



Penn Medicine



PATIENT RESOURCE PORTFOLIO

Maxillomandibular Advancement for Obstructive Sleep Apnea

DIVISION OF SLEEP SURGERY
DEPARTMENT OF OTORHINOLARYNGOLOGY
UNIVERSITY OF PENNSYLVANIA HEALTH SYSTEM



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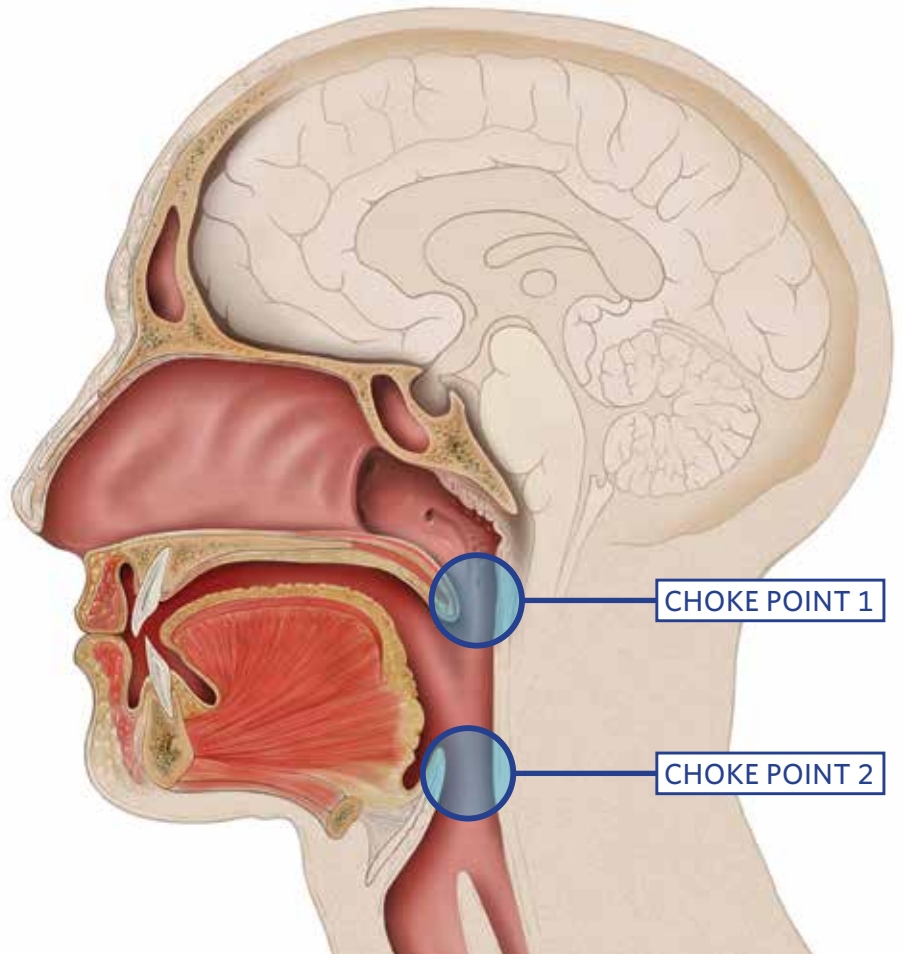
What is Maxillomandibular Advancement (MMA)?

Maxillomandibular advancement (MMA), also known as double-jaw surgery or bimaxillary advancement surgery, is the main form of skeletal surgery for treatment obstructive sleep apnea (OSA). MMA is generally considered for adult patients who are unable to tolerate continuous positive airway pressure (CPAP).

The aim of this surgery is to open the airway where it obstructs during sleep. This most often occurs behind the soft palate and tongue. By moving both the upper and lower jaws forward with MMA, these two “choke points” can be relieved.

This type of surgery for OSA has been performed successfully for more than 35 years with long-term success rates approaching 90%. The improvements in sleepiness, quality of life and cardiovascular risk appear similar to that of patients regularly using continuous positive airway pressure (CPAP).

