Special Article

Minimally Invasive Palatal Surgery for Obstructive Sleep Apnea

Jarinratn Sirirattanapan MD*

** Department of Otolaryngology, Faculty of Medicine, Srinakarinwirot University, Nakhon Nayok, Thailand*

Obstructive sleep apnea (OSA) is a common condition in Thai population characterized by recurrent episodes of apnea during sleep. Patients may have detrimental consequences and the management of OSA is complex and challenging. Many patients respond to medical treatments including weight loss, body position training, oral appliances and continuous positive airway pressure (CPAP). Although medical intervention fails, surgical procedure is the alternative options to improve the upper airway patency. Many palatal surgical procedures have been introduced to alleviate upper airway obstruction. However, most procedures are invasive, destructive, painful, also associated with significant morbidity. Recently, minimally invasive surgery also achieves the same results as the invasive procedures with less postoperative risks. The treatment outcomes have now been validated by many centers in appropriately selected patients. The types, results and complications of the procedures are reviewed.

Keywords: *Obstructive sleep apnea, Minimally invasive palatal surgery, Palatal implants, Palatal suspension, Uvulopalatopharyngoplasty*

J Med Assoc Thai 2013; 96 (Suppl. 1): S108-S114
Full text. e-Journal: *http://jmat.mat.or.th*

Obstructive sleep apnea (OSA) is a common condition characterized by recurrent episodes of upper airway obstruction. It results from the combination of a structurally small or narrowing upper airway (i.e. part of the velopharynx, oropharynx, or hypopharynx) and abnormal airway collapsibility[1-3]. The common features of OSA are present in daytime sleepiness and disruption of sleep due to increased ventilation effort in response to upper airway collapse[4-6]. Approximately 1 in 5 adults has at least mild OSA (apnea-hypopnea index [i.e. the number of apnea and hypopnea events per hour][6-16]. In this population, 1 in 15 patients has at least moderated OSA (apnea-hyponea index)[16-31]. The prevalence of OSA in Thailand is estimated to be 5% in men and 2% in women[32]. Clinical features of OSA include snoring, pause of breathing, fatigue, nocturnal or morning headaches, reduced concentration, mood disorders, hypersomnolence and excessive sleepiness[33,34]. OSA is a potentially life threatening medical disorder, associate with metabolic syndrome and also with cardiovascular disease[35-39]. Patients with untreated OSA may have detrimental consequences including cardiovascular morbidity and mortality, decreased health-related quality of life and increased incidence of motor vehicle accidents[40,41]. The management of OSA is complex and challenging. Many patients respond to medical treatments with weight loss, body position training for sleep, avoidance of alcohol and sedative medicine, oral appliances and continuous positive airway pressure (CPAP). When medical intervention fails, surgical option is the alternative[42].

Correspondence to:
Sirirattanapan J, Department of Otolaryngology, Faculty of Medicine, Srinakarinwirot University, Ongkharak, Nakhon Nayok 26120, Thailand.
Phone: 037-395-085, Fax: 037-393-087
E-mail: jeed9000@yahoo.co.th

Minimally invasive palatal surgery

Surgical intervention becomes a more viable option for such patients, improving upper airway patency by either actively opening the airway, removing anatomical obstructions, stiffening the pharyngeal wall, increasing its muscle tone, a combination there of or bypassing the collapsible segment[43]. Since the introduction of uvulopalatopharyngoplasty (UPPP) many palatal surgical procedures have been introduced to alleviate upper airway obstruction in patients with OSA[44]. Palatal surgery is now the largest, established surgical approach to OSA[45]. This procedure is effective and safe[46]. However, most procedures to reduce upper airway obstruction are invasive, destructive, painful, and associated with a significant morbidity[47-49]. Recently, minimally invasive surgeries

also achieved the same results as the invasive procedures but with less postoperative discomfort, less risk of developing velopalatal insufficiency and fewer complaints of a thickened secretion or foreign body sensation. The treatment outcomes have now been validated by many centers in appropriately selected patients. The criteria for minimally invasive surgery include a procedure under local anesthesia, low perioperative morbidity, an outpatient procedure or a low postoperative morbidity[50,51]. The aim of this paper is to review the new types of surgeries, the outcomes and the complications.

