

OBSTRUCTIVE SLEEP APNOEA

What is Obstructive Sleep Apnoea (OSA)?

Obstructive Sleep Apnoea (OSA) is a condition in which the upper airway collapses repeatedly during sleep. This creates an effect similar to that of being repeatedly choked throughout the night.

During these episodes, sleep is interrupted and there are recurrent dips in the blood oxygen levels, putting stress on the heart. As a result, sleep is unrefreshing and you would typically feel sleepy and irritable throughout the day.

Even a short sleep arousal can lead to unrefreshing sleep.

OSA IS COMMON

OSA is common and a worsening global health problem. Recent data from the Singapore Health Study estimated that 30.5 percent of Singapore's population has moderate to severe OSA.

As obesity is a risk factor for OSA, the prevalence of OSA is likely to rise further in the face of the worsening obesity epidemic.



What are the Symptoms of OSA?

- Excessive daytime sleepiness
- Loud, frequent snoring
- Choking or gasping episodes during sleep
- Observed to stop breathing during sleep
- Abrupt and frequent awakenings at night
- Unrefreshing sleep
- Waking up with a headache or a dry mouth
- Frequent urination at night
- Difficulties with concentration at work or studies
- Reduced libido

WHY OSA IS A CONCERN

OSA is strongly associated with cardiovascular health risks. People with OSA are at increased risk of high blood pressure, coronary artery disease, heart attacks, abnormal heart rhythms, stroke and sudden death.

In particular, OSA has been associated with difficult-to-treat high blood pressure. In addition, OSA also increases the risk of other serious health complications, such as depression, diabetes and cognitive impairment.

Many people with OSA suffer marked daytime sleepiness which impairs their executive function at work.

Their sleepiness also puts them at risk of motor vehicle accidents. All the above factors contribute to the significant impairment in the quality of life observed in people with OSA.

WHAT ARE THE RISK FACTORS FOR OSA?

- Obesity (*However, OSA may also occur in non-obese patients, especially in Asians*)
- Male gender (*For women, the risk is increased after menopause*)
- Smoking
- A narrowed upper airway
- A family history of sleep apnoea

HOW IS OSA DIAGNOSED?

Consult your physician if you have loud snoring or excessive daytime sleepiness despite getting enough sleep. Your physician will evaluate the possible causes and advise on the appropriate management.

Your physician may refer you to a sleep disorders clinic for a comprehensive evaluation of your problem. The evaluation usually involves an overnight sleep study. A sleep study is required for the diagnosis of OSA.



Snoring and obstructive sleep apnoea are more common in males.

WHAT IS A SLEEP STUDY?

A sleep study or polysomnogram (PSG) is an overnight non-invasive diagnostic test performed in a sleep laboratory.

The PSG monitors the different stages of sleep, breathing effort, oxygen levels, heart rhythm and muscle activity during sleep. The severity of OSA can also be determined.

WHAT ARE THE TREATMENTS FOR OSA?

A medical device called Continuous Positive Airway Pressure (CPAP) is considered the gold standard treatment for OSA. CPAP is safe, generally well-tolerated and highly effective.

This device must be worn nightly and long-term CPAP compliance is essential for its effectiveness.

If you are unable to tolerate CPAP therapy, other treatment options include mandibular advancement splints and surgery. These treatment options are described in detail under the following sections.

How Does CPAP Therapy Work?

CPAP therapy works by quietly delivering pressurised air to the nose and back of the throat to prevent the airway from collapsing during sleep.

There are two important parts of the CPAP machine that need to be decided on in careful consultation with your sleep physician, prior to using CPAP.

They are:

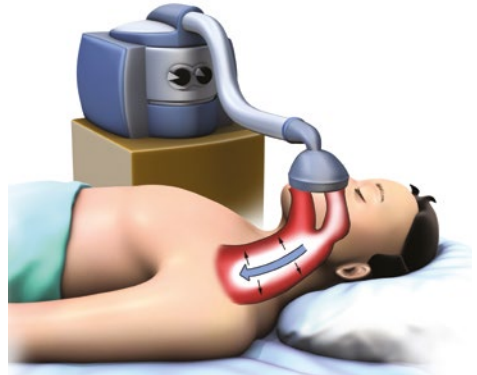
1. The Mask

CPAP is administered through a mask that seals either the nose, the mouth or both.