Why is Maxillomandibular Advancement performed?



Untreated obstructive sleep apnea has serious consequences:

Quality of Life

- Poor sleep quality with frequently interrupted sleep
- Excessive daytime sleepiness and fatigue
- Memory and cognition impairment
- Disruption of sleep quality for or bedpartners

Medical Health

- Increased risk of car accidents due to sleepiness while driving
- High blood pressure
- Diabetes
- Abnormal heart rhythm
- Heart attack
- Stroke

The first-line treatment for patients with OSA is CPAP. Given that 50% of patients are not able to tolerate CPAP long-term, Dr. Dedhia's team will discuss other options to patients in this CPAP Alternatives Clinic. These options include weight loss, oral appliance therapy, positional therapy and surgery (soft tissue surgery, hypoglossal nerve stimulation, MMA and tracheostomy).

Important considerations for MMA

- This is a major surgery, lasting roughly 6 hours. The recovery process is most difficult during the first 4-6 weeks, during which social support is key. Most patients return to work after 1 month. Lip and mouth numbness is the most common patient complaint, with sensation taking up to 1 year to return.
- You will look different after surgery as your jaws will assume a more forward position. While your loved ones will likely notice a difference, strangers will not perceive your appearance as "unusual". See before and after photos of Dr. Dedhia's patients (page 11).
- You will likely lose > 15 pounds following surgery due to difficulty in eating. Many patients will fully maintain their weight loss with improved sleep, diet and exercise.

What happens before surgery?

1 Initial consultation with Dr. Dedhia

Dr. Dedhia's team will take a detailed medical and sleep history, focusing on issues relevant to your OSA. A thorough review of previous sleep studies will be performed and a copy will be provided to you. If you have not had a sleep study, one will be performed. This is an essential part of determining your candidacy for MMA surgery.

Next a comprehensive sleep apnea focused physical exam will assess occlusion (how your teeth line up), the size, shape and position of the jaws, the size and position of the soft tissue structures in the oral cavity including the tongue, soft palate and tonsils. Finally, your upper airway will be examined while lying reclined in the examination chair using a flexible digital camera. By looking at the back of the throat and upper airway, the sites of obstruction leading to OSA can be better evaluated.

At this point, Dr. Dedhia will have explained the possible treatment options in detail including medical and surgical options. If both you and Dr. Dedhia feel that MMA surgery is the best treatment option, Dr. Dedhia will arrange dental impressions, preoperative photos, dental x-rays and an in office low dose CT scan. This CT scan will be used for surgical planning.

If you are interested in correcting your bite as part of the MMA procedure, a consultation with an orthodontist can be incorporated into the surgical planning process at this time.

2 Return visit with Dr. Dedhia

Upon the return visit with Dr. Dedhia, you will have the opportunity to ask any further questions. Details of the surgery will again be discussed in terms of what to expect on the day of surgery and following the surgery. You will be given a post-operative supply kit, including a soft toothbrush, dental wax, dental elastics with applicators.

3 Pre-operative visit with anesthesia

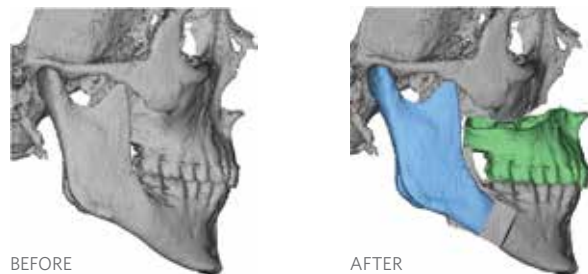
Our surgical scheduling team will arrange an appointment with the anesthesia pre-operative clinic. The primary goal of this visit is to ensure that you are deemed safe to undergo the proposed surgery. You will be asked to stop any blood thinning medications 7-10 days prior to surgery.

4 Virtual surgical planning session

Roughly 10 days prior to your surgery, the CT scan images and dental models will be used to create a precise digital 3D model of your jaws and skull. This virtual model creates a very accurate representation of the relationship of the upper and lower jaw.