Modified uvulopalatopharyngoplasty with uvula preservation

The aim of modified uvulopalatopharyngoplasty with uvula preservation or H-uvulopalatopharyngoplasty (H-UPPP) is to reduce the UPPP complication rate without compromising the surgical response[52,53]. Han[52] designed a new method, in which the uvula is preserved whereas a larger portion of the soft palate is removed. This was widely used in China and has been proved to be effective method. It is performed under general anesthesia with nasotracheal intubation. Bilateral tonsillectomy is done and the redundant bilateral pharyngeal mucosa and submucosal tissue are trimmed or resected to enlarge the oropharyngeal lumen. Two inverted V-shape incisions are made on the ventral surface of the soft palate, along both sides of the uvula. The response rate of H-UPPP is 51.9% to 69.1%, defined as a > 50% reduction of the AHI or AHI < 20 per hour postoperatively[52]. Complications include bleeding, airway obstruction and velopharyngeal insufficiency in minority of cases. Contraindications include acute tonsillitis, evident risk factors of general anesthesia, tendency to developing scar, unstable cardiovascular status and chronic obstructive pulmonary disease. Relative contraindications include severe hypoxia, special demands on phonation, morbid obesity, older than 65 or younger than 18 years old[52].

Cautery-assisted palatal stiffening operation

The procedure is designed to create scar and fibrosis on the soft palate and performed for mild obstructive sleep apnea. This was first introduced by Ellish[54], improved by Mair[55] and modified by Pang[56]. It is done under local anesthesia on an outpatient basis. Vertical cuts on both sides of the uvula and uvulectomy are performed. A horizontal rectangular strip about 7 mm in width by 50 mm in length of mucosa is removed down to the muscle of the soft palate and the edges are approached with Vicryl 3/0 suture. With the healing process, superior retraction and fibrosis of the soft palate result in a larger oropharyngeal airway. Pang et al[56] showed the AHI improved from 25.3 to 11 events/hour in 39 patients and the lowest oxygen saturation also improved in all patients. The overall success rate was 71.8 percent at mean 33.5 months. Complications are rare which include bleeding, dry throat, velopharyngeal incompetence, fistula and nasopharyngeal stenosis[56].

Uvulopalatal flap (UPF)

UPF procedure was introduced by Powell[57] and performed under general anesthesia, subsequently; this was modified to perform under local anesthesia[58,59]. The procedure provides the same anatomic results as the UPPP but with less postoperative pain, less risk of developing velopharyngeal insufficiency and fewer complaints of foreign body sensation. The excess palate and uvula are tacked up to the remaining function palate. If the reduction is too extreme, the flap could be released in the postoperative period. This procedure is reversible. It is performed with patient sitting upright and the soft palate is anesthetized with lidocaine 10% topical dispersion and 1% lidocaine with adrenaline of 4 mL is additionally injected at the midline of the soft. The mucosa, submucosa with glands and fat on the lingual surface of the uvula and soft palate are removed with a scalpel. The uvular tip is amputated and bleeding is controlled with electrocoagulation. The uvula is reflected back toward the soft palate and fixed into its new position with multiple sutures of absorbable Vicryl 4/0. The reposition and stabilization of the uvula on the soft palate are responsible for a wide opening of the retropalatal airway space and decreasing the airway resistance. UPF literature showed that short-term improvements between 3 to 12 months after surgery in OSA occurred in 52% to 100%[57-60]. Neruntarat showed that the non-responders had significantly higher preoperative BMI and AHI than the responders, 52% patients had long-term clinical success and 26% patients with short-term success failed in the long-term. However, there were no obvious factors that predicted the recurrence of OSA after the UPF procedure[61]. There are no serious complications in this procedure which include minor bleeding, transient nasal regurgitation, taste disturbance, dysphagia and foreign body sensation.

