

# Surgical Management of Obstructive Sleep Apnoea

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## Introduction

**O**SA is fast growing disease as a consequence of change in lifestyle.

Treatment includes conservative, CPAP or surgical.

There are numerous surgeries for treatment of sleep disordered breathing, depending on the site of obstruction. It includes nasal, palatal, hypopharyngeal, laryngeal or craniofacial procedures.

There are different diagnostic tools to determine the level of obstruction. Based on these and severity of symptoms of OSA, the type of surgery is selected. Since its a multilevel problem, sometimes a single surgery doesn't suffice. In such cases we need to do staged operations or combined procedures.

To start with, surgeries are done in mild to moderate cases or on patients who refuse CPAP usage. In very severe cases, surgeries can be done to facilitate the use of CPAP. Although with the advancement of techniques and better results, the need of CPAP may or may not be there even in severe cases.

Any major obstruction like deviated nasal septum, polyps, inferior turbinate hypertrophy, large tonsils, adenoids etc can cause the CPAP pressures to go high. This leads to intolerance of the machine and hence non compliance. Surgery provides space and reduces the required

pressure, hence better tolerance.

In case of refusal to use CPAP, failure of CPAP, surgery plays an alternative role.

Patients having simple snoring or upper airway resistance syndrome can benefit from surgery. Since there are no apnoeic episodes, the role of CPAP is limited in such cases.

## Indications for surgery

Surgery is considered in following situations

CPAP failure

Non compliance of CPAP

Primary snoring

Upper airway resistance syndrome

Facilitation of CPAP

Part of multilevel surgery

Minimally invasive surgery for primary snoring or very mild OSA

In case of simple or primary snoring and upper airway resistance syndrome, surgery is indicated.

Upper airway resistance - Patient has AHI < 5, but symptoms like daytime tiredness, fatigue, psychosomatic symptoms at times are present and patient could be non obese.

## Screening

Pre surgical work up includes the following

**AHI** - The severity of sleep apnoea is considered. It could be mild, moderate or severe as per the AHI index.

Hypopnoeas and oxygen desaturation are also taken into account. Nasal flow, snore index and arousals are also

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considered before planning a surgery.

History of previous surgery, DM/HT/thyroid/medication/tobacco/alcohol/allergy is noted.

Occupation of patient or night shifts are also important as they can affect sleep patterns.

ESS - Epworth sleepiness scale is noted, if more than 12, is considered positive.

PSQI - Pittsburg sleep quality index is used for severity.

VAS- Visual Analogue Scale- Assessment of symptoms like snoring on a scale of 0 to 10 can be done by the partner.

#### **Assessment**

It's essentially a structural problem, so need to look for levels of obstruction  
The obstructions could be static and dynamic.

Static obstructions are anatomic variations observed in awake state of patients.

Dynamic ones are the collapses observed during sleep state.

Dynamic obstructions are more reliable as they're seen during sleep endoscopy.

Following are the various sites and types of static obstructions commonly seen:

#### **Nose**

Small nares

DNS- Deviated nasal septum

ITH-Inferior turbinate hypertrophy

Polyps or any nasal mass, (fig:1)