This 3D virtual model is used to precisely plan the surgical bony cuts (osteotomies) and movements of the jaws. Measurements of important anatomical landmarks and their relationship to one another are made. These measurements are available for reference during the surgery.

Dental splints are created and printed using a 3D printer. These splints are used during the surgery to assist in placing the jaws exactly where they need to be to keep the patient's bite the same as compare to before the surgery. Below is a representation (before and after) of the movements of both jaws.



5 The day before surgery

You will receive a call reminding you what you are allowed to eat and drink the night before and the morning of surgery. You will also be provided information regarding the time and location to report the day of surgery.

What happens on the day of surgery?

After you are checked in to the preoperative area, you will meet the anesthesia team and operating room nurses. Dr. Dedhia and his surgical team will also meet you and go over any final questions or concerns you have. During the surgery, the nurse in the operating room will update your family/friends by phone. From the time that the patient enters the OR until the time the patient exits the OR, it can be roughly 7 hours.

Once in the operating room, you will be introduced to everyone working in the room for your surgery. The anesthesia team will give medications to make you comfortable and put you to sleep (this will be the last thing you remember until you wake up from surgery).

Once you are put to sleep, a breathing tube and urinary catheter are placed. At this point, the surgery will begin.

MMA Surgical Process

Part I: Submental intubation

The breathing tube will be passed from your mouth to under the chin by means of a small incision (1 inch). This technical application pioneered by Dr. Dedhia's team (1) keeps the breathing tube out of the working areas in the mouth and (2) allows the structures of the nose to be positioned optimally for breathing.

Part II: Arch bar placement

Heavy duty braces called arch bars are placed on the upper and lower teeth. These are necessary during the surgery and afterward to maintain your occlusion.

Part III: Upper jaw surgery

Through an incision inside your upper lip, the upper jaw is exposed and cut. The jaw is moved forward according to the 3D models and secured in position using titanium plates and screws.

Part IV: Lower jaw surgery

Through an incision inside your lower lip, the lower jaw is exposed and cut. The jaw is moved forward according to the 3D models and secured in position using titanium screws. Very small (1/4 inch) incisions on each cheek will be made to allow for screw placement.

Part V: Closure

The incisions are closed with absorbable sutures and the breathing tube is returned to the mouth. Finally, dental elastics are placed on the arch bars to help keep your bite same.

After the surgery, Dr. Dedhia will talk to your family/friends in person to review the events of the case as well as next steps.

What happens after surgery?

In-hospital Care

Following waking up in the recovery room, you will be transferred to the inpatient unit where you will stay to recover after surgery. Some patients will need to go to the intensive care unit (ICU) for closer monitoring.

Patients normally stay on the ENT Surgery unit for 2-3 nights. The plan will be for you to go home when you are comfortable caring for yourself at home. During your stay in the hospital, you will be seen by the ENT surgery team (Dr. Dedhia and/or one of this surgical trainees) at least 2 times per day to provide nasal and mouth care.

GOALS FOR POST-OPERATIVE DAY 1

1. Urinate on your own
2. Have your pain controlled
3. Get out of bed at least 3 times
4. Keep your jaw dressing around your head with ice packs inside the dressing
5. Practice drinking liquids as demonstrated by the team
6. Practice nasal washes as demonstrated by the team

GOALS FOR POST-OPERATIVE DAY 2 & 3

1. Control your pain with medication by mouth
2. Walk in the hallway at least 3 times
3. Shower
4. Keep your jaw dressing around your head with ice packs inside the dressing
5. With the help of family/friends (if needed), drink at least 6 cups (48oz) of liquids
6. With the help of family/friends (if needed), perform nasal washes three times
7. Obtain post-operative CT scan which will be reviewed by Dr. Dedhia's team

If you are doing well and are comfortable you can go home in the afternoon of post-operative day 2. If you need more time the ENT team would plan to discharge them on the following day (day 3).

A member of Dr. Dedhia's team will review the post-operative instruction with you and your family.