There are a variety of masks that can be used. Most of these are made from soft silicone or gel to maximise comfort. The mask chosen for you will be fitted by a sleep technician to suit your facial structure and breathing habits.

There are different types of masks to suit different needs, such as:

- Nasal masks
- Oral-nasal masks
- Nasal pillows
- Full face masks
- Oral masks



Continuous Positive Airway Pressure (CPAP)

2. The Machine

Most CPAP machines today are small, quiet and relatively portable. Modern CPAP devices can deliver a fixed pressure, or may have a sophisticated software that can detect obstruction and self-adjust the delivered pressure (auto-titrating machines).

The type and setting of each device will need to be individualised for you after consultation with a sleep specialist. An overnight CPAP titration sleep study may be required to determine the settings that are most suitable for you.

Weight Management

Weight reduction is important if you are overweight and have OSA. This can be achieved through dietary and lifestyle modifications and for some patients, bariatric surgery.

What Happens After OSA is Treated with a CPAP?

OSA sufferers who start using CPAP report sleeping better and feeling more energetic and less sleepy during the day.

Some report feeling better after the first day of treatment while for others, the improvement may only become apparent after a few weeks of sustained use.

The benefits of CPAP include:

- Improved sleep quality
- Improved daytime sleepiness
- Improved memory and cognition
- Improved blood pressure control
- Improvement in bed partner's sleep with the elimination of your snoring

Advice for People with OSA on CPAP treatment

It may take a while to get used to CPAP treatment, but it is important to persevere to reap the benefits of your treatment. Minor troubleshooting may be required, and it may take time to find the right device settings for you.

Some common problems encountered, and troubleshooting tips are as follows:

1. Dryness of the upper airway

This may occur due to low levels of humidity in the environment or as a result of a mask air leak.

The use of a humidifier will help in increasing air moisture, reduce dryness of the airways and increase comfort. It is also important to ensure that your mask fits well to reduce air leak.

2. Mask air leak

Re-adjust the mask if you experience mask air leak during the night. If it persists, work with your doctor and the sleep technologist/CPAP vendor to find an alternative mask that is more suitable for you.



People with OSA who use the CPAP report feeling more energetic during the day.

3. Difficulties in getting used to wearing a CPAP mask

You may wish to try using the CPAP while you are awake for short periods of time in the day, for example, while watching TV. When you are used to how it feels, you may start using the CPAP every time you sleep.

4. Difficulties in falling asleep

If you find the CPAP pressure too high as you are trying to fall asleep, a 'ramp' function on the CPAP machine may be used.

When this 'ramp' function is switched on, the CPAP machine will begin with a low pressure setting, and gradually increase to the targeted level of CPAP pressure as you fall asleep.

5. CPAP pressure is too high

If you feel uncomfortable with the pressures delivered by the CPAP machine during sleep, please highlight this to your doctor.

An overnight CPAP titration sleep study may be required to determine the settings that are most suitable for you.

With time, patience and support, CPAP can significantly benefit your overall health and quality of life.

Dental Splint

What is a Dental Splint or an Oral Appliance (OA)?

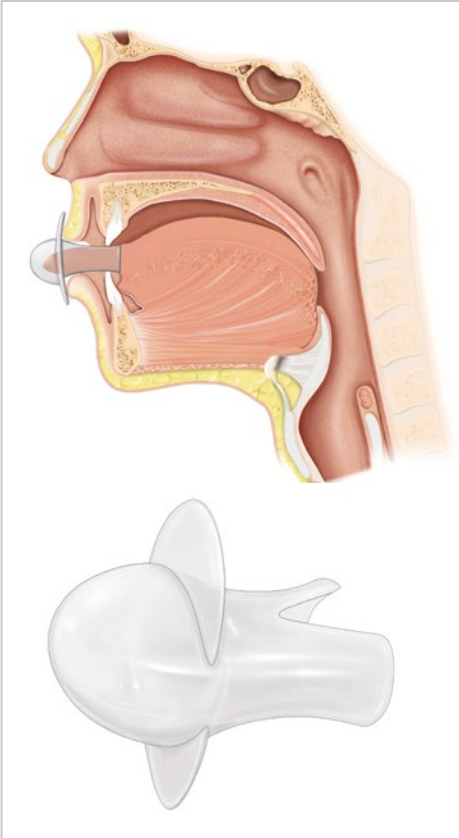
A dental splint or an Oral Appliance (OA) is an alternative to the CPAP in managing snoring and mild to moderate Obstructive Sleep Apnoea (OSA). OA looks like the removable functional braces worn by children, or mouth guards that protect the teeth during sports.