Narrow nasal valve



Fig. 1 : Showing nasal mass

**Nasopharynx** - Adenoids

**Oropharynx** -

Uvula- Bulky, hypertrophied, elongated

Webbing - Excessive soft tissue at posterior pillar

Soft palate - Long, bulky, thin

Tonsils - Size 0 to 4, as shown in fig. 2

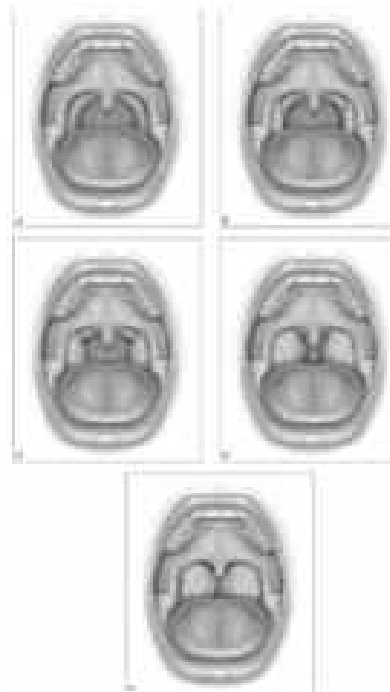
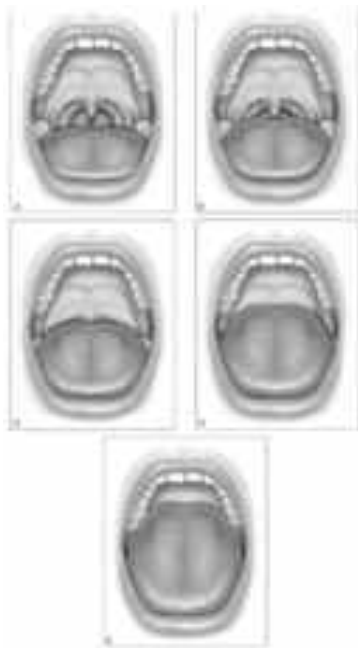


Fig. 2 : Tonsil grading A:0,B:1,C:2,D:3,E:4

### **Friedman's tongue position(1)**

- Type 1 - Tonsils, pillars and uvula visualised  
2a -Uvula seen fully  
2b -Most of Soft palate, base of uvula seen  
3 - Some of soft palate seen  
4 - Hard palate visualised only, fig:3



*Fig. 3 : Friedman's Tongue position - FTP*

Tongue base - Hypertrophied, bulky - muscular or mucosal

Presence of lingual tonsils

**Hypopharynx** - Vallecule

**Larynx** - Epiglottis

**Craniofacial**- Small chin

Retrognathia

Small maxilla

Small mandible

**Neck circumference**- In case of males >

35.5 cm

In females > 32 cm

**BMI - Body Mass Index** - Weight in kg/(Height in metre)(Ht in metre). BMI above 23 should be considered overweight.

### **Investigations**

**CT scan PNS** - In case of suspected nasal pathology, CT scan is a must.

**Fibreoptic laryngoscopy** - Awake laryngoscopy is done to assess the base of tongue and larynx.

### **Protocol**

For surgery BMI should be less than 40  
Simple snoring - Treatment wanted - DISE- Minimally invasive surgery - calculated surgery - to multi level surgery

If AHI < 5 - Minimally invasive surgery to multilevel surgery

AHI > 5 < 20 - CPAP trial - if refused - DISE - Minimally invasive to calculated surgery

AHI > 20 - CPAP trial -refusal - DISE- Multilevel surgery

### **Assessment of level of obstruction**

Drug induced sleep endoscopy (DISE) is done to assess the level of obstruction. Since OSA happens only during sleep, it's important to observe the patient in a sedated state. With the intra venous sedatives, a natural sleep stage close to stage 2 is achieved. A flexible fibreoptic laryngoscope is then inserted and obstructions noted, as described below.

### **DISE(2)**

**It's a very useful tool to find out level of obstruction prior to surgery and thus helps in confirming that correct**

**procedure is chosen. It enhances the success rate significantly.**

Indications - Level of obstruction  
Type of collapse  
CPAP failure  
Done prior to surgery for determining the type of surgery

Drugs used - Midazolam, Propofol, Dexmedetomidine are commonly used.

### **Procedure**

Patient is sedated with one of the above drugs in a controlled manner. In case of propofol, infusion pump can be used. Natural sleep cycle corresponding to stage 2 is achieved. This can be monitored by using BIS - Bispectral index score system. This aids in determining the depth of sedation. Once the patient starts snoring, the level of obstruction and type of collapse is noted.

It is based on various levels of obstruction as described below:

**VOTE** classification - This includes obstruction at Velum, Oropharynx, Tongue and Epiglottis.

At each level, the type of collapse is noted. It could be anteroposterior, lateral, circumferential

Based on these findings, surgery is planned.

**Advanced DISE** - Recent developments in DISE include usage of PSG channels along with sleep endoscopy. This helps in truly identifying obstructive episode, as against central apnoea.

### **Advantages -**

It aids in confirming the site of

obstruction and deciding the type of surgery.

Its gold standard for laryngeal OSA.

Patient is sedated to N2 level of sleep, mimicking natural stage 2.