When are my follow up appointments and what happens at these appointments?

10-14 days after surgery

This will be your first post-operative appointment. You will receive a date and time for this appointment prior to your discharge from the hospital.

During this appointment, Dr. Dedhia will assess your healing (swelling, the surgical incisions and your occlusion (bite)). Most patients have their dental elastics taken off at this appointment and can start eating a pureed diet afterwards.

3 weeks after surgery

You and Dr. Dedhia will discuss your recovery: sleeping, pain, eating and any other concerns you have. During this visit, Dr. Dedhia will evaluate your wound healing, bite and return of sensation of your face.

5-6 weeks after surgery

Dr. Dedhia's team will perform a sedated endoscopy and remove your arch bars (heavy braces). Most patients return to work following this appointment. It is recommended to start eating a soft diet at this time.

3 months after surgery

Dr. Dedhia will perform a comprehensive anatomic evaluation including an endoscopic of your airway. At this time, your jaws should have fully healed which allows you to return to a normal diet. You will also start physiotherapy for increasing your ability to open your mouth. To do this you will sequentially increase the number of tongue depressors you can fit between your teeth. Every day or so you will insert another tongue depressor in the middle of the stack, with your goal being to get 25 tongue depressors (= 4cm) between your teeth.

Finally, Dr. Dedhia will order a sleep study to evaluate the success of the surgery.

6 months after surgery

Dr. Dedhia will review your sleep study with you and provide a copy to you. Post-operative photographs and x-rays may also be taken. If additional care is needed, the plan will be discussed at this time.

12 months after surgery

This appointment serves as your final check up with Dr. Dedhia. Most patients graduate from needing to see Dr. Dedhia at this time!

What are the side effects and possible complications of MMA surgery?

Side Effects

- **Pain**

You can expect some pain, but it is uncommon to experience extreme pain after the operation. By comparison, this surgery is less painful than having your tonsils removed. With the use of pain medication, patients generally complain of a dull, achy pain and a feeling of discomfort due to the swelling in the face.

- **Nausea and vomiting**

Some patients experience nausea and vomiting following completion of the surgery. This commonly occurs as a reaction to the anesthetic medications. Nausea and vomiting are managed with anti-nausea medications during the hospital stay. If vomiting does occur, the dental elastics should be cut immediately.

- **Bleeding**

Oozing is very common following for the first 1-3 days following surgery. To help manage this, you are encouraged to remain inclined (with the head of bed elevated to at least a 30-degree angle). A suction (similar to like when you are at the dentist) will be provided to you in the hospital to help with any bloody secretions.

- **Swelling**

Swelling is expected following surgery. It is most prominent in the lips and will become more pronounced over the first post-operative week. Sleeping on an incline, gentle walking and using the Jobst dressing with icepacks will help keep the swelling down. The vast majority of swelling will resolve within 2 to 3 weeks; however, all swelling will not fully resolve for up to a few months.

- **Weight loss**

Due to dietary restrictions following surgery, most patients lose at least 15 pounds in the first 3 months after surgery. Generally, some of this weight will return over time (unless lifestyle changes are made).

- **Sensory changes**

All patients will have numbness or altered sensation in a distribution covering the lower face, surrounding and including the lips following the surgery. This is a result of stretching to the nerves caused by the movement of the upper and lower jaws forward. These sensory changes are often noticed when kissing one's partner, trying to enunciate certain sounds or smiling widely.

This numbness improves slowly (over several weeks to a few months) and returns fully in the vast majority of patients. For patients that are older (greater than 60 years old) or have medical problems that slow healing (diabetes), return of sensation can take much longer or may only partially return.

Some patients experience nerve related pain during the healing process (usually described as an electric shock like or burning sensation). This can be managed by using a nerve pain specific medications.

- **Changes in occlusion (*your bite*)**

The goal of MMA surgery is to maintain your bite from before surgery. Small shifts of 1 mm are common; in most patients, the bite will naturally fall back into a normal position. In some cases, patients require minor dental work to file down or re-contour the teeth into a natural bite. In the rare case that the bite is significantly misaligned, you may require surgical correction.