There are many names for an OA:

- Mandibular advancement device
- Mandibular advancement splint
- Sleep apnoea mouth guard
- Sleep apnoea dental appliance
- Sleep apnoea oral appliance

An OA is different from a dental splint, that is used to protect the teeth in bruxism (tooth grinding).

Proper examination and diagnosis are needed to determine the jaw structure and nature of airway obstruction, before prescribing an OA. Those who mouth breathe will not be able to use an OA as it fills the oral cavity and obstructs mouth breathing.



A tongue stabilising device clips onto the front of the tongue and pulls it forward to open the airway.

Another form of an OA, is the Tongue Stabilising Device (TSD). It also goes by many names: *tongue retaining device, sleep apnoea tongue device or tongue guard.*

It is a silicone suction cup that clips over the front of the tongue. Lip shields protrude from the device to keep the tongue positioned outside the mouth.

How Do Oral Appliances (OA) Work?

The tongue guard or TSD holds onto the tongue and prevents it from falling backwards into the airway during sleep. A customised OA is made of acrylic-like dental splints and is anchored on all teeth in both the jaws.

There are built-in mechanisms in the OA, such as screws, connectors or bite blocks, to thrust the mandible (lower jaw) forward. The tongue, soft palate, other muscles and soft tissues in the mouth and throat become stretched and taut as the mandible is re-positioned anteriorly.

With the tongue and soft palate shifted forward and away from the airway, the calibre of the airway increases.

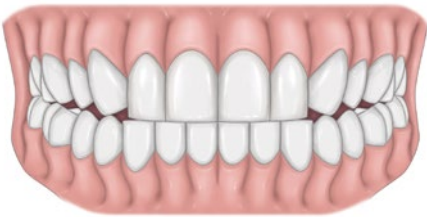
Sometimes an OA may be used together with a CPAP machine to reduce the air pressure for easier breathing. There is an OA adjustment (titration) period of four to six months, when the mandible is gradually advanced into an optimum position, before a second sleep study is done to determine the effectiveness of the OA.

What Can Oral Appliance (OA) Wearers Expect?

The common side effects in using an OA are an open mouth posture and drooling during sleep. The jaw muscles and teeth, especially the incisors, may be sore or painful at the start of OA use.

The pain and discomfort will reduce, after a wearing-in period of up to six months. The way the teeth fit together may change, and the lower teeth will bite in a more forward position in the morning. The change in bite is transient and lasts for an hour or so after the removal of the OA.

However, after many years of long-term use, there may be a small permanent change to the lower jaw position which becomes a couple more millimetres forward; it does not make a big visible change to the physical appearance.



There may be changes to the bite after wearing an oral appliance for a few years.

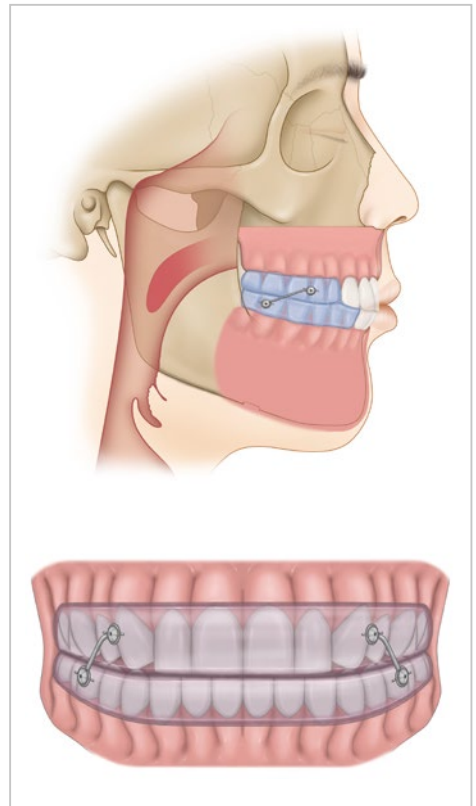
The horizontal gap between the upper and lower incisors may be reduced, and the lower incisors will shift to an edge-to-edge bite with the upper incisors. The bite of the molars will also change after a couple of years.