The type and degree of collapse is important in planning the surgery.

There are a few limitations of DISE.

Since it's a subjective assessment, observer's bias may happen. Only one site at a point can be observed.

Patient may not have an apnoeic episode during the procedure.

REM OSAs are difficult to observe, as this procedure lasts for 15-20 minutes.

### **Dynamic MRI**

Patient is put to sleep naturally and upper airway is assessed through a special software used in MRI.

### **Surgery**

This is based on tongue position, tonsil size, palate and BMI, as described below

**Staging of surgery** - This is based on the relation of palatal obstruction and hypopharyngeal obstruction.

Stage 1 FTP-1, Tonsil BMI<40.  
2a, 2b, size 3/4,

Stage 2 FTP 1, Tonsil BMI<40  
2a,2b. size 0,1,2,  
FTP 3/4 Tonsil BMI<40  
size 3,4.

Stage 3 FTP 3/4 Tonsil size BMI<40  
0,1,2

Surgeries can be divided into phase 1 and phase 2 according to Powell - Riley

### **Phase 1**

Nasal, palatal -UPPP, other palatal procedures

Genioglossus advancement  
Hyoid suspension  
Minimally invasive to multilevel  
Radiofrequency ablation  
Coblation

## Phase 2

Maxillomandibular advancement  
Distraction osteogenesis  
Hypoglossal nerve stimulation  
Trans robotic  
Tongue base radio frequency

Surgery is considered successful, based on the following criteria.

- If Apnoea hypopnoea index AHI < 20/ hour of sleep or 50% reduction in AHI, if pre operative AHI < 20
- Oxygen desaturation nadir > 90%
- Symptoms like daytime tiredness and fatigue significantly reduced
- Snoring reduced to socially acceptable level

## Adults

### Nose

Nasal valve repair  
Alar prolapse surgery  
Septoplasty  
Inferior turbinoplasty  
FESS - functional endoscopic sinus surgery

Nasal obstruction contributes to sleep disordered breathing especially by enhancing the sound of snoring. Since pharynx acts as a resistor during apnoea, nose becomes the rate limiting factor. It's important to address the nose, before doing any other surgery.

In case of deviated septum and spurs, septoplasty is effective.

Inferior turbinate hypertrophy (fig:4a) is treated by turbinoplasty (fig: 4b). In case of nasal polyps, sinusitis or other nasal masses endoscopic sinus surgery is done.

In case of primary snoring or upper airway syndromes, sometimes only nasal surgery helps in improving the symptoms.

In OSA, only nasal surgery is not enough, a multilevel approach is needed.



Fig. 4a : Inferior turbinate hypertrophy.



Fig. 4b: After turbinoplasty

**Oropharynx** - The first surgery described for OSAS is uvulopalatoplasty. Classic UPPP led to many complications and hence modified versions were devised. It was realised that this surgery can benefit only specific cases of OSA, and now being done only for such cases. With the aid of better diagnostic tools, the indications of modified UPPP(3) have been specified.

*Uvulopalatal flap* - The soft palate is shortened, and uvula folded upon itself,

and palate sutured in new position.

*Suture pharyngoplasty* - This simple procedure provides relief in cases of mild to moderate OSA.

Surgical outcomes are favourable in case of tonsil grade 3/4/ webbing, tongue base type 1-2.

Initial step involves tonsillectomy, followed by release of posterior pillar, then suturing of anterior and posterior pillars including tonsillar bed. The excess tissue at pillars - webs are cut and redundant mucosal part of uvula is removed. It provides good expansion of posterior palatal space. In our series, this procedure individually, as well as in combination with tongue base channeling has given good results (Fig. 5).

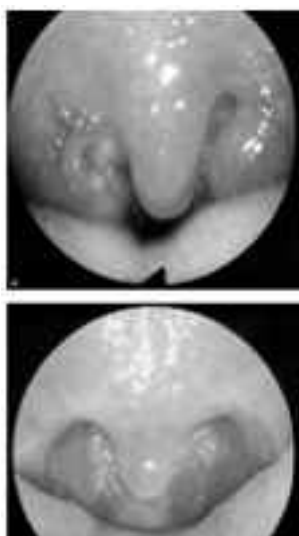


Fig. 5: Before and after modified UPP

#### *Palatoplasty*

*Transpalatal advancement pharyngoplasty* - Palatal osteotomies are performed, along with palatal advancement

*Anterior* - Anterior part of palate is addressed. Submucosal burning of tissue

is done with cauterly - CAPSO

*Lateral*- This procedure involves rotating of superior constrictor muscle, after creating a tunnel through palatoglossus muscle.