- **Limited mouth opening (*trismus*)**

Your mouth opening following MMA surgery will be more limited than it was before surgery due to stretching of the facial soft tissues. At the 3 month post-operative visit, Dr. Dedhia's team will demonstrate physiotherapy to help with mouth opening. It is important to wait until 3 months after MMA surgery before working to increase your mouth opening as this allows the bony cuts to fully heal.

- **Persistent snoring**

Snoring is generally improved following surgery; however, for those whom loud snoring persists post-operatively, it typically resolves in the first 2 weeks following surgery as the airway swelling subsides.

Possible Complications

- **Infection**

To prevent the risk of infection, you will receive prophylactic antibiotics during the surgery, and we will closely monitor the healing surgical sites. If infection were to develop, treatment most often involves a course of antibiotics. For cases where infection is in the area of plates and screws (hardware), a second small surgery may be needed to remove the hardware and drain the infected area. *The risk of this complication is roughly 20%.*

- **Damage to teeth**

With placement of heavy braces and movement of the jaws, tooth discoloration, damage to the tooth roots, tooth crowns of mild shifting of the teeth (especially ones in the front) can occur. If it is bothersome, consultation with a dentist is encouraged 3 months after surgery. *The risk of this complication is roughly 20%.*

- **Bony nonunion** (*failure of the bony cuts to heal together*)

Under rare circumstances but, more frequently in patients with impaired wound healing, the bony segments created by the surgical cuts may fail to heal together. In this situation, an infection often results. Revision surgery is generally required to fix this problem. *The risk of this complication is roughly 10%.*

- **Fracture of the mandible** (*the lower jaw*)

The lower jaw can occasionally be fractured in an area not intended during the operation (great care is taken to avoid this from happening). If this were to happen, a reconstructive plate may be needed to stabilize the bony fragments. *The risk of this complication is roughly 10%.*

The bony cuts take a minimum of 6 weeks to heal and are not fully healed until 3 to 4 months after surgery. It is very important to avoid trauma to the upper and lower jaws following surgery. This includes both trauma from impact (getting hit in the face) and chewing hard food, resulting in significant pain and/or change in bite. If you experience these symptoms, please contact the Sleep Surgery Team as soon as possible.

- **Longstanding numbness**

During surgery, there are four sensory nerves (upper right, upper left, lower right and lower left) to the face that are at risk. If one of these nerves is inadvertently severed, it will be repaired during surgery. Despite repair, it can result in both slow and incomplete return of sensation. *The risk of this complication is roughly 10%.*

- **Nasal obstruction**

One of the goals of MMA surgery for sleep apnea is to improve breathing through the nose following surgery. This is one of the reasons why we perform submental intubation as part of the MMA surgery. The submental intubation allows us to make sure that the nasal septum (the midline divider of the nose) is secured in the midline and that both nasal passages are widely open at the end of the surgery. In some cases, a blockage of one side of the nose can happen during healing. This may need to be corrected with a minor procedure depending on the effect of the patient's breathing. *The risk of this complication is roughly 5%.*

- **Temporomandibular joint problems**

As the lower jaw assumes a more forward position, the temporomandibular joint (TMJ) can experience strain, resulting in long standing discomfort. Infrequently, the TMJ can be resorbed over time requiring additional surgery. *The risk of TMJ complications is roughly 3-5%.*

- **Palatal necrosis**

One extremely rare but potentially serious complication of MMA surgery is where the blood supply to the palate (the roof of the mouth) is compromised. If this happens, the bone and soft tissue of palate will not survive, requiring another major surgery to repair it. *The risk of this complication is less than 1%.*

It is important to note that no reported patient deaths have occurred as a result of the MMA surgery.

Frequently Asked Questions (FAQ)

What is the chance that MMA will cure my sleep apnea?

MMA surgery has been shown to cure obstructive sleep apnea (OSA) or convert it to a mild form in nearly 90% of patients.

