Palatal Surgery

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5.1 Introduction

Surgery for adult obstructive sleep apnea (OSA) is part of a changing paradigm in management of what is a complex and morbid condition. Of historic interest, early surgical procedures focused primarily on ablating the palatal structures, intending to create physical space in the upper airway to facilitate breathing. Ikematsu described the first sleep procedure, the uvulopalatoplasty in 1964 [1], but the procedure only garnered popularity amongst surgeons worldwide after Fujita's 1981 publication [2], which detailed his extensive experience using a modification of the original technique. In the same year, Sullivan et al. [3] published a landmark paper introducing continuous positive airway pressure (CPAP) into the treatment of OSA. The role of surgery was then principally as a salvage option for individuals who failed CPAP.

In the subsequent decades, surgical techniques were refined. A variety of procedures, techniques and approaches have been described, each attempting to strike a balance between sufficiently altering the anatomic subsites involved in the individual's disease and avoiding the complications that arise from surgery to the airway, especially in the context of the OSA patient.

Critical to understanding the evolving role of surgery in OSA is an awareness of the interplay of anatomic and non-anatomic factors in the individual patient. Anatomic scoring systems have traditionally been used to predict which patients may improve with surgery, the most widely used of these are the Friedman [4] and Mallampati [5] classifications. However, improved outcomes following surgery are not wholly dependent upon anatomy. The concept of physiologic endo-phenotypes,

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based on the work of Eckert [6] and Malhotra, has challenged traditional descriptions of pathogenesis. Poor outcomes following surgery may occur because predictive tools based solely on anatomy fail to account for the non-anatomical factors in OSA, such as ventilatory control instability and arousal threshold [7]. What is not known is how these physiologic measures can be incorporated into a sound clinical assessment and whether surgery alters underlying physiology.

In the future, the challenge will be to provide individualized treatment, and, in the hands of the sleep surgeon, this means tailoring proven surgical procedures to the individual. There remains a pressing need for effective alternative therapies for OSA beyond CPAP and a need to develop predictive tools to identify those patients who would benefit best from the available surgical treatments.

5.2 Preoperative Evaluation

Patients with sleep-disordered breathing (SDB) should be evaluated by a dedicated sleep physician or surgeon. The evaluation should include taking a comprehensive history, a structured examination and polysomnography. Optimization of device use, such as CPAP or mandibular advancement splint, should be prioritized. Modifying lifestyle factors contributing to SDB including achieving a healthy weight, optimizing sleep hygiene, managing other sleep disorders such as insomnia and addressing associated medical issues are important.

Patients unable to maintain first-line treatment should be considered for surgical intervention. The choice of operation depends on patient, disease and surgeon factors. The challenge in decision-making is trying to apply effective procedures to the individual in the setting of patients who seek surgery as their preferred option.

Patients opting for surgery need to engage in a detailed discussion about the goals, the risks and benefits of surgery and the requirement for ongoing surveillance of their potentially chronic condition even after they have recovered from surgery.

Pre- and postoperative plans for management of the individual patient typically include medical management of blood pressure, analgesia and approaches to limit complications. Theatre and ward staff require specific training in the management of the surgical patient with OSA, including formalization of postoperative orders (albeit ones that are still flexible to the individual patient) and structured plans for a deteriorating patient.

5.3 Surgical Technique

5.3.1 Uvulopalatopharyngoplasty

Uvulopalatopharyngoplasty (UPPP) is the most widely used and researched procedure in OSA surgery [8]. Modifications to the original uvulopalatopharyngoplasty are the result of complications, such as difficulty swallowing, velopharyngeal insufficiency and phonatory change in up to 40–60% of patients [9, 10]. Severe complications are uncommon. *Reduction in the rate of complications likely reflects refinement in surgical technique*, with higher adverse events reported in studies published during the 1980s and lower frequencies in more recent decades [11]. Kezirian [12] published data on a large cohort of 3130 patients and reported mortality in 0.2% of patients and serious perioperative complications in 1.5%, results reproduced in other long-term studies [13, 14].