*Expansion sphincter pharyngoplasty (4)*- Tonsillectomy is performed, followed by identification of posterior pharyngeus muscle. It is resected in lower one third, with posterior attachment kept with horizontal fibres of superior constrictor muscle. The muscle is rotated superolaterally after creating a tunnel. This aids in superior pull and lateral expansion.

*Zeta* - This involves splitting of soft palate in midline, and removing of anterior mucosa. Palatoglossus muscle is cut and sutured to posterior palatine mucosa, hence creating anterolateral space.

*Barbed* - It is recent technique, indicated for anteroposterior and lateral collapse. It involves a special knotless barbed suture, which is inserted at various points on the hard and soft palate. It results in expansion and uplifting of the palate without any invasive surgery. The concept is based on translocation sphincteroplasty. Various landmarks like nasal point, pterygoid hamulus, are identified and barbed suture is placed through these points.

This is most recent, safe and effective method for treatment of all degrees of OSA. It works well as stand alone procedure or as a part of multi level surgery. Its anticipated that this procedure might replace most of the invasive palatal



surgeries. The surgical outcome has been very favourable, as per studies done by Vicini et al, as it helps in expanding lateral as well as anteroposterior walls.

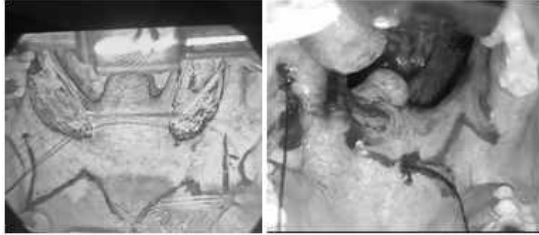


Fig. 6: Landmarks for barbed pharyngoplasty, barbed sutures shown

**Palate Implants** - Could be used for mild OSA.

Snoreplasty, uvulectomy are minor procedures done for simple snoring or mild disease.

### **Tongue base surgeries**

**Hyoid suspension** - It is done for retrolingual obstruction or as a part of multilevel surgery.

It is based on anterior movement of hyoid bone, thereby increasing the posterior airway space. It involves stabilisation of hyoid bone by attachment to superior border of thyroid cartilage. After dissection hyoid bone is exposed and mobilised in anteroinferior direction and fixed to thyroid cartilage with sutures.

Tongue base can be resected by various methods in case of retrolingual obstruction.

Lingualplasty involves removal of a part of tongue, usually midline resection, to reduce the bulk.

This is done posterior to circumvallate papillae.

Recently tongue base resections are being

done by coblation or through robotic surgery.

**Genioglossus advancement** - This procedure is done for severe OSA. It involves mobilising the area of genioglossus muscle insertion on the mandible. The genial tubercle is moved anteriorly after performing chin osteotomy.

**MMA**- This is done as phase 2 surgery, in case of failure of CPAP or previous multilevel surgeries.

It includes expansion of naso, or oro and hypopharyngeal airways. Surgery on upper and lower jaws is performed.

**DOG**- It's a phase 2 surgery, indicated in craniofacial defects.

**Transrobotic- TORS(5)**-Robotic surgery is used for resection of tongue base. It provides an excellent view of the tongue base and instrumentation via robot makes it more efficient and accessible.

**HSSS** - In case of failure of primary surgery, an implant is put in branches of hypoglossal nerve. This helps in retrolingual obstruction and has very high cure rates.

**Radiofrequency ablation** - Interstitial radio frequency is based on tissue resistance when current is applied. It's useful as minimally invasive procedure in simple snoring or UARS. It can be used as an adjuvant to multi level surgeries. There are various probes for inferior turbinate, soft palate, tonsil, tongue base. Usually 3-4 points are chosen for channeling, which causes stiffening of the tissue without any invasive procedure. It usually requires two

to three sessions for the maximum effect. It can be used to perform RF UPP(6), providing better results.

