“CHANGES IN THE FINDINGS OF DRUG INDUCED SLEEP ENDOSCOPY IN ACCORDANCE WITH DEPTH OF SLEEP MEASURED BY BISPECTRAL INDEX IN OBSTRUCTIVE SLEEP APNOEA”

This dissertation is submitted to

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REGISTRATION No.: 221914003

BONAFIDE CERTIFICATE

This is to certify that this dissertation entailed **"CHANGES IN THE FINDINGS OF DRUG INDUCED SLEEP ENDOSCOPY IN ACCORDANCE WITH DEPTH OF SLEEP MEASURED BY BISPECTRAL INDEX IN OBSTRUCTIVE SLEEP APNOEA"** submitted by **Dr.AISHWARYA. C,** appearing for M.S. ENT., registration number - 221914003 Branch IV Degree examination in May 2022 is a bonafide record of work done by him under my direct guidance and supervision in partial fulfillment of regulations of the Tamil Nadu Dr. M.G.R. Medical University, Chennai, Tamil Nadu, India.

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CERTIFICATE – II

This is to certify that this dissertation work titled **"CHANGES IN THE FINDINGS OF DRUG INDUCED SLEEP ENDOSCOPY IN ACCORDANCE WITH DEPTH OF SLEEP MEASURED BY BISPECTRAL INDEX IN OBSTRUCTIVE SLEEP APNOEA"** of the candidate **Dr.AISHWARYA. C** with registration Number 221914003 for the award of M.S in the branch of Otorhinolaryngology. I personally verified the urkund.com website for the purpose of plagiarism check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows 19.8 percentage of plagiarism in the dissertation.

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DECLARATION

I solemnly declare that the dissertation **"CHANGES IN THE FINDINGS OF DRUG INDUCED SLEEP ENDOSCOPY IN ACCORDANCE WITH DEPTH OF SLEEP MEASURED BY BISPECTRAL INDEX IN OBSTRUCTIVE SLEEP APNOEA"** is done by me at the Madras Medical College and Government General Hospital, Chennai during 2019-2022 under the guidance and supervision of **Prof.*Dr.F.ANTHONY IRUDHAYARAJAN M.S., D.L.O.,***

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ABBREVATIONS

OSA	:	Obstructive Sleep Aponea
OSAS	:	Obstructive sleep apnoea syndrome
OSAHS	:	Obstructive sleep aponea hypopnea syndrome
DISE	:	Drug induced sleep endoscopy
SNE	:	Sleepnasendoscopy
BIS	:	Bispectral index
UARS	:	Upper airway resistance syndrome
RDI	:	Respiratory disturbance index
RERA	:	Respiratory effort related arousal
CSA	:	Central sleep apnoea
AHI	:	Apnea Hypopnea Index
OAI	:	Obstructive apnoea index
CAI	:	Central Apnoea Index
EDS	:	Excessive daytime sleepiness
LVH	:	Left Ventricular Hypertrophy
EEG	:	Electroencephalagram
EMG	:	Electromyogram
EOG	:	Electro occulogram
ECG	:	Electrocardiogram
MRI	:	Magnetic Resonance Imaging
BMI	:	Body Mass Index
ESS	:	Epworth sleepiness scale
MMS	:	Modified Mallampatti score
FTP	:	Friedmans Tongue Position
Spo2	:	Oxygen Saturation

REM	:	Rapid Eye Movement
NREM	:	Non Rapid Eye Movement
ASA	:	American Society of Anaesthesiologists
VOTE	:	Velum, Oropharynx, tongue base, Epiglottis
FDA	:	Food and drug Administration of US
PIC	:	Patient interface cable
MIC	:	Monitor interface cable
SQI	:	Signal quality indicator
CPAP	:	Continuous Positive Airway pressure
PAP	:	Positive airway pressure
PAS	:	Posterior Air Space
MP-H	:	Mandibular Plane and Hyoid Distance
AP	:	Antero Posterior
SMILE	:	Submucosal intraoral lingual excision
UPPP	:	Uvulopalatopharyngoplasty
SDB	:	Sleep Disordered Breathing
AASM	:	American Academy of Sleep Medicine
TST	:	Total Sleep Time
MMA	:	Maxillo-mandibular advancement