Palatal implants

The palatal implants induce the stiffening of

the soft palate and increase the upper airway stability with minimal pain and complications. The procedure is performed under local anesthesia as an outpatient basis[62,63]. A patient is in sitting position and three polyester implants are placed into the soft palate inferiorly to the soft and the hard palate junction. The first implant is inserted in the midline while the others are inserted 2 mm to each side of the midline. After the procedure, patient is observed for 10-20 min. Post-operative medications include antibiotic for 7 days and acetaminophen elixir and/or anesthetic lozenges as needed for pain relief. The procedure is less invasive and reversible and the implant is made of polyethylene terephthalate, which has been used in implantable medical devices[64-66]. The response is characterized by a chronic inflammatory, fibrous capsule formation and granulomatous tissue with an intercellular matrix infiltration. This results in the encapsulation of the implant and it remains intact for the life of the biomaterial[67]. The implants and the fibrotic response provide structural support to and stiffen the soft palate. These reduce the palatal tissue collapse that can obstruct the upper airway and cause OSA. The inserts stiffen and support the tissue of the soft palate and reduce upper airway collapse. Subsequently, this has been widely adopted and performed in conjunction with other procedures[68,69]. It has been shown that short-term improvement in OSA occurred in 26-63%[62,63,68,69] and the long-term in 47.3-52.2% after follow-up for at least 1 year to 2 years[70-72]. The responders had significantly lower preoperative BMI, AHI and MMP level than non-responders[72]. There were no serious complications after the procedure. Patients who undergo palatal implants may experience extrusion at a rate of 2-8%[63,70] and palatal abscess which were resolved without consequence. Palatal implants in carefully selected patients with mild OSA, provide fairly good long-term results, however, a regular follow-up is important because an increase in the thickness of the soft palate would be expected. This should consequently lead to a narrower nasopharyngeal opening, followed by increased obstruction.

Palatal suspension

Palatal suspension (PS) introduced by Neruntarat[73] provides the enlargement of the retropalatal area because the soft palate is suspended anteriorly to the hard palate. The excessive palate and uvula are tacked up to open the airway. If the tension is too extreme, the suspension could be released during the operative period. It does not put the airway at risk and it appears to be a safe and effective procedure for OSA with palatal obstruction. The patient is in Rose position under general anesthesia with nasotracheal intubation. A palatal incision begin at the central hard palate posterior to the alveolus approximately 2 cm anterior to posterior border of the hard palate and continued posteriorly in a curvilinear fashion. A mucoperiosteal flap is elevated exposing the hard palate and the proximal part of the soft palate. Bleeding could be controlled with suction electrocautery and Nylon suture (3-0) is passed submucosally beginning from the flap to an exit hole at the base of the uvula. The suture is then passing back through its exit site and across the base of the uvula to the opposite side. The needle is passed back to the flap in the same manner. Palatal trench is performed on hard palate with drill as inverted U shape and the soft palate is mobilized using steady anterior traction and the suture is tied. This should not be too rigid and a small dimple should be palpated in the base of the uvula and the knot is buried in the trench under the flap sutured with an absorbable material. Based on the criteria that the AHI decreased more than 50% from the baseline and the final AHI was less than twenty, 64% (15 of 25) of PS patients and 65.4% (17 of 26) of uvulopalatopharyngoplasty patients achieved a surgical response. There was no statistically significant difference between the groups when comparing the surgical results. Data collected from VAS showed the discomfort to be worst a few days postoperatively and nearly resolved by postoperative day 7 in PS group and day 10 in UPPP group, respectively. Bleeding, airway obstruction, infection, and extrusion of suture material were not encountered. This technique is minimally invasive procedure thus swallowing problem and swelling are minimal and transient. The ability to reverse the procedure is an advantage leaving no change in anatomy despite failure of the procedure. PS procedure provides the same results as UPPP, but with less postoperative pain, less risk of developing velopharyngeal insufficiency, fewer complaints of foreign body sensation and time saving. PS is easily and effectively performed with low chance of significant pain and complications comparable with UPPP. One minimal invasive UPPP for treated OSA in which reported by Melder, the procedure combined palatal ablation and suspension suture technique; PASS technique. The procedure was used to treat the palatal component of obstruction for OSA. Palatal ablation was performed. Four compartments, submucosal, periosteal based sutures were placed from the hard palate to the palatopharyngeus muscle and

