 15 palatal complications, 8 (13.6%) had a transient VPI, 4 (6.8%) had an ONF, 2 (3.4%) had a soft tissue wound dehiscence, and 2 (3.4%) had long-term hard palate numbness. One patient experienced both transient VPI and palatal numbness. A return to the operating room for management of complications was required for 3 patients: 2 for an ONF and 1 for a soft tissue dehiscence. Dehiscence at the bony island incision site occurred in 3 of the 4 patients with ONF, while the final ONF dehiscence occurred at the drill hole site. Overlying soft tissue necrosis developed in all 4 patients prior to ONF formation (Figure 2). All patients with ONF located at the bony island site were initially treated conservatively with an obturator for up to 5 months. Of these 3 patients, only one required return to surgery. This fistula was repaired with a combined greater palatine and naso-septal soft tissue flap, with placement of a free bone graft from the mandible due to defect size. The patient who developed an ONF at the drill hole site did not respond to conservative management after 4 months. A combined oral/nasal local rotational flap was required for closure. No patients had a long-term VPI. The only risk factor for a palatal complication that reached statistical significance was the presence of a high-arched palate. This demonstrated an significant association with ONF ($P < .0016$). The remaining factors did not appear to be associated (Table 2).

Figure 2. Soft tissue necrosis overlying impending ONF.

Thirty-nine patients had complete sleep parameter data sets available for analysis. The mean follow-up time was 5.2 months. All preoperative sleep parameters were significantly different compared to postoperative results (Table 3). BMI also demonstrated a significant difference before and after surgery. A subjective improvement in snoring was reported by a household member—partner, relative, or close acquaintance—of all patients.

Discussion

The use of TPA in sleep surgery should be employed in appropriately selected patients. It is commonly reserved for palates that require additional widening of the retropalatal space beyond that achievable through mUPPP. In addition to increasing the retropalatal space, the procedure stiffens the oropharyngeal structures by tensing the muscles that are attached to the posterior edge of the hard palate. Oral examination and either awake or asleep dynamic assessment is utilized to select patients for TPA. The procedure is technically demanding and involves drilling of the hard palate. Therefore it is unsurprising that it comes with a unique set of complications. ONF is especially problematic as it significantly affects a patient's quality of life due to the necessity for fitting of an obturator and slow recovery process. Hence, it is imperative that patients at high risk for ONF formation be identified.

This paper's ONF rate of 6.4% is similar to what has previously been reported in the literature.[8] We found that age older than 60 years, BMI greater than 30 kg/m^2, severe OSA, previous palatal surgery, presence of inflammatory nasal disease, gastroesophageal reflux, and smoking did not affect ONF formation rates or palatal complications in general. The presence of a high-arched palate was the only factor that we found to be significantly associated with an increased risk of developing an ONF. One postulated explanation is that this anatomical variant adds surgical complexity through difficult soft tissue dissection, more acute angles for drilling, and a narrower surgical field in an already limited area of access. Hence, there is a greater chance of disrupting the bone and mucosal vascular blood supply, as well as higher likelihood of suboptimal bone apposition and wound closure.

A high-arched palate has previously been linked to OSA[10,11] and nasal obstruction;[12] however, the definition of a high-arched palate is clinically subjective and inconsistent. Currently there is no objective clinical criteria or measurable anatomical landmarks to identify a patient who has a high-arched palate. Radiological computed tomography measurements of narrower maxillary width have correlated a higher-arched palate to persisting nasal obstruction following soft tissue surgery,[13] but the difference was 1 mm, making it very hard to identify in the clinical setting and its relevance to TPA surgery is unknown. The degree of arching that becomes clinically relevant for OSA, nasal obstruction, and TPA surgery has yet to be properly explored.

