

REVIEW

Anterior palatoplasty in the treatment of obstructive sleep apnoea - a systemic review

La palatoplastica anteriore nel trattamento delle apnee ostruttive del sonno: una revisione sistematica

K.P. PANG¹, E.B. PANG², K.A. PANG², B. ROTENBERG³

¹ Consultant, Otolaryngology, Asia Sleep Centre, Paragon, Singapore; ² Student, Otolaryngology, Asia Sleep Centre, Paragon, Singapore; ³ Consultant, Otolaryngology Head and Neck Surgery Western University, London Ontario, Canada

SUMMARY

This study seeks to determine the objective and subjective success rates of anterior palatoplasty and its variants for the treatment of obstructive sleep apnoea (OSA). A systematic review with two independent searches of Medline, PubMed, Cochrane Library and Evidence Based Medicine Reviews was performed to identify publications relevant to OSA and anterior palatoplasty. All relevant studies published before 30 June 2015 were included. Six studies were included in the systematic review. The numbers of patients in each paper ranged from 13 to 77 (total = 240), and mean age ranged from 21 to 51 years. Substantial and consistent improvement in polysomnography (PSG) outcomes were observed in patients after the anterior palatoplasty, with or without multilevel surgery. The results showed that the anterior palatoplasty technique provides significantly improvement in the post-operative Apnoea-Hypopnea Index. The mean pre-operative AHI (in the 6 papers) improved from 16.3 to 7.1, the snore visual analogue scale improved from 7.5 to 3.1 and the Epworth score reduced from 11.3 to 7.3 post-operatively. The overall pro-rated pooled success rate for all the patients was 72.5%, with a mean follow-up of 17.3 months. Anterior palatoplasty is an effective option in the management of patients with mild to moderate OSA.

KEY WORDS: Anterior palatoplasty • Obstructive sleep apnoea • Systemic review • Level of Evidence: 2a

RIASSUNTO

Obiettivo di questo studio è determinare il tasso di successo, oggettivo e soggettivo, della palatoplastica anteriore e delle sue varianti nel trattamento delle apnee ostruttive del sonno. È stata quindi effettuata una revisione sistematica attraverso due ricerche indipendenti utilizzando Medline, PubMed, Cochrane Library and Evidence Based Medicine Reviews al fine di identificare le pubblicazioni di rilievo in merito alle apnee ostruttive del sonno e alla palatoplastica anteriore. Sono stati considerati tutti gli studi importanti pubblicati prima del 30 giugno 2015. Sono stati inclusi sei studi nella revisione sistematica. Il numero di pazienti in ciascun lavoro variava da 13 a 77 (per un totale di 240 pazienti), e l'età media variava da 21 a 51 anni. Dopo la palatoplastica, con o senza "chirurgia multilivello", è stato osservato un netto e consistente miglioramento dei parametri della polisonnografia. I risultati hanno mostrato che con la palatoplastica anteriore si ottiene un significativo miglioramento dell'Indice di Apnea/Ipopnea (AHI) postoperatorio. Il valore medio (dei 6 lavori) di AHI preoperatorio è migliorato da 16,3 a 7,2 e la scala visuo-analogica del russamento da 7,5 a 3,1, la scala di Epworth, infine, si è ridotta da 11,3 a 7,3. Il tasso di successo globale per tutti i pazienti è risultato pari a 72,5%, considerando un tempo di follow-up medio di 17,3 mesi. In conclusione, la palatoplastica anteriore è un'opzione efficace nella gestione dei pazienti con apnee ostruttive del sonno, di grado lieve e moderato.