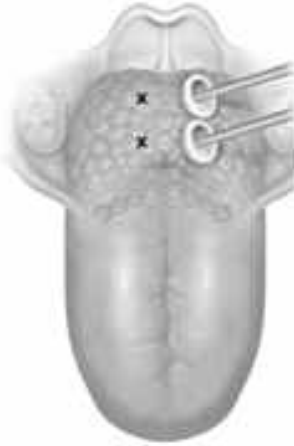


Fig. 7: Sight of tongue base channeling - RF

**Coblation** - It is widely used for adenoidectomy, tongue base resections, tonsillectomy.

Channeling can be done for inferior turbinate through new device called turbinator.

Tongue base and soft palate channeling is also done.

#### **Paediatric OSA**

Adenotonsillectomy is most commonly done OSA surgery in children.

There could be various craniofacial anomalies, macroglossia, choanal atresia, tonsilloadenoid hypertrophy, syndromes like Pierre Robin, laryngomalacia.

Symptoms include, nasal allergies, nasal obstruction, adenoid facies, mouth breathing, nocturnal enuresis, hyperactivity, reduced attention span, heart disorders, failure to thrive.

According to the level of obstruction, surgical management is done.

Nasal endoscopic procedures, choanal

atresia surgeries-, coblation or microdebrider adenoidectomy, tonsillectomy or tonsillotomy, lingual tonsil removal, tongue resection, laryngeal surgery are done.

#### **Laryngeal OSA**

Epiglottopexy is done in case of floppy epiglottis or other lesions.

For morbid obesity, bariatric surgery is preferred.

**Tracheostomy** - In case of morbid obesity, failure to thrive, severe OSA where other surgeries can't be done or patient is unable to tolerate CPAP, this procedure is done. It is life saving for the patient.

**Post operative period** - Patients usually fare well after these procedures, though in case of major invasive surgeries, one day ICU stay is considered. In case of palate and tongue base surgeries, there's pain and difficulty in swallowing for 2 to 4 days, which subsides with pain killers. Soft diet and antibiotics are given for a week. At times there could be dehiscence of a few sutures but it heals eventually. Gargles are usually avoided due to sutures. In case of nasal surgeries, post op endoscopic cleaning once a week is required for 2-3 weeks. Nasal wash is given everyday to remove crusts. Due to surgical swelling, there could be an increase in snoring for first few days which later subsides. Healing takes 4-6 weeks and improvement of symptoms can be noted slowly. Post op examination after this period shows a larger oropharyngeal space almost mimicking a square and stiffened tissue resistant to collapse.



Opening of posterior palatal space and retrolingual space is seen. In case of partial uvulectomy, complete healing of uvula is seen. There is no velopharyngeal insufficiency with these new procedures as care is taken not to damage the muscle plane.

Improvement in terms of daytime tiredness, snoring, relief from nasal obstruction and better quality of life is significantly noted. A PSG should be done not before 6 months of surgery.

### **Discussion**

First and foremost it's important to know whether we are dealing with primary snoring, UARS or sleep apnoea. The treatment differs for all these three entities.

Surgery is a good option for primary snorers, UARS, mild to moderate OSA or CPAP failures in severe OSA.

The results of nasal surgery in snoring are better than in OSA.

It improves daytime vigilance, reduces the sound of snoring, facilitates nasal CPAP by reducing nasal resistance. Nasal surgery works best when part of a multilevel surgery.

Adenoidectomy has good results in paediatric OSA, along with tonsillectomy. TAR has proved to be a successful procedure in various studies in children. It has shown to reduce ventricular enlargement and hypertrophy, improves airway in syndromic patients and long term effect in quality of life.

In adults, TAR helps improve simple snoring. In case of OSA, usually it needs to

be combined with other palatal or tongue base procedures.

UPPP has been shown to improve symptoms in both simple snoring and OSA. However, classical UPPP is hardly done now a days. The modified versions have reduced the complications significantly and have provided good results. Earlier techniques of UPPP were more morbid and success rate for OSA was around 59-60%. But with modified versions, the results have significantly improved.