TABLE OF CONTENTS

AIMS AND OBJECTIVES

1. To prospectively evaluate the changes in degree and site of upper airway collapsibility according to change in depth of sedation as determined by bispectral index in Drug induced sleep endoscopy in OSA patients.
2. To evaluate the usefulness of Bispectral index in accessing effects of sedation depth on DISE.
3. To improve the chances of successful outcome after sleep surgery by accurately determining the site of obstruction in OSAS patients.

INTRODUCTION

Obstructive sleep apnoea is a component of sleep disordered breathing and is characterised by repetitive partial or complete collapse of upper airway during sleep, resulting in disruption of normal sleep architecture and usually associated with arterial desaturations (1). If these respiratory events occur more than five times per hour of sleep and are associated with symptoms, most commonly snoring, excessive daytime fatigue, and witnessed apnoea, the term obstructive sleep apnoea/ hypopnoea syndrome(OSAS) is applied.(2)

At present OSAS has been identified as a separate risk factor or an entity for increased susceptibility to stroke, myocardial infarction, cardiac arrhythmias, hypertension, dyslipidemia, insulin resistance and diabetes mellitus, depression and sexual dysfunction. Impairment of alertness also increases the risk of susceptibility to occupational hazards and automobile accidents. Henceforth majority of this renewed interest within otorhinolaryngologist has been focused on sleep related breathing disorder OSA and this recognition has led to a multidisciplinary approach with creation of new medical discipline, SLEEP MEDICINE with a teams made up of otorhinolaryngologists, pulmonologists, neurologists,

maxillofacial surgeons and behavioural psycologists and bariatric surgeons. Nowadays we play a major role in both surgical and non-surgical treatment of OSA as we expertise in upper airway dysfunction.

Drug induced sleep endoscopy (DISE) or sleep nasendoscopy is an investigation which provides dynamic visualisation of anatomical areas responsible of generation of noise (snoring) or site of obstruction under condition which mimic sleep and aids in proper case selection for surgical management of OSAS.

Bispectral (BIS) monitoring system is a neurophysiological monitoring device which continually analyses a patient`s electroencephalogram during sedation and general anaesthesia to assess the level of consciousness and depth of sedation.(5). BIS values are found to be comparable between sedation induced sleep and natural sleep. Therefore it may offer us a measure that allows us to identify the ideal depth of sedation and assess the site of upper airway obstruction in OSAS patients.

DEFINITIONS

SLEEP DISORDERED BREATHING

It includes a spectrum of problems which involves obstruction of upper airway during sleep.

It includes

1. Obstructive sleep apnoea
2. Upper airway resistance syndrome(UARS)
3. Central sleep apnoea (CSA)
4. Sleep related hypoventilation disorder
5. Sleep related hypoxemia disorder(44)

OSA

Obstructive sleep apnoea is characterised by partial or complete collapse of upper airway during sleep resulting in disruption of normal sleep architecture associated with arterial desaturation

OSAHS

Obstructive sleep apnoea hypoxemia syndrome, If the respiratory events are more than 5 per hour of sleep associated with symptoms of snoring, witnessed apnoea and excessive day time sleepiness

UARS (upper airway resistance syndrome)

UARS describes patients with symptoms of OSA and polysomnographic evidence of sleep fragmentations but have minimal obstructive apnoea or hypopneas (RDI < 5) and do not exhibit oxyhemoglobin desaturation.

RESPIRATORY EVENT DEFINITIONS AND TYPES(40)

APNEA

A cessation of airflow for at least 10 sec

HYPOPNEA

A reduction in airflow (>= 30%) at least 10 sec with >= 4% oxyhemoglobin desaturation

Or A reduction in airflow (>= 50%) at least 10 sec with >= 3% oxyhemoglobin desaturation or an electroencephalogram(EEG) arousal.

OBSTRUCTIVE APNOEA

Apnoea for >/= 10 seconds with continued respiratory effort throughout the apnoea.