PAROLE CHIAVE: Palatoplastica anteriore • Apnee ostruttive del sonno • Revisione sistematica • Livello di evidenza: 2a

Acta Otorhinolaryngol Ital 2018;38:1-6

Introduction

Snoring is considered a social nuisance and an objectionable social problem. It is caused by the vibration of the structures in the oral cavity and oropharynx – namely the soft palate, uvula, tonsils, base of tongue, epiglottis and pharyngeal walls. Many sleep authorities believe that it

may represent an alarm to alert one to the possibility of obstructive sleep apnoea (OSA). OSA is a common sleep disorder; Young et al. studied 602 state employees with attended overnight polysomnography and found that the incidence of sleep disordered breathing (SDB) was 24% in men and 9% in women ¹. Most of these patients are

undiagnosed. It is estimated that up to 93% of females and 82% of males with moderate to severe OSA remain undiagnosed². OSA is due to the collapsibility of the upper airway during sleep. These collapsible soft tissues, when subjected to negative pressure within the upper airway, may lead to complete or partial obstruction of the upper airway leading to cessation of breathing, increased sympathetic activity, increased blood pressure and hypoxaemia. Collapse of the upper airway is often multilevel, at the level of the palate/velopharynx, the base of tongue and/or the lateral pharyngeal walls. Patients with OSA have either a thick redundant soft palate and/or bulky lateral pharyngeal walls that contribute to the collapse and obstruction of the upper airway in these patients. These areas of collapse should be addressed, if one is aiming to relieve the patient of the apnoeas.

Many techniques that have been introduced to treat snoring and OSA, mainly aimed to create scar tissue, in order to incite fibrosis and stiffen the palate. With the stiffened palate, the vibration of the palate diminishes, and hence snoring is reduced. An anterior palatal stiffening operation was first introduced by Ellis in 1994³ (this involved stripping of a small area of uvular and palatal mucosa) and modified by Mair in 2000⁴. Both techniques had promising results, although they produced a stellate and puckered scar on the soft palate that resulted in tenting and pulling of the lateral pharyngeal walls medially, and therefore narrowing of the lateral distance between the tonsillar pillars laterally. These anatomic manifestations might explain why some patients did not experience much benefit from the procedure. Pang et al. described the modified cautery assisted palatal stiffening operation (CAPSO) technique done under local anaesthesia (LA)⁵. This technique had showed encouraging results for patients with snoring and mild OSA⁵. The modified CAPSO technique was renamed as the anterior palatoplasty in 2009, as the technique involved the anterior surface of the soft palate primarily⁶. We present a systemic review of anterior palatoplasty and its variants since its introduction 8 years ago.

Materials and methods

We performed a systematic literature search using Medline, Google Scholar, Cochrane Library and Evidence Based Reviews (up to June 30, 2015) databases for procedures that included anterior palatoplasty and its variants, mainly the modified CAPSO and the barbed anterior palatoplasty⁷. The overall search strategy combined search terms of anterior palatoplasty, palate surgery, uvulopalatopharyngoplasty, sleep apnoea, obstructive sleep apnoea and outcomes.

Selection criteria

All relevant studies published prior to June 30, 2015 were included. All included studies had to be published in English and/or another language but with English translation. We included case control studies and/or cohort studies, with or without any form of comparison with the traditional treatment method for snoring and/or OSA. We included both adult and paediatric studies. The selection criteria for individual patients were based on patients with or without nasal obstruction, with mainly retro-palatal obstruction/narrowing and no hypo-pharyngeal collapse.

Data extraction

For studies that met inclusion criteria, data was extracted into a standardised worksheet. Extracted data included the name of the first author, year of publication, study design, number of study subjects in each treatment group, the age and gender of subjects, description of the surgical procedure, pre-operative and post-operative apnoea-hypopnea index (AHI) and success rates.

The primary effectiveness outcome measure was pre-operative and post-operative AHI values following the anterior palatoplasty with or without any comparison with the traditional uvulopalatopharyngoplasty and/or other surgical method like uvulopalatal flap (UVF). The secondary outcome was surgical success rate defined as a reduction of post-operative AHI by 50% (compared to pre-operative AHI) and an AHI value below 20. Means with standard deviations (SD) were summarised for the major outcome, and the AHI change before and after surgical intervention was evaluated as for the treatment effect. Other outcomes taken into consideration include, snoring visual analogue scale (VAS) reduction, Epworth sleepiness scale (ESS), snoring reduction (as a percentage), pain levels (as a VAS), pain duration (number of days) and two-year satisfaction (based on patient and bed partner reports).

Statistical methods

Data was analysed using a generic inverse method and $p < 0.05$ was regarded as statistically significant. Combined summary statistics of the standardised (STD) paired difference in mean for the individual studies are shown. Combined STD paired differences in means were calculated and a 2-sided p -value < 0.05 was considered to indicate statistical significance.