Will there be any visible external scarring?

Yes. While all major scars are inside the mouth, there will be one small (1/4 inch) scar on each cheek and a 1/2 inch scar under the chin.

Will I look different?

Yes. Your jaws will assume a more forward position. While your loved ones will likely notice a difference, strangers will not perceive your appearance as “unusual”. See before and after photos of our patients (page 11).

Is this surgery very painful?

No. You can expect some pain, but it is uncommon to experience extreme pain after the operation. By comparison, this surgery is less painful than having your tonsils removed. With the use of pain medication, patients generally complain of a dull, achy pain and a feeling of discomfort due to the swelling in the face.

Can I eat and talk after the operation?

Yes. Your jaw will NOT be wired shut but held in place with elastic bands.

Your diet should be entirely liquid while the elastics are in place (10-14 days), then a pureed diet can be consumed until the heavy braces (arch bars) are removed around 6 weeks.

Following removal, a soft diet should be consumed until 3 months. At the 3 month visit, Dr. Dedhia will likely approve you for a regular diet.

How much time should I take off work?

Depending on the nature of your job, you will need between 3 to 6 weeks to return to full duty.

How long after the surgery can I start doing sports and performing other physical activities?

Sometime between 6 and 12 weeks after surgery.



Patient Advocate

A grateful patient having undergone MMA surgery for OSA with Dr. Dedhia (while at Emory University in Atlanta) has graciously offered to make himself available to patients considering this procedure as treatment for their OSA.

Mr. Deangelo Norris

Business Phone: 404-616-0680 • Email: dnorris@gmh.edu

Patient Photos

PRE-OPERATIVE



POST-OPERATIVE





About Dr. Dedhia

All Roads Lead to Penn

Dr. Raj C. Dedhia is a native of Wilkes-Barre, PA. He came to the University of Pennsylvania for his undergraduate studies in Biological Basis of Behavior and Health Care Systems (Wharton School). Prior to starting medical school, he moved to Paris, France to study the French health system. He completed medical school at Northwestern University in Chicago, IL and returned to the University of Pennsylvania to begin his residency in Otorhinolaryngology-Head & Neck Surgery. However, he prematurely left Philadelphia for love, joining his soon-to-be wife, Kavita, at the University of Pittsburgh Medical Center to complete their otolaryngology residencies.

Following residency, they moved their young family to Seattle to complete his fellowship in Sleep Medicine & Surgery at the University of Washington. As they completed their training, Dr. Dedhia and his wife, Dr. Kavita Dedhia, joined the otolaryngology faculty at Emory University in Atlanta, GA in 2015. In 2019, Drs. Dedhia accepted positions at the University of Pennsylvania School of Medicine's Department of Otorhinolaryngology, where they hope to stay for a long, long time.

Leading the Field of Sleep Surgery

Dr. Dedhia is one of the first 10 otolaryngologists in the U.S. to complete a fellowship in sleep medicine, providing him a deep-seated understanding of obstructive sleep apnea. He provides all medical and surgical options for the disease, including the full gamut of sleep surgery such as drug-induced sleep endoscopy, reconstructive nasal surgery, soft tissue surgery, hypoglossal nerve stimulation and skeletal surgery. In 2018-2019, Dr. Dedhia had the distinguished honor of training one of four sleep surgery fellows in the United States.

He holds a Masters in Clinical Research which has paved the way for him to receive 3 foundation grants (American Heart Association, American Sleep Medicine Foundation and Triological Society) related to sleep apnea. He has published over 20 peer-reviewed articles and serves as Associate Editor for the Journal of Clinical Sleep Medicine. He regularly lectures for the American Academy of Sleep Medicine and American Academy of Otolaryngology.

His Proudest Professional Accomplishment

In both 2017 & 2018, Dr. Dedhia received the Emory Clinic Patient Satisfaction Award, given to the top 10% of physicians at Emory. This award was a reflection of his patient care mantra, "Treat others how you want to be treated".