CENTRAL APNOEA

The complete cessation of respiratory movement and flow for 15 seconds.(some authors say >/= 10 seconds)

MIXED APNOEA

The complete cessation of flow for >/= 10 seconds with respiratory effort initially absent, but returning midway through the apnoea.

CENTRAL APNOEA

The complete cessation of respiratory movement and flow for 15 seconds.(some authors say >/= 10 seconds)

ANATOMY OF STRUCTURES CONTRIBUTING TO OBSTRUCTION IN OSA

The cause of obstruction may be static or dynamic obstruction

Static obstruction being septum, turbinates, polyps, adenoids, tonsils, skeletal abnormalities, obesity(33)

Dynamic obstruction are due to collapsible segment between bony upper airway and trachea. Its patency depends mainly upon the dilating muscle activity.

The major dilators of pharynx includes

Tensor palati

Genioglossus

Sternohyoid and geniohyoid

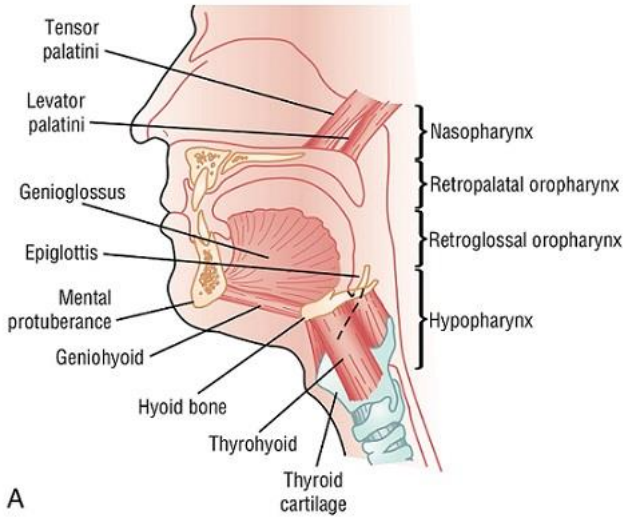


Fig 1 : Anatomy of pharynx

STRUCTURES CAUSING STATIC AND DYNAMIC OBSTRUCTION

	STATIC	DYNAMIC
NOSE	Septal deviation Sinonasal polyposis Adenoid hypertrophy Nasal mass Chonal atresia	Turbinate hypertrophy Nasal valve collapse
TONGUE	Macroglossia Retrognathia Lingual tonsil hypertrophy	Hypotonia Loss of coupling
PHARYNGEAL	Soft palate length Tonsillar hypertrophy Inferiorly placed hyoid Decreased maxillary projection Omega shaped epiglottis	Lateral pharyngeal wall collapse

THE BALANCE OF FORCES MODEL(34)

This model integrates the anatomic and physiologic factors impacting the airway.

Transmural pressure of the upper airway: Ptm

This is the difference between the dilating pressures (Pout) and collapsing pressures of the airway(P in)

Ptm = P out- P in

Pout includes dilator muscle tone, positive intraluminal pressure

Pin includes tissue mass, surface adhesive forces, negative intraluminal pressure

Changes in Ptm alters the airway size

PASSIVE CRITICAL CLOSING PRESSURE (P crit)

The upper airway patency/ collapsibility depends upon the relative contribution of two control mechanisms

1. Passive - mechanical loads on upper airway
2. Active - neuromuscular control by dilator muscles of pharynx

During sleep, the dilator muscles are in relative hypotonia passive state, thus the active contribution is minimal. The measurement of closing pressure due to mechanical loads on upper airway in this state is called Pcrit.

Pcrit is measured while patients are in CPAP to minimize the dilator muscle activity. In normal subjects Pcrit is markedly negative. It progressively increases with age In snorers and OSA patients, Pcrit becomes closer to atmospheric pressure or even above.

PHARYNGEAL STABILITY/COLLAPSIBILITY AND ITS MEASUREMENT

Flow in a rigid non collapsible structure is defined using Hagen poiseulle law, where flow is directly proportional to pressure difference and inversely proportional to its resistance.