The type of soft tissue dissection of the hard palate has also been reported to improve ONF rates. Shine et al[4] reported that changing from a gothic arch incision to a propeller incision decreased the fistula rate from to 12.9% to 3.4%. The corresponding author recommends a propeller incision for high-arch palate patients and a gothic arch only for broader, flatter palates.

The available evidence on TPA as a standalone procedure was reviewed in a meta-analysis[8] and showed a significant reduction in AHI and LSAT. Unfortunately, they did not report on subjective sleep symptoms. The meta-analysis excluded studies that did not meet entry-level criteria because other levels of obstruction were addressed simultaneously at surgery. This is a common issue faced when analyzing contemporary OSA surgical intervention. In our study, all patients had the retrolingual space simultaneously addressed, as concurrent multilevel procedure is increasingly utilized in OSA surgery.[14] Other quality of life parameters following TPA, such as sleepiness and snoring, are seldom reported in conjunction with polysomnographic parameters,[3] but these have shown similar significant improvement. As expected, due to the recovery process for most OSA surgeries, a reduction in BMI was seen at the follow-up appointments, but it is unlikely the sole factor for these improvements. Loss of weight is considered a beneficial side effect of OSA surgery that bolsters surgical result, and patients are encouraged to maintain the weight loss that occurs.

Like other studies on TPA, this paper is limited by its retrospective nature and low patient numbers. This is an inherent problem in evaluating procedures that are performed relatively infrequently, even in high-volume sleep surgery

Table 2. Risk Factors That May Contribute to Palatal Complications.

Potential risk factor (*n*)	Palatal complication, No. (*P* value)	ONF, No. (*P* value)
Age >60 (8)	2 (1.0)	1 (0.45)
BMI >30 (13)	2 (0.48)	0 (0.57)
Gastroesophageal reflux (8)	1 (0.67)	0 (1.00)
Inflammatory nasal disease (20)	4 (0.54)	1 (1.00)
High-arched palate (13)	5 (0.28)	**4 (0.0016)**
Current smoker (10)	2 (1.00)	0 (1.00)
Previous palate surgery (8)	2 (1.00)	0 (1.00)
OSA severity (mild vs. moderate vs. severe)	*P* = .29	*P* = .71

Table 3. Comparison of Pre- and Postoperative Sleep Parameters.

Parameter (*n* = 39)	Preoperative mean (standard deviation)	Postoperative mean (standard deviation)	*P* value
Apnea–hypopnea index	37.1 (15.5)	13.5 (11.9)	<.01
Lowest oxygen saturation	81.0 (8.7)	86.0 (5.3)	<.01
ESS	9.7 (5.1)	5.3 (3.1)	<.01
Snoring Severity Score	7.5 (1.5)	1.5 (1.9)	<.01
BMI	27.6 (2.9)	26.8 (2.5)	<.01

units. Our study may not have been adequately powered to demonstrate a difference for risk factors evaluated. Another limitation was the designation of a high-arched palate, which was based on the clinical judgment of a single surgeon, with no objective measurements or parameters. Ideally, future studies should be multicentered, prospective trials that compare multilevel surgery involving TPA to those without TPA. It is also important to objectively and clinically define a high-arched palate. This will allow surgeons to appropriately identify patients at risk of developing an ONF, allowing for appropriately informed consent and ability to compare studies within the medical literature.

Conclusion

This study suggests that TPA has a role in current sleep surgery paradigms. When performed in the appropriately selected patient, TPA can significantly improve both objective and subjective outcome measures of OSA. Surgeons contemplating TPA on patients with high-arched hard palates should do so with caution and consider altering the approach to a propeller rather than gothic arch incision, as well as forewarning their patients of the increased risk of developing a fistula.

Author Contributions

Lyndon Chan: Primary Author, collection of data, data analysis and interpretation, manuscript writing and final approval.
Leon Kitipornchai: collection of data, manuscript writing and final approval.
Stuart Mackay: Concept and design, provision of patients, manuscript writing and final approval.

Declaration of Conflicting Interests

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