If oral hygiene practice is poor during OA use, tooth cavities and tooth loosening may occur. Dental fillings, crowns, bridges, implants and gum treatment should be done first before the OA is made.

An OA does not last forever. It may be necessary to replace an OA every three to five years depending on the maintenance of the OA and whether it still fits.

Advice to Oral Appliance Wearers

An OA cannot be worn if there is poor oral health maintenance. Teeth are anchors for the OA, and OSA management is not effective when teeth are loose or lost through a lack of oral healthcare.



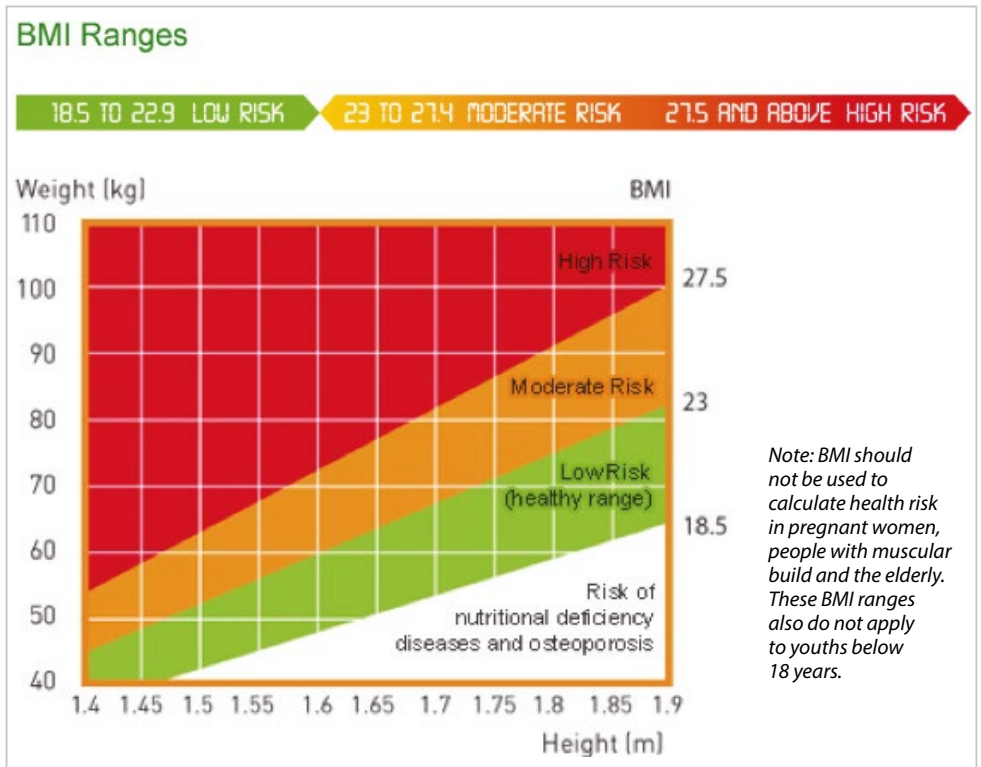
An oral appliance reduces snoring and OSA by posturing the lower jaw forward to open the airway.

Sleep studies are necessary every few years to determine if the OA is still effective. OA treatment becomes less effective with weight gain and increased severity of OSA.

The following are advised in OSA treatment using an OA:

- Maintain good oral health and have a dental check-up every six months.

- Make sure the nasal passage is patent for breathing through the nose.
- Exercise regularly and keep to a healthy weight in the BMI range below 23.