free bilateral edges of the soft palate. Gentle tension resulted in widening of the palate. Results of PASS technic was used for the palatal component to treat mild apnea or multilevel surgery for moderate to severe OSA. This procedure was approximately 7.5 mm advancement bilateral of palate at palatal arches. PASS procedures for mild apnea resulted in palatal stiffening and significant relieve palatal obstruction. Post-operative the polysomnography was performed and the results shown 70% reduction in RDI. These procedures were marked the mucosal sparing technic resulted in no complication of velopharyngeal insufficience[74]. Long-term follow-up is recommended for both technics because some initially successfully treated patients will relapse in the long term.

Radiofrequency of soft palate

Radiofrequency (RF) procedure described by Powell et al[75] is undertaken to stiffen the pharyngeal tissue, enlarge the upper airway and decrease the airway resistance without cutting the tissue. Electro-surgical energy is conducted to reduce the volume of the palatal tissue by producing coagulation necrosis and healing by scar formation and musculature contraction. The soft palate is anesthetized with lidoocaine 10% topical dispersion and 5 to 10 ml lidocaine 1% with adrenaline solution was additionally injected. This procedure is performed with the patients sitting upright. The mid portion of the palate from the uvular base to the posterior nasal spine was selected for treatment. The needle electrode is inserted midline and paramedian in the soft palate in each treatment session. RF energy is applied for 300 watts for each site. The tissue adjacent to the unprotected portion of the needle underwent ablation while the overlying mucosa is left intact. The procedure is performed in stages with at least 2 weeks between the treatments. RF literature showed that short-term improvements in OSA occurred in 17 to 66% for RF palatal reduction[75-77]. It has been showed that the non-responders had significantly higher pre-operative BMI and AHI than the responders. In the long-term study, there were significant differences between short-term and long-term results. Forty-six percent of patients had long-term success and 16.7 percent of patients with short-term success failed in long-term. There are no serious complications after the procedure which include transient aspiration, dysphagia and swelling floor of mouth[78]. A regular follow-up with recommen-0dation concerning weight control is also important for preventing a relapse.

Conclusion

Minimally invasive palatal procedure is easily and effectively performed with low chance of significant pain and complications in properly selected OSA patients. Long-term follow-up is recommended because some initially successfully treated patients will relapse in the long term.

Potential conflicts of interest

None.

References

1. Hudgel DW. Mechanisms of obstructive sleep apnea. Chest 1992; 101: 541-9.
2. Bonsignore MR, Marrone O, Insalaco G, Bonsignore G. The cardiovascular effects of obstructive sleep apnoeas: analysis of pathogenic mechanisms. Eur Respir J 1994; 7: 786-805.
3. Shepard JW Jr, Thawley SE. Localization of upper airway collapse during sleep in patients with obstructive sleep apnea. Am Rev Respir Dis 1990; 141: 1350-5.
4. American Sleep Disorders Association. Obstructive sleep apnea syndrome. In: The international classification of sleep disorders: diagnostic and coding manual. 2nd ed. Westchester, IL: American Academy of Sleep Medicine; 1990: 52-8.
5. Gould GA, Whyte KF, Rhind GB, Airlie MA, Catterall JR, Shapiro CM, et al. The sleep hypopnea syndrome. Am Rev Respir Dis 1988; 137: 895-8.
6. Guilleminault C, Stoohs R, Clerk A, Cetel M, Maistros P. A cause of excessive daytime sleepiness. The upper airway resistance syndrome. Chest 1993; 104: 781-7.
7. Young T, Peppard PE, Gottlieb DJ. Epidemiology of obstructive sleep apnea: a population health perspective. Am J Respir Crit Care Med 2002; 165: 1217-39.
8. Hoffstein V, Mateika S. Cardiac arrhythmias, snoring, and sleep apnea. Chest 1994; 106: 466-71.
9. Javaheri S, Parker TJ, Liming JD, Corbett WS, Nishiyama H, Wexler L, et al. Sleep apnea in 81 ambulatory male patients with stable heart failure. Types and their prevalences, consequences, and presentations. Circulation 1998; 97: 2154-9.
10. Javaheri S. Central sleep apnea-hypopnea syndrome in heart failure: prevalence, impact, and treatment. Sleep 1996; 19 (10 Suppl): S229-31.
11. Somers VK, Dyken ME, Mark AL, Abboud FM. Sympathetic-nerve activity during sleep in normal