Procedural technique

Most of the papers had the anterior palatoplasty technique done under general anaesthesia, however, the anterior palatoplasty technique can be done under local anaesthesia in

the office as well. General anaesthesia would be the standard choice if the patient had relatively larger sized tonsils (tonsil size 2, 3 or 4) and a tonsillectomy was needed.

The procedure may be done under local anaesthesia in the office as an out-patient. The patient was seated in an examination chair with the mouth open. Topical lidocaine (10%) was used to anaesthetise the palatal region. A total of 2 to 4 ml of 1:80,000 adrenaline and 2% xylocaine was injected into 3 sites of the soft palate. A partial uvullectomy (usually using diathermy/radiofrequency/coblation) may be performed, followed by supero-lateral cuts (para-uvular cuts) on either side of the uvula (especially if there were very prominent posterior and/or anterior palatal arch webbing), through both soft palatal arches. A horizontal rectangular strip of mucosa was removed from the soft palate (about 40 mm to 50 mm in length by 7 mm to 10 mm in width); down to the muscle layer. Haemostasis was achieved with electrocautery. The horizontal stripped area on the soft palate would be sutured with Vicryl 4/0 round body curved needle. A minimum of 10 to 20 sutures are used to appose the wound edges (while suturing, the entire soft palate would be transposed anteriorly and superiorly). All patients were prescribed anaesthetic gargles (Diffiam) and lozenges (Diffiam), non-steroidal anti-inflammatory agents (Naproxen Sodium), narcotics (e.g. codeine) and/or cyclo-oxygenase-2 inhibitors.

The same procedure may be carried out under general anaesthesia with the patient supine using the Boyle-Davies mouth gag with an oral intubation. Tonsillectomy was first performed followed by anterior palatoplasty (in the same fashion as described above). The anterior and posterior tonsillar pillars may or may not be sutured together, depending on the author/surgeon's preference.

Barbed anterior palatoplasty is a variant or evolved technique of the anterior palatoplasty⁷. The technique is similar to the anterior palatoplasty, and the barbed thread

would be the addition in order to allow the suture to suspend the different mucosa and muscular planes without the need to tie knots. The authors used the double needle QUILL® knotless tissue closure device, Angiotech Pharmaceutical Inc., Vancouver, Canada⁷. After the standard anterior palatoplasty, the barbed suture is passed from the pterygoid hamulus, pterygo-mandibular raphe from both sides, and passed through the rectangle box superiorly and inferiorly in a zig-zag fashion. The authors conclude their description of the procedure by including the Roman Blind technique proposed by Mantovani et al.^{8,9}.

Results

From the Medline and PubMed search, with the keywords "sleep apnoea" and "palatoplasty" search yielded 20 papers; after narrowing the search down to specific "anterior palatoplasty" in "sleep apnoea" only 10 papers were retrieved, which had included palatoplasty for cleft palates. The refined database search only identified six studies potentially eligible for review (specific to sleep apnoea and the anterior palatoplasty method) and analysis (Tables I, II)^{5-7,10-12}. Two studies had a comparison group with either the uvulopalatal flap¹⁰ or the modified uvulopalatopharyngoplasty¹¹, this is illustrated separately in Table III. The other studies had reported the various result outcomes in terms of AHI, lowest oxygen desaturation, Epworth sleepiness scale, snore VAS, snoring reduction, and/or pain score and pain duration (Tables I, II). Five studies reported the ages, the mean body mass index (BMI) and pre/post-operative AHI; only 2 papers reported their pre/post-operative lowest oxygen values, while four papers reported their overall post-operative success rates, defined as a reduction of post-operative AHI by 50% (compared to pre-operative AHI) and an AHI value below 20^{5-7,10-12}. The numbers of patients in each paper ranged from 13 to

Table I. Pre-operative and post-operative AHI, LSAT and success rates of the six papers included.