Healthy BMI Chart (extracted from www.healthhub.sg)

Jaw Surgery in Managing Adults with OSA

In severe OSA cases, after all alternative forms of treatment have been tried and are not effective, there is an option for Maxillomandibular Advancement (MMA) surgery or jaw surgery.

It is a major surgical procedure, whereby both the upper and lower jaws are surgically advanced using orthognathic surgery techniques. It is done in conjunction with fixed orthodontic braces to shift the upper and lower teeth into a good bite after the surgery.

The duration of treatment may take as long as one to three years. All soft tissues and muscles attached to the jaws are brought forward. This pulls on the lax soft tissues to tighten them up.

The airway and larynx open up and become much bigger when the soft palate and tongue are relocated anteriorly after surgery. Long-term studies show a high success rate in managing OSA with this procedure, which also achieves good quality of life outcomes.

Surgery

Surgery is indicated for OSA when first-line treatment, such as behavioural and lifestyle modifications, CPAP therapy as well as dental appliances, have failed. Surgery is also recommended, when you have easily correctible abnormalities of the upper airway, such as enlarged tonsils and adenoids.

Patients may also need nasal surgery if they have nasal congestion affecting CPAP usage.

Planning for the Surgical Treatment of OSA

When surgery is being considered for a patient, the upper airway should be examined with a flexible nasoendoscope performed by an Ear, Nose and Throat (ENT) specialist to identify the sites of upper airway obstruction during sleep.

Obstruction can occur at one or several locations: nose, soft palate in the oral cavity, tonsils, base of the tongue and epiglottis.

A combination of surgeries may be performed when the obstructions occur at multiple sites. It is therefore crucial to identify the obstructing areas in order for the surgery to be tailored for each individual, and to avoid unnecessary surgery.

Other investigations to evaluate the upper airway may be performed, including:

- Lateral cephalometry
- Computed tomography (CT) or magnetic resonance imaging (MRI) scans of the upper airway, awake or asleep
- Drug-induced sleep endoscopy
- Computer-assisted airway measurements (CAM)

Types of Surgery for OSA

The purpose of surgery is to reduce, remove or reposition tissues of the upper airway, in order to increase the upper airway dimensions and reduce obstructions.



Normal airway



OSA airway

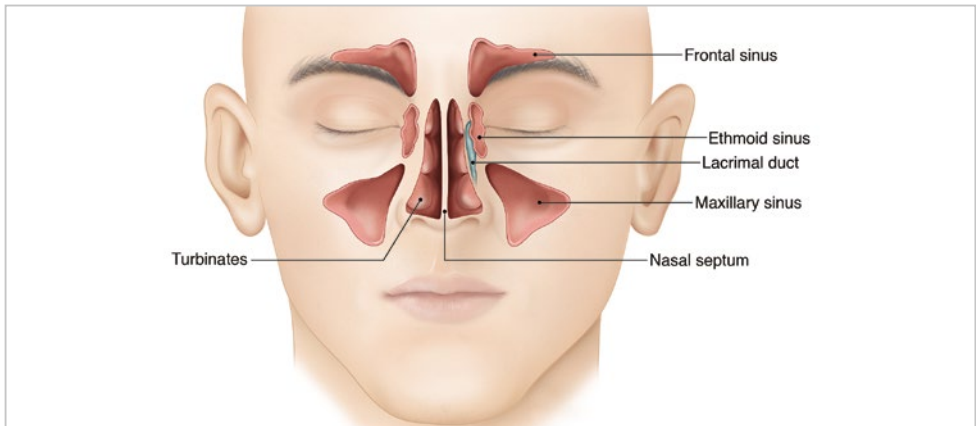
1. Nasal Surgery

In the nose, normal structures like the turbinate may be enlarged due to allergic rhinitis. The nasal septum that divides the nose into the left and right sides may also be deviated to one side.