Pharynx is a collapsing segment bordered by proximal rigid structure nasal passage and distal rigid structure trachea

Thus Resistance to flow via pharynx is given defined by starling resistor

STRALING RESISTOR MODEL

The transmural pressure of proximal rigid upper nasal passage is P us (pressure upstream)

The transmural pressure of distal rigid trachea is P ds (pressure downstream)

Starling resistor model is explained with 3 scenarios

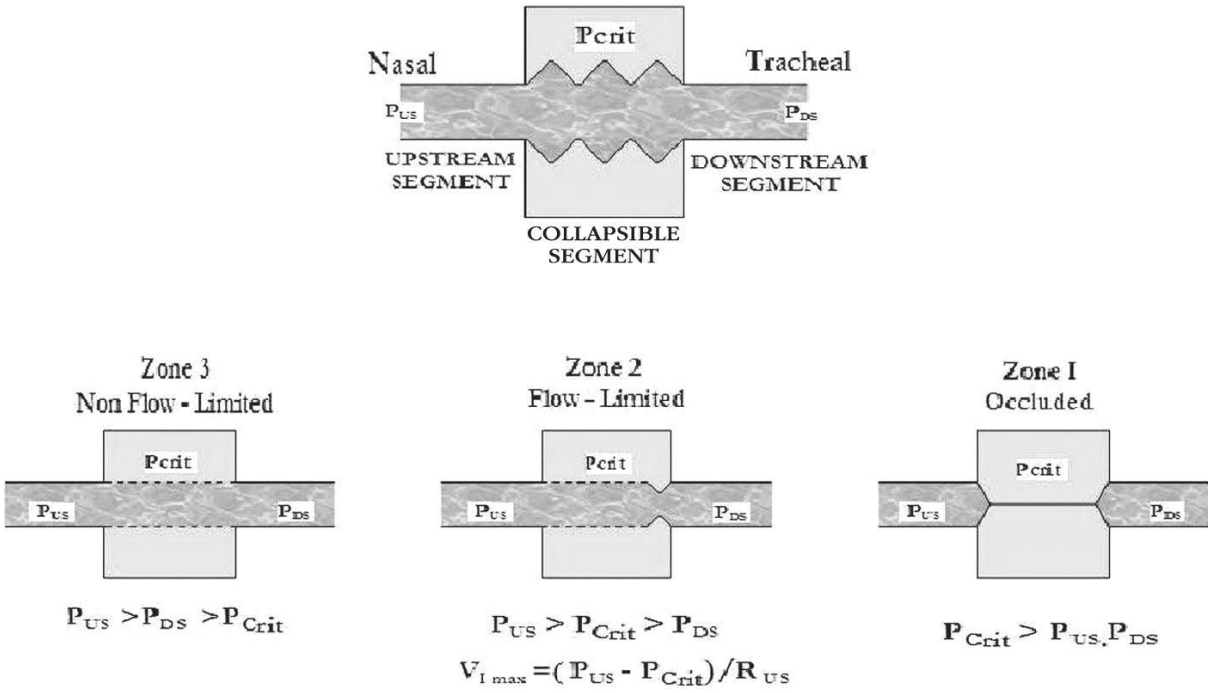


Fig 2 : Starling resistor model

1. During wakefulness, the down- stream pressure which is the low negative (-5cm h2o) inspiratory pressure, is lesser than the pharynx and nasal passage. P us > Ptm > P ds, thus unimpeded flow of air. During sleep, particularly in snorers and OSA patients, the above balance of forces changes leading to scenarios 2 and 3
2. P tm decreases and Pcrit increases nearing atmospheric pressure. Thus the pharyngeal transmural pressure is lesser than the downstream pressure but higher than upstream

   P us < Ptm < Pds

   P us > P crt > Pds

Choke point / collapse occurs near downstream segment, this restricts the airflow. Due to flow restriction, a higher negative inspiratory pressure is generated downstream, which further collapses the choke point and closes the airway. The closed pharynx is now exposed to positive upstream pressure which dilates and opens the airway. The cycle then repeats.