	N	Age	BMI	AHI		LSAT		% Success	F/U
				Pre	Post	Pre	Post		
Pang 2007 ⁵	13	35.7	28.4	12.3	5.2	88.3	92.5	75	3
Pang 2009 ⁶	39	39.3	24.9	25.3	11.0	81.4	92.0	71.8	33.3
Marzetti 2013 ¹⁰	38	> 20	26.7	22.0	8.6			86	2
Ugur 2013 ¹¹	50	43	28.8						24
Ugur 2014 ¹²	42	39.2	35.3	13.2	7.3			57.1	24
Salamanca 2014 ⁷	24	46	28.6	8.9	3.8				
<i>Overall</i>	<i>206</i>		<i>28.6</i>	<i>16.3</i>	<i>7.1</i>	<i>84.5</i>	<i>92.0</i>	<i>72.5</i>	<i>17.3</i>

N = total number in study; Age = mean age of patients; BMI = mean body mass index of patients; AHI = Apnoea-hypopnea index; LSAT = Lowest oxygen saturation; Success rate in %; F/U = mean follow up in months.

Note: Success rates (in all articles) defined as 50% reduction of pre-operative AHI and an AHI < 20.

Table II. Illustrating the pre-operative and post-operative ESS, snore VAS and pain scores of the six papers included.

	N	Age	BMI	ESS		Snore VAS		Pain score	Pain duration
				Pre	Post	Pre	Post		
Pang 2007 ⁵	13	35.7	28.4	12.2	8.9	8.3	3.3	Mild	10 days
Pang 2009 ⁶	39	39.3	24.9	16.0	7.9	8.4	2.5	Mild	10 days
Marzetti 2013 ¹⁰	38	> 20	26.7	8.5	4.9		80%↓	5.1	7 days
Ugur 2013 ¹¹	50	43	28.8	8.4	6.5	5.3	3.4	6	
Ugur 2014 ¹²	42	39.2	35.3	11.5	8.3	6.2	3.4		
Salamanca 2014 ⁷	24	46	28.6			9.2	2.9	Mild-mod	
Overall	206		28.6	11.3	7.3	7.5	3.1		

N = total number in study; Age = mean age of patients; BMI = mean body mass index of patients; ESS = Epworth Sleepiness Scale; VAS = Visual Analogue Scale.

Table III. Demonstrating the comparative results between the Anterior Palatoplasty (AP) with the respective traditional techniques of the Uvulopalatal Flap (UPF) and the modified Uvulopalatopharyngoplasty (ModUPPP).

		N	Age	BMI	ESS		AHI		Snore VAS		Success%	F/U	Pain VAS	Pain (d)	2 yr satisfaction
					Pre	Post	Pre	Post	Pre	Post					
Marzetti 2013 ¹⁰	AP	15	48.3	26.5	8.5	4.9	22.0	8.6	80%↓		86	2	5.1	7	
	UPF	19	46.3	26.6	8.1	5.2	23.0	9.6	70%↓		84	2	6.8	10.8	
Ugur 2013 ¹¹	AP	26	43.2	28.1	8.4	6.5			5.3	3.4		24	6.0		85%
	ModUPPP	24	42.1	29.8	9.8	7.3			6.8	4.6		24	8.0		70%

N = total number in study; Age = mean age of patients; BMI = mean body mass index of patients; AHI = Apnea-hypopnea Index; LSAT = Lowest Oxygen Saturation; ESS = Epworth Sleepiness Scale; VAS = Visual Analogue Scale; Pain (d) = Duration of pain in days; Success rate in %; F/U = mean follow up in months.

Note: Success rates (in all articles) defined as 50% reduction of pre-operative AHI and an AHI < 20.

77 (total = 206), and mean age range from 21 to 51 years. Mean BMI was 28.6. Substantial and consistent improvement in PSG outcomes were observed in patients after the anterior palatoplasty, with or without multilevel surgery. The results showed that the anterior palatoplasty technique is associated with significant improvement in post-operative AHI. The mean pre-operative AHI (in the 6 papers) improved from 16.3 to 7.1 postoperative, the lowest oxygen saturation improved from a mean of 84.5% to 92% (in the 2 papers that reported); the snore visual analogue scale (in the 5 papers) improved from 7.5 to 3.1, the Epworth score (in the 5 papers) reduced from 11.3 to 7.3, post-operatively (Tables I, II). One study by Marzetti et al. reported an overall snoring reduction of 80% in their 34 patient cohort.