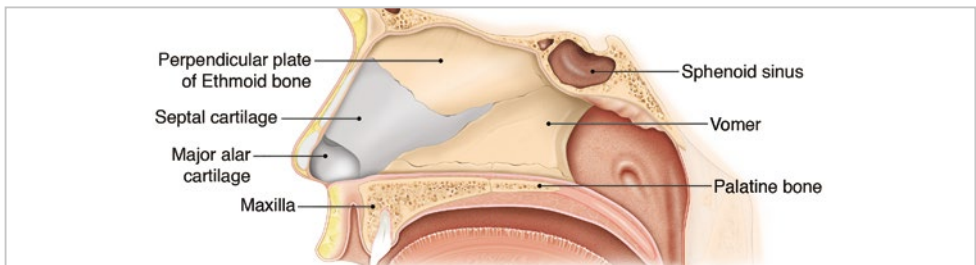
Sinusitis, nasal polyps and enlarged adenoids can also contribute to nasal obstruction which results in mouth breathing.

This causes the tongue to fall backwards, contributing to upper airway obstruction. Nasal obstruction also reduces CPAP compliance due to nasal discomfort.

Treatment of nasal obstruction begins with allergen avoidance, medications like antihistamines, intranasal steroids, nasal decongestants and antibiotics when required. Nasal surgery is indicated when medical therapy fails.



Nasal passage with sinuses



Nasal septum and upper airway

Surgical options to relieve nasal airway obstruction include:

- Reducing the size of the turbinates
- Straightening the deviated nasal septum
- Removing enlarged adenoids
- Endoscopic sinus surgery to treat nasal polyps and sinusitis

2. Palatal Surgery

The area behind the soft palate is the most common site of obstruction, contributing to snoring and OSA.

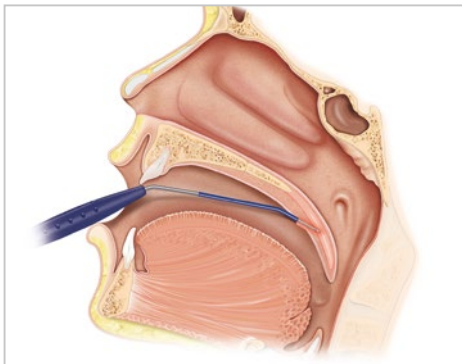
This is usually a result of bulky, floppy, low-lying soft palate, enlarged tonsils, excessive posterior tonsillar pillar muscles or mucosa, elongated uvula and redundant lateral pharyngeal mucosa.

For those with snoring and mild or moderate OSA, radiofrequency ablation of the soft palate may be performed under local anaesthesia, to reduce the floppiness and bulkiness of the soft palate.

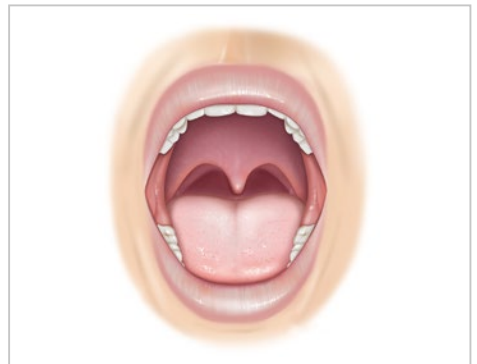
Alternatively, tonsillectomy and Uvulopalatopharyngoplasty (UPPP) or one of its many variations can be performed under general anaesthesia to increase the airway dimensions behind the soft palate.



Narrowed oropharyngeal airway with long soft palate



Radiofrequency of the soft palate



Enlarged oropharyngeal airway

Some of the variations of UPPP include:

- **Uvulopalatal flap**
- **Relocation pharyngoplasty**
- **Lateral pharyngoplasty**
- **Barbed reposition pharyngoplasty**