Flutter/ snoring occurs at the choke point which is exposed to alternating negative and positive pressures.

3. P tm decreases even further and Pcrit approaches atmospheric pressure or even above. Now

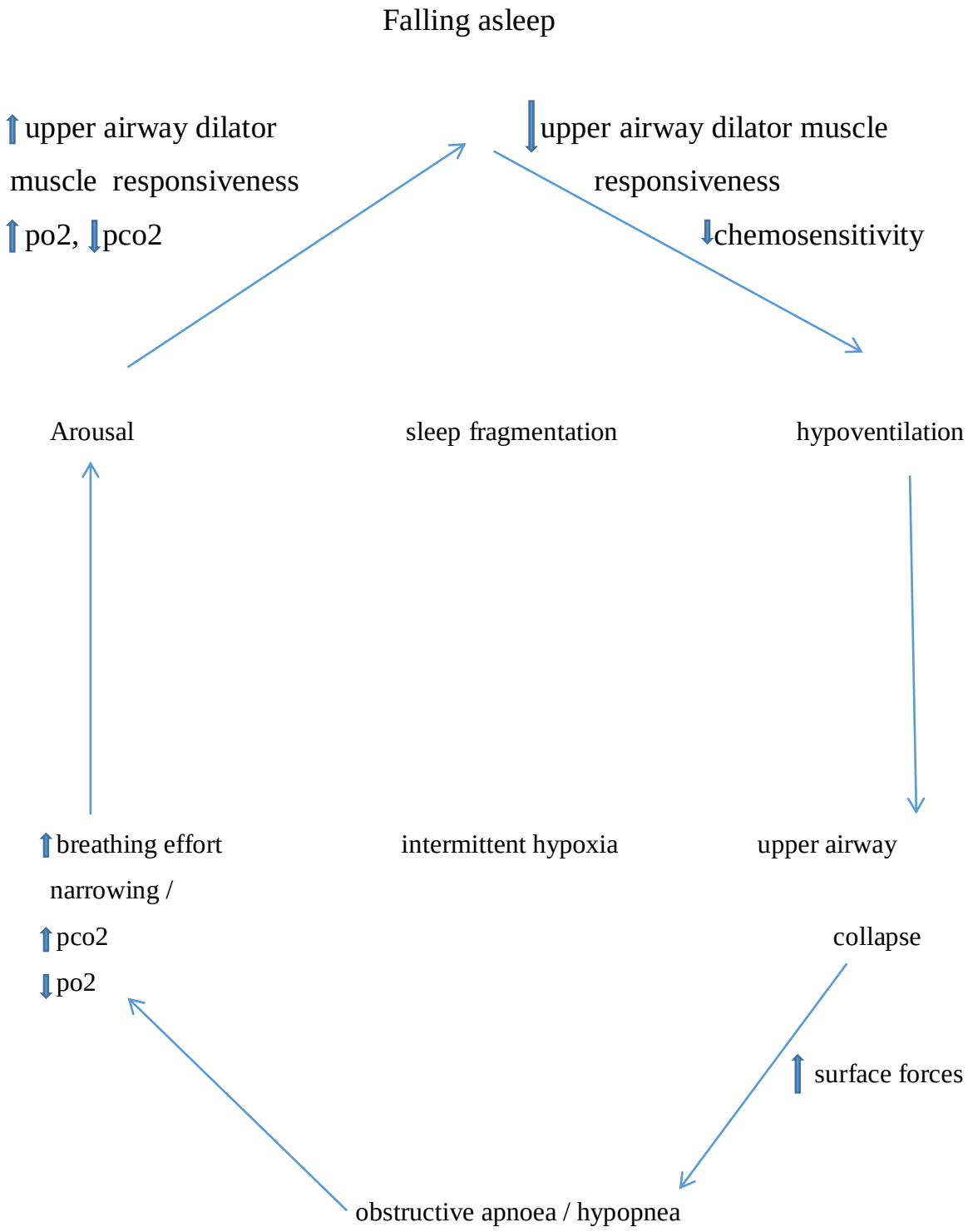
   P us > P ds > P tm

   P crt > P us > Pds

   Airway collapse occurs (apnoea) and no flow occurs regardless of driving pressure across the tube.