subjects. N Engl J Med 1993; 328: 303-7.
12. Tilkian AG, Guilleminault C, Schroeder JS, Lehrman KL, Simmons FB, Dement WC. Hemodynamics in sleep-induced apnea. Studies during wakefulness and sleep. Ann Intern Med 1976; 85: 714-9.
13. Somers VK, Dyken ME, Clary MP, Abboud FM. Sympathetic neural mechanisms in obstructive sleep apnea. J Clin Invest 1995; 96: 1897-904.
14. Sajkov D, Cowie RJ, Thornton AT, Espinoza HA, McEvoy RD. Pulmonary hypertension and hypoxemia in obstructive sleep apnea syndrome. Am J Respir Crit Care Med 1994; 149: 416-22.
15. Shiomi T, Guilleminault C, Stoohs R, Schnittger I. Leftward shift of the interventricular septum and pulsus paradoxus in obstructive sleep apnea syndrome. Chest 1991; 100: 894-902.
16. Stoohs R, Guilleminault C. Cardiovascular changes associated with obstructive sleep apnea syndrome. J Appl Physiol 1992; 72: 583-9.
17. Virolainen J, Ventila M, Turto H, Kupari M. Effect of negative intrathoracic pressure on left ventricular pressure dynamics and relaxation. J Appl Physiol 1995; 79: 455-60.
18. White SG, Fletcher EC, Miller CC 3rd. Acute systemic blood pressure elevation in obstructive and nonobstructive breath hold in primates. J Appl Physiol 1995; 79: 324-30.
19. Bradley TD. Right and left ventricular functional impairment and sleep apnea. Clin Chest Med 1992; 13: 459-79.
20. Morgan BJ, Denahan T, Ebert TJ. Neurocirculatory consequences of negative intrathoracic pressure vs. asphyxia during voluntary apnea. J Appl Physiol 1993; 74: 2969-75.
21. Somers VK, Dyken ME, Skinner JL. Autonomic and hemodynamic responses and interactions during the Mueller maneuver in humans. J Auton Nerv Syst 1993; 44: 253-9.
22. Morgan BJ, Crabtree DC, Puleo DS, Badr MS, Toiber F, Skatrud JB. Neurocirculatory consequences of abrupt change in sleep state in humans. J Appl Physiol 1996; 80: 1627-36.
23. Teran-Santos J, Jimenez-Gomez A, Cordero-Guevara J. The association between sleep apnea and the risk of traffic accidents. Cooperative Group Burgos-Santander. N Engl J Med 1999; 340: 847-51.
24. Lindberg E, Carter N, Gislason T, Janson C. Role of snoring and daytime sleepiness in occupational accidents. Am J Respir Crit Care Med 2001; 164: 2031-5.
25. Spiegel K, Leproult R, Colecchia EF, L'Hermite-Baleriaux M, Nie Z, Copinschi G, et al. Adaptation of the 24-h growth hormone profile to a state of sleep debt. Am J Physiol Regul Integr Comp Physiol 2000; 279: R874-R883.
26. Spiegel K, Leproult R, Van Cauter E. Impact of sleep debt on metabolic and endocrine function. Lancet 1999; 354: 1435-9.
27. Leproult R, Copinschi G, Buxton O, Van Cauter E. Sleep loss results in an elevation of cortisol levels the next evening. Sleep 1997; 20: 865-70.
28. Shearer WT, Reuben JM, Mullington JM, Price NJ, Lee BN, Smith EO, et al. Soluble TNF-alpha receptor 1 and IL-6 plasma levels in humans subjected to the sleep deprivation model of spaceflight. J Allergy Clin Immunol 2001; 107: 165-70.
29. Irwin M. Effects of sleep and sleep loss on immunity and cytokines. Brain Behav Immun 2002; 16: 503-12.
30. Redwine L, Hauger RL, Gillin JC, Irwin M. Effects of sleep and sleep deprivation on interleukin-6, growth hormone, cortisol, and melatonin levels in humans. J Clin Endocrinol Metab 2000; 85: 3597-603.
31. Narkiewicz K, van de Borne PJ, Cooley RL, Dyken ME, Somers VK. Sympathetic activity in obese subjects with and without obstructive sleep apnea. Circulation 1998; 98: 772-6.
32. Neruntarat C, Chantapant S. Prevalence of sleep apnea in HRH Princess Maha Chakri Srinthorn Medical Center, Thailand. Sleep Breath 2011; 15: 641-8.
33. Strumpf DA, Millman RP, Hill NS. The management of chronic hypoventilation. Chest 1990; 98: 474-80.
34. Reynolds CF 3rd, Kupfer DJ, Taska LS, Hoch CC, Sewitch DE, Restifo K, et al. Sleep apnea in Alzheimer's dementia: correlation with mental deterioration. J Clin Psychiatry 1985; 46: 257-61.
35. Gami AS, Somers VK. Obstructive sleep apnoea, metabolic syndrome, and cardiovascular outcomes. Eur Heart J 2004; 25: 709-11.
36. Lett HS, Blumenthal JA, Babyak MA, Sherwood A, Strauman T, Robins C, et al. Depression as a risk factor for coronary artery disease: evidence, mechanisms, and treatment. Psychosom Med 2004; 66: 305-15.
37. Indications and standards for use of nasal continuous positive airway pressure (CPAP) in sleep apnea syndromes. American Thoracic