3. Hypopharyngeal and Base of Tongue Surgery

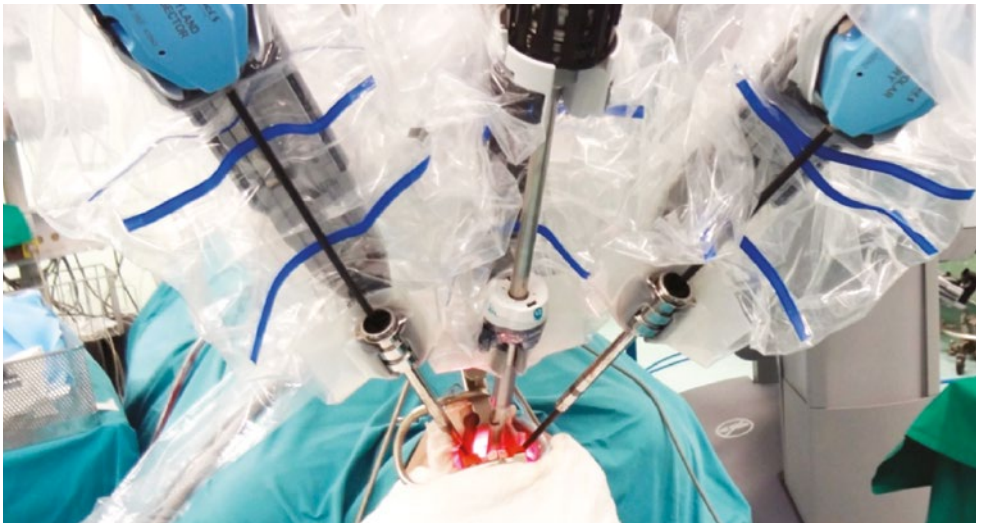
The base of the tongue and lingual tonsils (lymphoid tissue at the base of tongue) may be enlarged, contributing to upper airway obstruction during sleep.

The epiglottis (cartilage situated behind and below the base of the

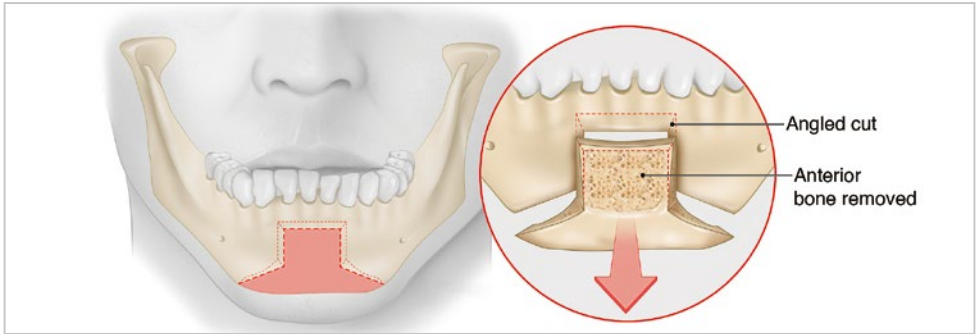
tongue) can also cause airway obstruction during sleep. Some people may have a small lower jaw that leaves less room for the tongue, resulting in posterior displacement of the tongue, reducing the size of the upper airway.

Options to treat obstruction, include both soft tissue surgery as well as bony skeletal surgery. **Soft tissue surgery** involves radio frequency ablation to reduce the size of the tongue, or **median glossectomy** to remove the middle portion of the back of the tongue.

Transoral Robotic Surgery (TORS) can be used to access the back of the tongue, allowing for superior access and view of the tongue base and hypopharyngeal area.



The da Vinci Transoral Robotic Surgery (TORS) for OSA



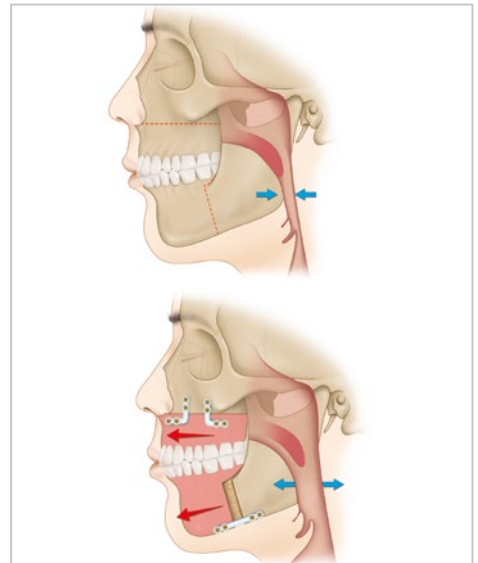
Genioglossus advancement – tongue muscle is pulled forward to increase the airway space at the back, and to increase the tension of the tongue, to reduce obstruction during sleep.