PATHOPHYSIOLOGY OF OSA(8)

Nocturnal Symptoms	Daytime Symptoms
Awakenings	Daytime sleepiness or fatigue
Insomnia	Morning headaches
Nocturia	Difficulties with concentration and short-term memory
Obstructive breathing	Depression
Loud snoring	Anxiety
Choking/gasping	Irritability
Witnessed apneas	Sexual dysfunction
Signs of OSA	**Condition with Increased Risk**
Upper body obesity	Pregnancy
Crowded pharyngeal airspace	Menopausal status in women
Retrognathia	Family history of OSA
Reduced cricomental space	Hypertension
Macroglossia	Stroke
Lateral peritonsillar narrowing	Diabetes mellitus
Lower extremity edema	Alcohol use
Tonsillar hyperplasia	Pulmonary hypertension
Elevated Mallampati score	


Falling asleep
upper airway dilator muscle responsiveness
po2, pco2
upper airway dilator muscle responsiveness
chemosensitivity
Arousal
sleep fragmentation
hypoventilation
breathing effort
narrowing /
pco2
po2
intermittent hypoxia
upper airway
collapse
surface forces
obstructive apnoea / hypopnea

PHYSIOLOGIC CONSEQUENCES OF INTERMITTENT HYPOXIA

OSA produces intermittent hypoxia and sleep disruption with evidence for downstream cascades of systemic activation, oxidative stress and inflammatory pathways that align with the pathogenic mechanism in metabolic disorder.

1. COR PULMONALE

   Hypoxia, hypercapnia, increased sympathetic stimulation, increased intrathoracic pressure, diastolic dysfunction (LVH), and endothelial dysfunction due to remodelling causes pulmonary hypertension leading to corpulmonale

2. Sympathetic activation also leads to

   Insulin resistance

   Disordered lipid metabolism

3. Sleep fragmentation leading to neurological consequences

   Excessive day time sleepiness

   Behavioural and cognitive adverse effects

EVALUATION OF OSA PATIENTS(36)

The gold standard investigation to diagnose OSA is Polysomnography (PSG)

History should include STOP BANG questionaries; Epworth sleepiness scale and history of co-morbidities.

General examination

BMI,

Neck circumference (parapharyngeal pad of fat)