The overall pro-rated pooled success rate for patients (in the 4 studies that reported, n = 132) was 72.5%, with a mean follow-up of 17.3 months (Table I).

Two of these six articles had included a comparison group, other than the anterior palatoplasty technique ¹⁰⁻¹¹ (Table III). Marzetti et al. had compared the anterior palatoplasty technique with the traditional uvulopalatal flap technique ¹⁰. They found that the respective AHI and ESS

had significant improvement in the anterior palatoplasty group compared to the uvulopalatal flap group (p < 0.05) (Table III). Of interest, Marzetti et al. reported that both pain intensity and duration was lower in the anterior palatoplasty compared to the uvulopalatal flap group. Ugur et al. also reported similar results with the anterior palatoplasty group showing greater improvements in both ESS and snoring reduction compared to the modified uvulopalatopharyngoplasty group ¹¹ (Table III). Ugur et al. also showed that the 2 year overall satisfaction rate was significantly higher in the anterior palatoplasty group than in the modified uvulopalatopharyngoplasty group (85% vs. 70%, respectively) ¹¹ (Table III).

Discussion

In 2000, Mair et al. ⁴ reported a promising 77% success rate for snoring reduction in 206 patients, at one year follow up, who underwent the cautery-assisted palatal stiffening operation (CAPSO). Pang et al. ⁵ modified the CAPSO technique and had showed encouraging results in a small group of patients with snoring and mild OSA. The modified CAPSO technique had combined the laser assisted uvulopalatoplasty (LAUP) ¹³ technique first de-

scribed by Kamami and simple horizontal stripping of the soft palatal mucosa. Kamami et al. studied 417 snorers who underwent LAUP and found a reduction of snoring in 95% of patients after one year. Most authors report modest improvement after LAUP for patients with mild OSA^{3,4,13}. By combining the use of cautery with the principles of the laser palatoplasty and the creation of a horizontal denuded mucosal strip on the soft palate, with the suturing/closure of this horizontal strip, this technique is able to move the soft palate anteriorly and superiorly, while opening up the anterior-posterior velopharyngeal space. This technique opens up the retropalatal area by transposing the soft palate anteriorly; this is similar to advancing the entire palate forwards, as in Woodson's transpalatal advancement pharyngoplasty¹⁴ but without bone surgery, with less resulting morbidity and a lower risk of oro-nasal fistula.

The 3-year follow-up of 77 patients (38 snorers and 39 patients with OSA) reported by Pang et al. showed that AHI improved in patients with OSA, from 25.3 ± 12.6 to 11.0 ± 9.9 ($p < 0.05$)⁶. The overall success rate (reduction of at least 50% of the pre-procedure AHI and post-procedure AHI below 20) for this OSA group was 71.8% (at mean 33.5 months, median follow-up at 31 months and a range of 29 to 39 months). The mean snore scores (VAS) improved from 8.4 to 2.5 (for all 77 patients) ($p < 0.05$)⁶. Lowest oxygen saturation also improved in all OSA patients, from a mean pre-operative 81.4 ± 19.2 to 92.0 ± 16.9 ($p < 0.05$)⁶. All patients had improvement in their snoring, and patients and their sleep partners were satisfied with the result at a mean of over 30 months postoperatively. The VAS showed gradual reduction in the snoring intensity with time, ranging from a preoperative level of 8.4 (range 7.5 to 9.1) to a low of 2.5 (range 1.0 to 4.6) at about 30 months postoperative⁶. Similar improvements were seen in the Epworth scale which decreased from 16.2 (range 8 to 20) to 7.9 (range 5 to 13) postoperatively ($p = 0.05$)⁶.

Marzetti et al. demonstrated the highest success rate in their 34 selected patients with mild to moderate OSA, with an impressive 86% success¹⁰, while Ugur et al. produced only a 57.1% success rate in 42 patients with mild to moderate OSA after a 24 month follow-up¹². Salamanca et al. introduced the improved "barbed Roman blinds" technique with promising reductions in both AHI and snoring VAS, even if, unfortunately, they did not report on the success rate in their study of 46 patients⁷.