Bony skeletal surgery to the lower jaw can also be performed to increase the airway size behind the tongue, and increase tension on the tongue to prevent it from falling backwards and causing obstruction during sleep. Examples of such surgeries include:

- **Sliding genioplasty**
Surgery to cut and reposition a part of the chin bone towards the front.
- **Genioglossus advancement**
Surgery where the tongue is pulled forward.
- **Hyoid suspension**
Surgery where the hyoid bone (U-shaped bone in the front midline of the neck) and its muscle attachments to the tongue and airway are pulled forward.

4. Maxillomandibular Advancement Surgery

Maxillomandibular advancement (MMA) is a more invasive but effective surgery, with up to a 90 percent success rate.



In maxillomandibular advancement surgery, the upper and lower jaws are surgically advanced to open the airway.

This procedure is performed when nasal, palate and tongue base surgeries are not effective enough. It involves breaking the mid-face and lower jaw bones to move them forward, increasing the space behind both the palate as well as the tongue base.

5. Hypoglossal Nerve Stimulation

Hypoglossal nerve stimulation is a novel form of therapy in treating OSA by increasing upper airway muscle tone during sleep.

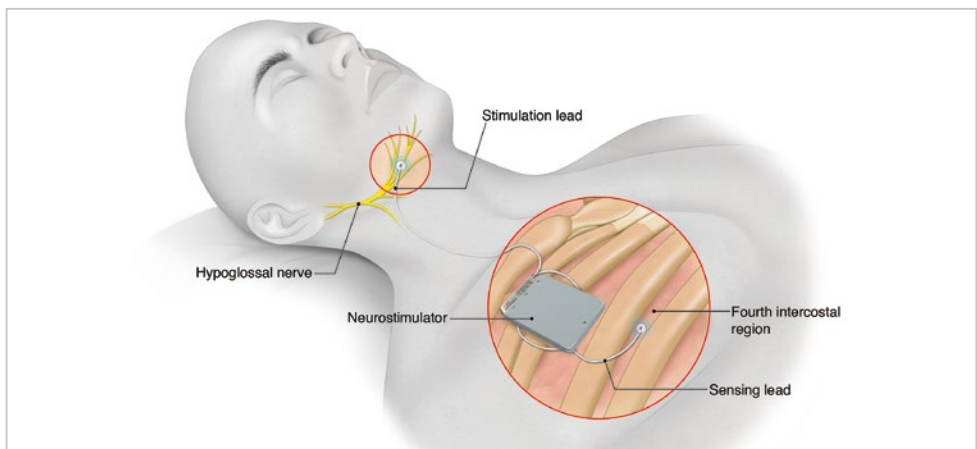
This is achieved by implanting a device beneath the skin in the chest. This device is switched on by the patient just before sleep, and it applies mild stimulation to the hypoglossal nerve that supplies the tongue. This achieves optimal tongue protrusion required to prevent tongue base obstruction during sleep.

6. Tracheostomy

Tracheostomy involves creating a hole in the windpipe (trachea) in the lower part of the neck to bypass the upper airway obstruction. The patient, thereafter, will be breathing through the hole in the lower neck during sleep.

A tracheostomy tube may be placed through this hole to help with the breathing. It is used in people with refractory airway obstruction, and in the morbidly obese with medical conditions that contraindicate surgeries that are more extensive.

Although this is a simple procedure with a success rate of almost 100 percent, this option is poorly accepted by patients, due to the stigma and problems that comes with breathing through a hole in the lower part of the neck.



Hypoglossal nerve stimulation

CONCLUSION

There are numerous surgical options for the treatment of OSA for patients who have failed CPAP therapy. Everyone has a different upper airway and a different cause of OSA. A single surgical treatment protocol will not work for all.

Surgery needs to be individualised to each and every single patient to ensure that unnecessary surgery is not performed. The most conservative surgical option is also the most effective.

ADVICE ON RISK REDUCTION FOR OSA

- Reduce weight if you are obese
- Exercise regularly
- Quit smoking
- Avoid consuming alcohol at night. Alcohol causes relaxation of the upper airway muscles.
- Avoid sleeping pills/sedatives as these may cause relaxation of the upper airway muscles.

For enquiries, contact SingHealth Duke-NUS Sleep Centre at:

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