Society. Official statement adopted March 1944. Am J Respir Crit Care Med 1994; 150: 1738-45.
38. Young T, Palta M, Dempsey J, Skatrud J, Weber S, Badr S. The occurrence of sleep-disordered breathing among middle-aged adults. N Engl J Med 1993; 328: 1230-5.
39. Rosen RC, Rosekind M, Rosevear C, Cole WE, Dement WC. Physician education in sleep and sleep disorders: a national survey of U.S. medical schools. Sleep 1993; 16: 249-54.
40. Partinen M, Guilleminault C. Daytime sleepiness and vascular morbidity at seven-year follow-up in obstructive sleep apnea patients. Chest 1990; 97: 27-32.
41. Kales A, Caldwell AB, Cadieux RJ, Vela-Bueno A, Ruch LG, Mayes SD. Severe obstructive sleep apnea—II: Associated psychopathology and psychosocial consequences. J Chronic Dis 1985; 38: 427-34.
42. Park JG, Ramar K, Olson EJ. Updates on definition, consequences, and management of obstructive sleep apnea. Mayo Clin Proc 2011; 86: 549-54.
43. Neruntarat C. Obstructive sleep apnea. Bangkok: Vacharin; 2003.
44. Fujita S, Conway W, Zorick F, Roth T. Surgical correction of anatomic azbnormalities in obstructive sleep apnea syndrome: uvulopalatopharyngoplasty. Otolaryngol Head Neck Surg 1981; 89: 923-34.
45. Zodpe P, Cho JG, Kang HJ, Hwang SJ, Lee HM. Efficacy of sucralfate in the postoperative management of uvulopalatopharyngoplasty: a double-blind, randomized, controlled study. Arch Otolaryngol Head Neck Surg 2006; 132: 1082-5.
46. Lundkvist K, Januszkiewicz A, Friberg D. Uvulopalatopharyngoplasty in 158 OSAS patients failing non-surgical treatment. Acta Otolaryngol 2009; 129: 1280-6.
47. Nikanne E, Virtaniemi J, Aho M, Kokki H. Ketoprofen for postoperative pain after uvulopalatopharyngoplasty and tonsillectomy: two-week follow-up study. Otolaryngol Head Neck Surg 2003; 129: 577-81.
48. Troell RJ, Powell NB, Riley RW, Li KK, Guilleminault C. Comparison of postoperative pain between laser-assisted uvulopalatoplasty, uvulopalatopharyngoplasty, and radiofrequency volumetric tissue reduction of the palate. Otolaryngol Head Neck Surg 2000; 122: 402-9.
49. Sher AE, Schechtman KB, Piccirillo JF. The efficacy of surgical modifications of the upper airway in adults with obstructive sleep apnea syndrome. Sleep 1996; 19: 156-77.
50. Maurer JT. Update on surgical treatments for sleep apnea. Swiss Med Wkly 2009; 139: 624-9.
51. Neruntarat C. Minimally invasive surgery for obstructive sleep apnea. Bangkok: Vacharin; 2011.
52. Han D, Ye J, Lin Z, Wang J, Wang J, Zhang Y. Revised uvulopalatopharyngoplasty with uvula preservation and its clinical study. ORL J Otorhinolaryngol Relat Spec 2005; 67: 213-9.
53. Yang H, Wang Y, Dong M. Effect of H-uvulopalatopharyngoplastyon endothelium dependent flow-mediated dilation in patients with moderate to severe obstructive sleep apnea syndrome. Lin Chung Er Bi Yan Hou Tou Jing Wai Ke Za Zhi 2012; 26: 402-3, 407.
54. Ellis PD. Laser palatoplasty for snoring due to palatal flutter: a further report. Clin Otolaryngol Allied Sci 1994; 19: 350-1.
55. Mair EA, Day RH. Cautery-assisted palatal stiffening operation. Otolaryngol Head Neck Surg 2000; 122: 547-56.
56. Pang KP, Terris DJ. Modified cautery-assisted palatal stiffening operation: new method for treating snoring and mild obstructive sleep apnea. Otolaryngol Head Neck Surg 2007; 136: 823-6.
57. Powell N, Riley R, Guilleminault C, Troell R. A reversible uvulopalatal flap for snoring and sleep apnea syndrome. Sleep 1996; 19: 593-9.
58. Neruntarat C. Uvulopalatal flap for snoring on an outpatient basis. Otolaryngol Head Neck Surg 2003; 129: 353-9.
59. Neruntarat C. Uvulopalatal flap for obstructive sleep apnea on an outpatient basis. IMJ 2002; 9: 45-9.
60. Li HY, Li KK, Chen NH, Wang PC. Modified uvulopalatopharyngoplasty: The extended uvulopalatal flap. Am J Otolaryngol 2003; 24: 311-6.
61. Neruntarat C. Uvulopalatal flap for obstructive sleep apnea: short-term and long-term results. Laryngoscope 2011; 121: 683-7.
62. Nordgard S, Stene BK, Skjostad KW. Soft palate implants for the treatment of mild to moderate obstructive sleep apnea. Otolaryngol Head Neck Surg 2006; 134: 565-70.
63. Goessler UR, Hein G, Verse T, Stuck BA, Hormann K, Maurer JT. Soft palate implants as a minimally invasive treatment for mild to moderate obstructive sleep apnea. Acta Otolaryngol 2007; 127: 527-31.
64. Peyman GA, Koziol JE. Intraocular lens fixation