Early research was limited by the lack of high level trials, small numbers within trials, heterogeneity of the study groups and lack of consensus on what constituted surgical “success”. However, whilst these limitations are still challenging in sleep surgery literature, emerging evidence suggests that outcomes with modified UPPP may provide similar outcomes to CPAP in quality of life and mortality domains [15, 16]. The SKUP [17] trial randomized 65 consecutive patients with moderate to severe OSA into two groups: the surgical arm underwent UPPP variant surgery, and the control group had limited conservative management for 7 months. Both groups had AHI and other PSG parameters compared at baseline and at the end of the study. There was a mean reduction in AHI of 60% in the UPPP group compared with an 11% reduction in AHI in the control group, a highly significant and clinically relevant finding. Follow-up studies demonstrated improvement in daytime sleepiness, vigilance and quality of life [18]. Another randomized controlled trial (RCT) [19] of 42 patients with moderate to severe OSA who had failed CPAP comprised two groups: the surgical arm underwent UPPP, and the control group did not receive treatment. In the surgical arm, 97% of patients were satisfied with the outcome, there was a mean reduction in AHI of 54% (compared with 12% in the control group) and there was also improvement in snoring and daytime somnolence.

Contemporary modifications of uvulopalatoplasty involve opening of the superolateral velopharyngeal ports without resection of functional soft tissue. One such technique is demonstrated in Fig. 5.1 [20].

In this technique, superolateral ports are opened by accessing and removing lateral palatal space fat [21]. The lateral palatal space is bounded medially by the curving fibres of palatopharyngeus muscle, laterally by the superior constrictor muscle, inferiorly by the superior pole of the tonsil, medially and ventrally by the palatoglossus muscle and ventrally by the mucosa of the palate. After removal of fat in this space, tension on the palatal folds is eliminated by a relatively high division of the posterior pillar and muscle complex. The proximal part of the musculo-mucosal complex is then repositioned by suturing it to the soft tissue adjacent to the space created by fat removal, sometimes as high as the tensor veli palatini fascia at the hamulus.

Variations on this technique are well described. Cahali [22] outlined the importance of the muscular lateral pharyngeal wall in the pathogenesis of OSA and was the first to develop a technique designed to splint the lateral pharyngeal wall. Li [23] developed the Taiwanese relocation pharyngoplasty, involving advancement of the soft palate and splinting of the lateral pharyngeal wall.

Other authors, such as Woodson and Pang [24], describe patient-specific modifications according to individual anatomy and include repositioning of the lateral wall of the pharynx and closure of the palatal pillars after tonsillectomy in what is