Of great interest are the two papers comparing the anterior palatoplasty technique with the uvulopalatal flap (Marzetti et al.¹⁰) and the modified uvulopalatopharyngoplasty (Ugur et al.¹¹). Both studies had shown improvements in both techniques compared, but greater impressive improvements in both AHI, ESS and snoring reduction VAS

score were consistently demonstrated in the anterior palatoplasty group of patients.

It was also highlighted in 4 of the 6 papers reviewed here-in that the overall pain intensity and duration post-operatively in the anterior palatoplasty technique was lower than with other traditional palatoplasty techniques^{5,6,10,11}. These six investigations demonstrated subjective and objective improvements in the 240 patients studied; this may suggest that the palatal fibrotic scar achieved by this anterior palatoplasty technique is superior over other techniques described, and appears to be able to maintain the encouraging results in the long term. Pang et al. hypothesised a number of advantages of this procedure⁶. It is anatomically sound (as it causes fibrotic scarring superiorly and anteriorly) and it can be done as an office-based procedure on an out-patient basis or part of a tonsillectomy (with or without preservation of the uvula) under general anaesthesia. The procedure is also fairly quick, low-cost and does not require expensive equipment.

Conclusions

This systematic review has shown that anterior palatoplasty has comparably favourable results in relation to other methods of palatal surgery in adults. The procedure is simple to perform, is anatomically sound and has minimal complications.

References

- 1 Young T, Palta M, Dempsey J, et al. *The occurrence of sleep-disordered breathing among middle-aged adults*. N Engl J Med 1993;328:1230-5.
- 2 Young T, Evans L, Finn L, et al. *Estimation of the clinically diagnosed proportion of sleep apnea syndrome in middle aged men and women*. Sleep 1997;20:705-6.
- 3 Ellis PD. *Laser palatoplasty for snoring due to palatal flutter: a further report*. Clin Otolaryngol Allied Sci 1994;19:350-1.
- 4 Mair EA, Day RH. *Cautery-assisted palatal stiffening operation*. Otolaryngol Head Neck Surg 2000;122:547-56.
- 5 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.
- 6 Pang KP, Tan R, Puraviappan P, et al. *Anterior palatoplasty for the treatment of OSA: three-year results*. Otolaryngol Head Neck Surg 2009;141:253-6.
- 7 Salamanca F, Costantini F, Mantovani M, et al. *Barbed anterior pharyngoplasty: an evolution of anterior palatoplasty*. Acta Otorhinolaryngol Ital 2014;34:434-8.
- 8 Mantovani M, Minetti A, Torretta S, et al. *The "Barbed Roman Blinds" technique: a step forward*. Acta Otorhinolaryngol Ital 2013;33:128.

- ⁹ Mantovani M, Minetti A, Torretta S, et al. *The velo-uvulopharyngeal lift or “roman blinds” technique for treatment of snoring: a preliminary report.* Acta Otorhinolaryngol Ital 2012;32:48-53.
- ¹⁰ Marzetti A, Tedaldi M, Passali FM. *Preliminary findings from our experience in anterior palatoplasty for the treatment of obstructive sleep apnea.* Clin Exp Otorhinolaryngol 2013;6:18-22.
- ¹¹ Ugur KS, Kurtaran H, Ark N, et al. *Comparing anterior palatoplasty and modified uvulopalatopharyngoplasty for primary snoring patients: preliminary results.* B-ENT 2013;9:285-91.
- ¹² Ugur KS, Ark N, Kurtaran H, et al. *Anterior palatoplasty for selected mild and moderate obstructive sleep apnea: preliminary results.* Eur Arch Otorhinolaryngol 2014 ;271:1777-83.
- ¹³ Kamami YV. *Outpatient treatment of sleep apnea syndrome with CO 2 laser; LAUP: laser-assisted UPPP results on 46 patients.* J Clin Laser Med Surg 1994;12:215-9.
- ¹⁴ Woodson BT, Toohill RJ. *Transpalatal advancement pharyngoplasty for OSA.* Laryngoscope 1993;103:269-76.

Received: February 20, 2017 - Accepted: June 7, 2017