with dacron. J Am Intraocul Implant Soc 1978; 4: 192-6.
65. Palmaz JC. Review of polymeric graft materials for endovascular applications. J Vasc Interv Radiol 1998; 9: 7-13.
66. von Recum AF. Applications and failure modes of percutaneous devices: a review. J Biomed Mater Res 1984; 18: 323-36.
67. Tilney NL, Boor PJ. Host response to implanted dacron grafts. A comparison between mesh and velour. Arch Surg 1975; 110: 1469-72.
68. Friedman M, Lin HC, Gurpinar B, Joseph NJ. Minimally invasive single-stage multilevel treatment for obstructive sleep apnea/hypopnea syndrome. Laryngoscope 2007; 117: 1859-63.
69. Friedman M, Schalch P, Joseph NJ. Palatal stiffening after failed uvulopalatopharyngoplasty with the Pillar Implant System. Laryngoscope 2006; 116: 1956-61.
70. Nordgard S, Hein G, Stene BK, Skjostad KW, Maurer JT. One-year results: palatal implants for the treatment of obstructive sleep apnea. Otolaryngol Head Neck Surg 2007; 136: 818-22.
71. Walker RP, Levine HL, Hopp ML, Greene D. Extended follow-up of palatal implants for OSA treatment. Otolaryngol Head Neck Surg 2007; 137: 822-7.
72. Neruntarat C. Long-term results of palatal implants for obstructive sleep apnea. Eur Arch Otorhinolaryngol 2011; 268: 1077-80.
73. Neruntarat C. Palatal suspension and uvulopalatopharyngoplasty for obstructive sleep apnea. IMJ 2010; 17: 54-9.
74. Meldere PC. PASS Palatal ablation and suspension suture technique: A Novel minimally invasive UPPP. Otolaryngol Head Neck Surg 2011; 145(2 Suppl): P132.
75. Powell NB, Riley RW, Troell RJ, Li K, Blumen MB, Guilleminault C. Radiofrequency volumetric tissue reduction of the palate in subjects with sleep-disordered breathing. Chest 1998; 113: 1163-74.
76. Blumen MB, Dahan S, Fleury B, Hausser-Hauw C, Chabolle F. Radiofrequency ablation for the treatment of mild to moderate obstructive sleep apnea. Laryngoscope 2002; 112: 2086-92.
77. Woodson BT, Nelson L, Mickelson S, Huntley T, Sher A. A multi-institutional study of radiofrequency volumetric tissue reduction for OSAS. Otolaryngol Head Neck Surg 2001; 125: 303-11.
78. Neruntarat C, Chantapant S. Radiofrequency surgery for the treatment of obstructive sleep apnea: short-term and long-term results. Otolaryngol Head Neck Surg 2009; 141: 722-6.