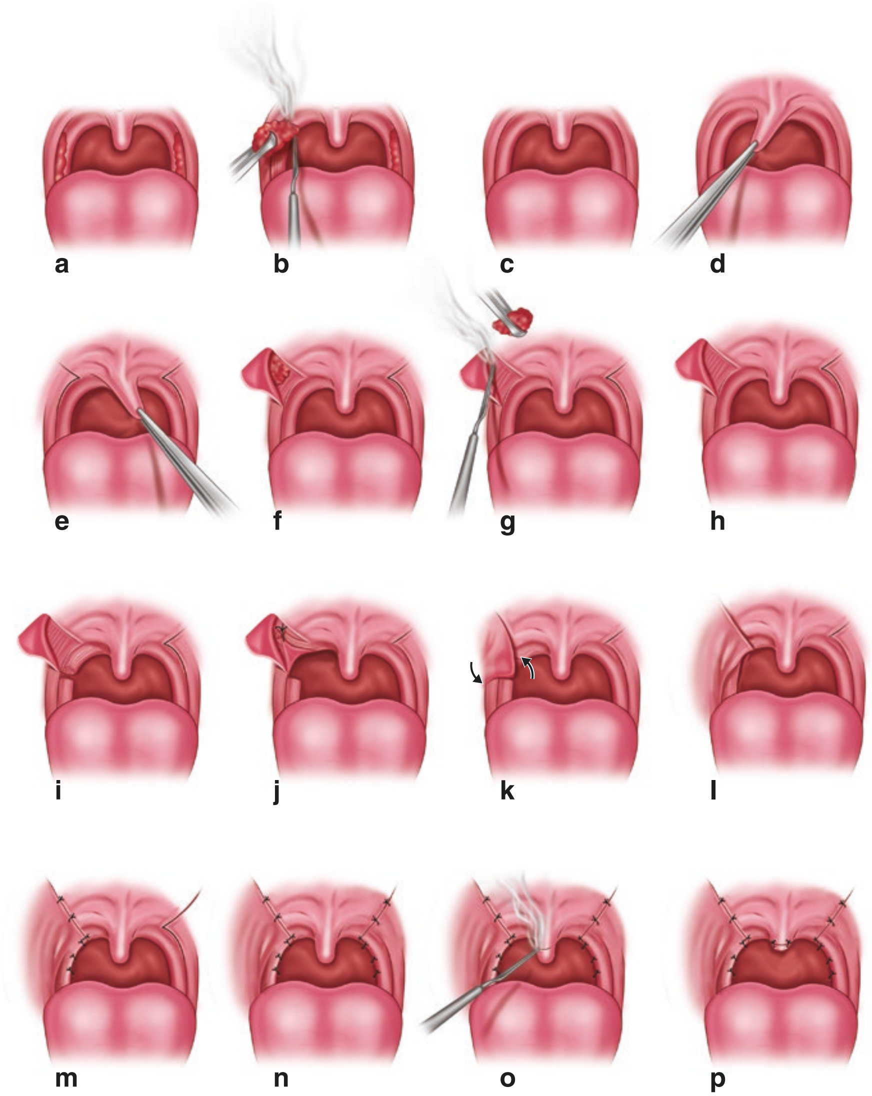

Fig. 5.1 Australian modified uvulopalatopharyngoplasty. (1) Resection of the tonsils, with preservation of pillar mucosa (**a**–**c**). (2) Traction on the uvula caudally while elevating a triangular flap of mucosa on each side as shown diagrammatically (**d**–**f**). (3) Resection of supratonsillar fat bilaterally (**g**). Demonstrating post-resection of supratonsillar fat (**h**). (4) Division of posterior pillar mucosa and musculature at the junction of upper third/lower two-thirds (**i**). (5) Suture advancement of the upper part of the posterior pillar musculature into the superolateral velopharyngeal port created in steps 2 and 3 using 2/0 Vicryl (**j**). (6) Closure of the overlying mucosa using 3/0 Vicryl (**k**–**n**). (7) Resection of approximately 50–75% of the uvula in a beveled fashion to create a neo-uvula (**o**, **p**)

referred to in the literature as expansion sphincteroplasty. The Woodson technique was adapted from Orticochea [25] and involves isolating the palatopharyngeus muscle, the main bulk of the lateral pharyngeal wall musculature, before rotating and repositioning this muscle to create lateral wall tension.

5.3.2 Tonsillectomy

The role of tonsillectomy alone in adults with OSA was the subject of a recent meta-analysis by Camacho et al. [26]. Seventeen studies were included for analysis. Success was defined as AHI <20/h and ≥50% reduction in AHI. This was achieved in over 85% of patients, with 57% achieving complete cure, defined as post-tonsillectomy AHI <5. Preoperative predictors of success included patients with large tonsils and AHI <30/h; therefore carefully selected patients for bilateral tonsillectomy alone is the key.

5.3.3 Resective/Ablative Techniques

The earliest techniques involved resection of the uvula and soft palate tissue [27]. Kamami [28] described laser-assisted uvulopalatoplasty (LAUP), an in-office procedure, with the patient in a seated position and performed under local anaesthesia. Its introduction was based on encouraging but limited short-term data [29]. Camacho [30] published a recent meta-analysis of longer-term data demonstrating poor success rates in OSA and worsening of the RDI or AHI in 44% of patients and concluded that the **LAUP be performed with caution or, preferably, not at all**. The provision of LAUP in Australia has had a marked decline in relative and absolute numbers [31], reflecting contemporary opinion that LAUP should be abandoned.

5.3.4 Stiffening Procedures

Pillar implants are designed to stiffen the palatal tissue involved in snoring to prevent vibration during breathing by inducing a local inflammatory response that creates fibrosis. Several studies [32–36] have assessed clinical effectiveness and efficacy, including one randomized, double-blind, sham surgery controlled trial by Friedman [37]. Overall, the authors of these studies reported significant but modest improvements in AHI in the context of mild OSA [35] and a reduction in snoring intensity and frequency [33, 34]. The technique is reportedly attractive for patients not willing to undergo traditional surgical correction [33]. However there is a risk of implant extrusion or awareness of the implant, with complication rates as high as 20%, particularly in women and those who undergo the procedure under general anaesthesia [37].