waist hip ratio

Physical examination of upper airway

High arched palate

Elongated uvula

Retrognathia/ micrognathia

Retro position of maxilla

Shorter length of mandible

Inferiorly positioned hyoid

Bulky tongue/ soft palate

Webbing of tonsillar pillars

Modified mallampati score,

Friedmans tongue position,

Brodsky grading for tonsillar hypertrophy,

LEVEL OF OBSTRUCTION

Mullers manovoure,

Lateral cephalometry

Drug induced sleep endoscopy

Dynamic MRI

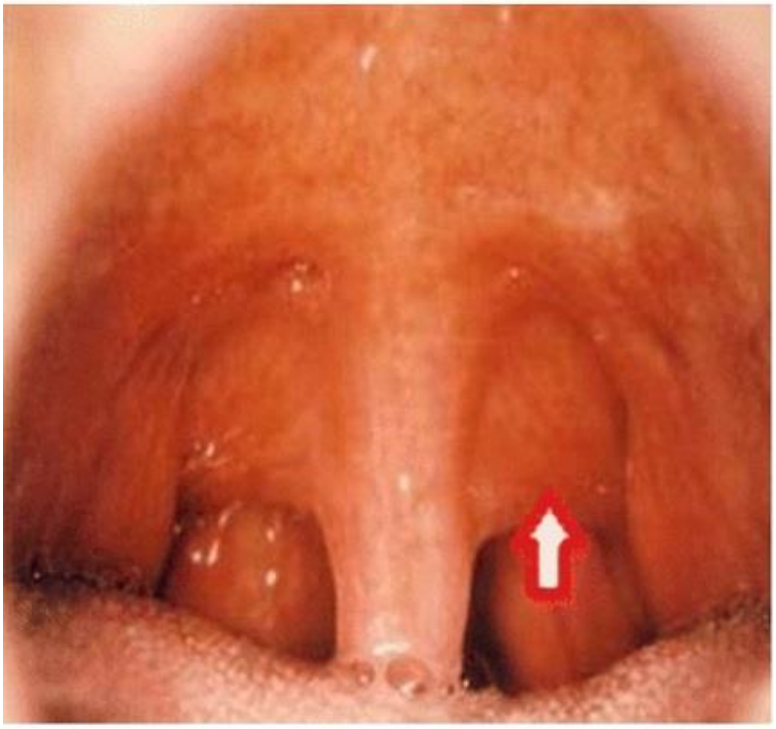
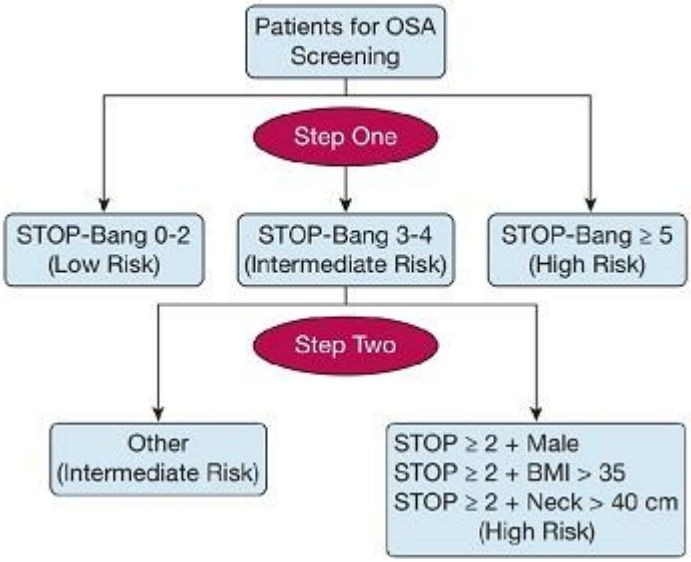


Fig 3: Tonsillar pillar webbing

STOP BANG QUESTIONNARIES (27)

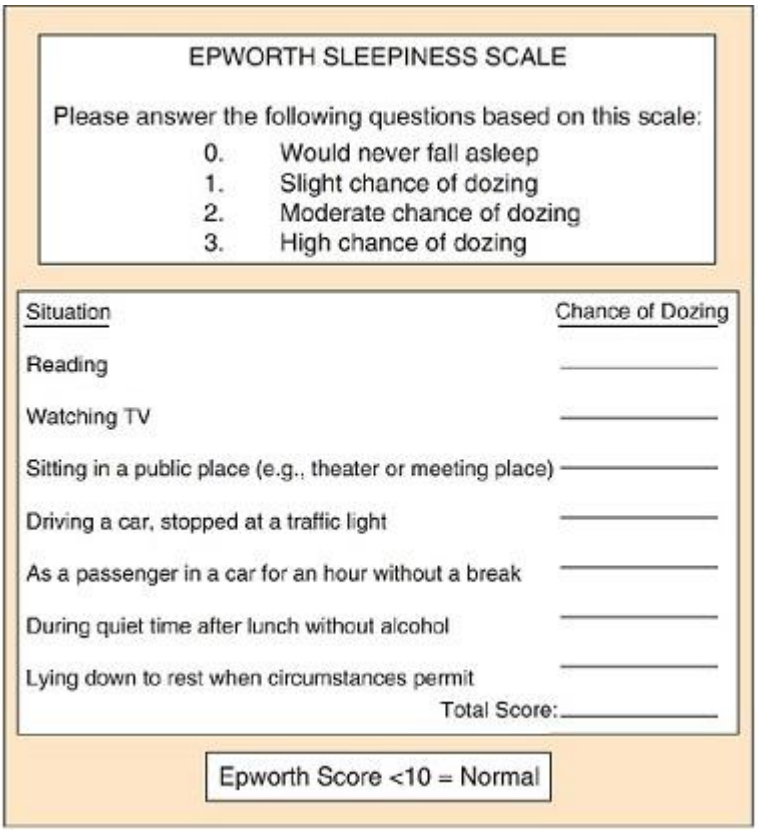
It is developed as an easy and reliable screening tool to identify the risk of developing OSAS. Includes