การผ่าตัดชนิด minimally invasive palatal surgery ในผู้ป่วยโรคหยุดหายใจขณะหลับ

จรินรัตน์ ศิริรัตนพันธ

โรคหยุดหายใจขณะหลับจากการอุดกั้นพบได้บ่อยในคนไทย ผู้ป่วยมีการอุดกั้นทางเดินหายใจช่วงบนเป็นระยะๆ ขณะหลับ เกิดโรคแทรกซ้อนที่เป็นอันตรายหลายอย่างตามมา การรักษาโรคมีความซับซ้อนและท้าทาย ผู้ป่วยตอบสนองต่อการรักษาวิธีอนุรักษ์ ได้แก่ การลดน้ำหนัก ฝึกการนอนตะแคง การใช้เครื่องมือทางทันตกรรม และการใช้เครื่องอัดอากาศ เมื่อการรักษาวิธีอนุรักษ์ไม่ได้ผลในผู้ป่วยบางคน การรักษาด้วยวิธีผ่าตัดเป็นอีกทางเลือกที่จะทำให้ทางเดินหายใจช่วงบนของผู้ป่วยดีขึ้น มีการผ่าตัดบริเวณเพดานอ่อนหลายวิธีที่นำมารักษาผู้ป่วย แต่การผ่าตัดเหล่านี้มีการตัด และทำลายเนื้อเยื่อมาก มักทำให้ผู้ป่วยปวดแผลและมีภาวะแทรกซ้อนหลายอย่างตามมา ปัจจุบันการผ่าตัดแผลเล็กตัดเนื้อเยื่อออกน้อย มีผลการผ่าตัดเทียบเคียงได้กับการผ่าตัดแบบเดิม พบภาวะแทรกซ้อนหลังผ่าตัดน้อย มีรายงานจากหลากหลายสถาบันถึงผลที่น่าสนใจในผู้ป่วยที่เข้ารับการรักษาอย่างเหมาะสม ได้นำเสนอวิธีการผ่าตัดผลการผ่าตัดรักษาตลอดจนภาวะแทรกซ้อนที่อาจเกิดขึ้น