Other techniques, such as suturing, injection and radio frequency, designed to stiffen the soft palate, have been reported, and techniques continue to evolve. However, whilst these procedures are reported to be low-risk in-office procedures, it is not clear how effective they are in the long term. In a 6-year follow-up study on radio frequency of the soft palate for SDB [38], relapse of snoring was seen in nearly all of the 97% (74/77) of patients. Application of sutures to the soft palate to shorten, conglomerate and tense the tissue has been described, such as by Hur in 2008 [39], and also more recent variations in type and technique [40–42]. Injection snoreplasty involves a sclerosant directly infiltrated into the submucosal layer of the soft palate [43, 44]. Brietzke [45] reported reduction in subjective snoring "success rates" from 92 to 75% at a mean of 19-month follow-up.

5.3.5 Transpalatal Advancement

Transpalatal advancement (TPA) was described by Woodson in 1993 [46]. It is an adjunct to (modified) UPPP with the goal of increasing the volume of the velopharynx by removing the bone of the hard palate to facilitate fixation of the soft palate in an anterior position.

Two main incisional approaches to the hard palate bone have been described: the gothic arch incision [46] and the propeller incision [47]. Both give broad exposure to the hard palate, and the mucosal flaps raised are then elevated posteriorly over the palatine aponeurosis. The bone of the posterior part of the hard palate is then removed. The original description outlined removal of the entire posterior part of the hard palate, detaching the soft tissue from the bone centrally. A further modification was described, where a 2–3 mm strip of bone remained posteriorly, creating a bone island. Palate bone anterior to this is removed to create space into which the remaining island of tissue is advanced [46]. Division of the tensor veli palatini tendon laterally and pre-levator fascial fibres medially allows this tissue to be mobilized. The bone is secured with sutures passed through the anterior hard palate and back around the bone and soft tissue advancement flap. The mucosal flaps are approximated.

The cleft palate literature provides insights into palatal bone healing [48]. Understanding the factors contributing to healing is crucial because of the small but clinically significant risk of oronasal fistula. A robust soft tissue flap may allow the underlying bony anastomosis to heal, and, conversely, a poor soft tissue flap may compromise healing and result in oronasal fistula. Shine and Lewis reported a difference in flap survival between the traditional Gothic arch and the propeller incisions [47], and prevailing opinion holds that different flaps may be chosen for different arch heights of the palate. A recent systematic review and meta-analysis [49] examined the clinical efficacy of TPA in terms of AHI and lowest oxygen saturation. In the review, studies were excluded if concurrent surgeries for other levels of obstruction were performed at the same time. AHI and lowest oxygen saturation were improved with TPA: AHI reduced from 54.6 ± 23 preoperatively to 19.2 ± 16.8 postoperatively, and lowest oxygen saturation improved from 81.9 ± 8.1 preoperatively to 85.4 ± 6.9 postoperatively. Others, in concurrent surgical procedures excluded from analysis, have used this as a common component of multilevel airway surgery [50, 51].

5.4 Postoperative Complications

Common occurrences after palatal surgery in OSA include pain (usually managed with regular acetaminophen-based analgesia and other breakthrough pain relievers and steroids) and bleeding (similar incidence to tonsillectomy, when included with palatal surgery). In addition, procedure specific complications such as velopalatal insufficiency or VPI have a documented transient incidence—it occurs permanently only **very rarely** outside of the setting of "old style" ablative surgeries or revision operations. Oronasal fistula is the main operation specific concern in transpalatal advancement, and has been discussed by Shine and Lewis [47]. Management is usually conservative and includes dental-made temporary upper plate and rarely surgical closure.

In the Kezirian cohort [12], the authors identified three main risk factors for complications. These were increased body mass index (BMI), OSA severity (in that study, denoted by higher AHI) and comorbid disease. Other factors to consider are age and bleeding dyscrasias.

5.5 Future Directions and Summary

Despite the difficulties in running RCTs [52] and synthesizing the data into recommendations which can be applied to real-world practice, the application of future surgical therapies will need to be guided by high-level evidence. This will allow stratification of patients according to their individual anatomy and physiology and provide the basis for patient education. Within the next year, data form the Australian RCT comparing modified UPPP and coblation (radiofrequency in saline medium) tongue channeling with conservative treatment following device failure, will be available.

Currently the evidence supports a measured approach, incorporating careful patient and procedure selection and implementation of reconstructive palatal techniques, in order to achieve desirable outcomes in symptom and disease control.

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