Uvulopalatal flap developed at Stanford showed improved results when combined with tongue base radiofrequency in study done by Li et al.

Friedman et al introduced Zeta palatoplasty with improvised results. AHI was reduced to 50% and significant alleviation of subjective symptoms observed.

Lateral pharyngoplasty by Cahali and later expansion sphincter pharyngoplasty (ESP) by Pang and Woodson showed a significant reduction in AHI, as well as BMI, and excessive daytime sleepiness. According to Sher's criteria of surgical success ESP had success rate of 82.6% as against UPPP, which was 68.1%.

Recently developed barbed pharyngoplasty developed by Mantovani et al has shown very promising results. Vicini et al have shown in their studies, a very high success rate of this procedure.

Palatal procedures have played a major role in successful results for snoring and OSA.

Depending on the type of collapse, the type of palatoplasty is chosen and successful outcomes have been observed, as stand alone and combined procedures.

Palatal implants are less effective and indicated in only specific cases. Transpalatal advancement has shown 57% success rate.

Tongue base surgeries are generally reserved for severe disease and good results have been obtained. Tongue base resection can achieve a success rate of upto 80%, depending on the procedure and amount of tissue resected. If TORS or coblation is used, better results have been obtained.

Hypopharyngeal surgeries work very well in post lingual obstruction.

Hyoid suspension has shown a success rate of around 78% in Amsterdam study.

Phase 2 surgeries are morbid but success rates are very high. They are generally done in case of failure of phase 1 surgeries. Success rate of these surgeries like MMA could be 97%.

Improvised version of tongue base surgery through transrobotic approach has provided good results

HSSN surgery is reserved for patients with failed previous procedures and retrolingual obstruction. It has shown very good results.

Radiofrequency ablation is more effective as a combination surgery with other procedures. As a stand alone procedure, it requires 2-3 sessions, before showing significant effects.<sup>7</sup>

Coblation is effective in performing TAR, tongue base resections, channeling and has given better results than conventional methods.

### **Summary**

In our experience, RF UPP, suture pharyngoplasty combined with RF tongue base, nasal procedures along with RF soft palate, tonsil, tongue base, barbed pharyngoplasty, web excision, partial uvulectomy and channeling, tonsilloadenoidectomy in children have worked very well. There was significant reduction in daytime tiredness, fatigue, snoring, increased compliance of CPAP, reduction in AHI and in case of primary snoring/UARS, marked alleviation of all symptoms.

### **Conclusion**

Surgical management of OSA requires thorough ENT examination and is highly recommended in all cases of sleep disordered breathing ranging from simple snoring, UARS to OSA.

With the aid of diagnostic tools like DISE, assessment of level of obstruction has become easier. The type of surgery is chosen, based on this.

Nasal surgeries have shown best results when combined with other procedures.

Among palate surgeries, modified UPPP, suture pharyngoplasty, RF UPP, Zeta and EPS have good success rates. Barbed pharyngoplasty has shown promising results and is likely to replace other invasive palatal procedures. TORS and HSSN are other recent techniques

which have very high success rates. Phase 2 surgeries are also highly successful.

Apart from above surgeries, radio frequency ablation and coblation have paid major role in improving surgical outcomes and lowering morbidity. In children TAR has the best outcome.

A patient with SDB can be treated with CPAP, other devices or surgery.

With advent of new techniques and diagnostic tools, surgery is a valid and effective option in treatment of OSA.

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#### **Breathing self-management programme improves quality of life in asthma**

A breathing retraining exercise programme, incorporating a training DVD and accompanying booklet, achieved similar improvements in quality of life scores as conventional face to face training in patients with asthma.

This self-management approach offers a practical prospect of improving care for our asthma patients more conveniently and inexpensively.

**The Practitioner, 2018, Vol 262, 8**

#### **Smoking just one cigarette a day raises risk of CHD and stroke**

Smoking one cigarette per day carries a risk for cardiovascular disease of around half that of those who smoke 20 per day, a systematic review and meta-analysis has found.

‘Smokers need to quit completely rather than cut down if they wish to avoid most of the risk associated with heart disease and stroke, two common and major disorders caused by smoking.’

**Peter Saul, The Practitioner, 2018, Vol 262, 5**