1. Snoring
2. Tiredness
3. Observed apneas
4. High blood pressure
5. BIM> 35kg/m2
6. Age> 40 years
7. Neck circumference> 40 cm in females and >43 cm in males
8. Male gender



EPWORTH SLEEPINESS SCALE (26)

Developed in 1990 by Murray Johns et al. for the diagnosing sleep disorder or monitoring response to treatment.



EPWORTH SLEEPINESS SCALE

Please answer the following questions based on this scale:

0. Would never fall asleep
1. Slight chance of dozing
2. Moderate chance of dozing
3. High chance of dozing

Situation	Chance of Dozing
Reading	
Watching TV	
Sitting in a public place (e.g., theater or meeting place)	
Driving a car, stopped at a traffic light	
As a passenger in a car for an hour without a break	
During quiet time after lunch without alcohol	
Lying down to rest when circumstances permit	
Total Score:	

Epworth Score <10 = Normal

A score < 10 is normal

11-14: Mild sleepiness

15-17: moderate sleepiness

18-24: severe sleepiness necessitating treatment

MODIFIED MALLAMPATTI SCORING

In 1985, Mallampatti et al proposed a grading system to predict difficult intubation by evaluating the relation between the tongue and other oropharyngeal structures which is assessed with maximal protrusion of tongue

Friedman yet al modified the mallampatti scoring by assessing the airway without tongue protrusion as it is the natural position during sleep

Grade 1	tonsil pillars and soft palate clearly visible
Grade 2	uvula, pillars and upper pole of tonsils visible
Grade 3	only part of soft palate visible, tonsils, pillars and base of uvula cannot be seen
Grade 4	Only hard palate visible

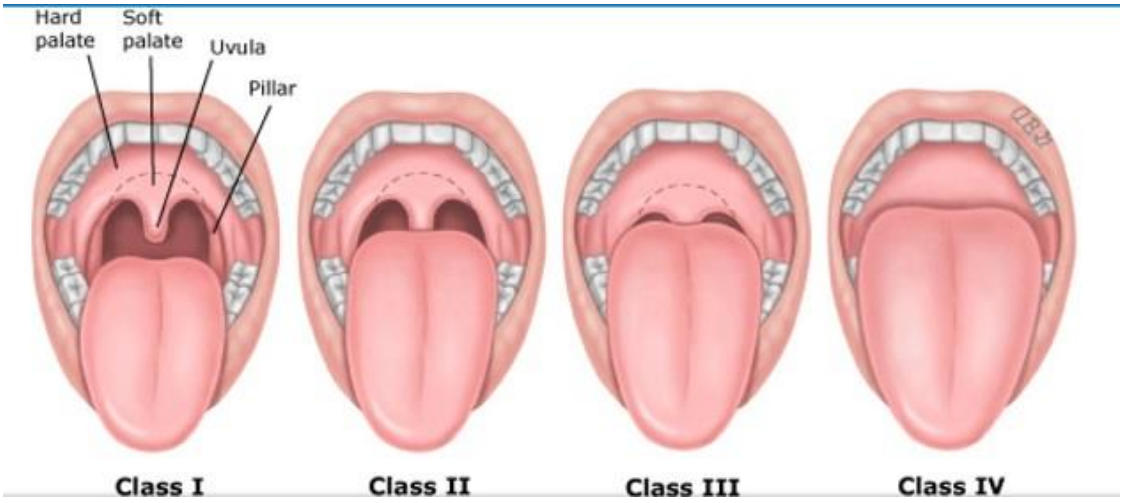


Fig 4 : Modified Mallampatti scoring

FRIEDMAN"S TONGUE POSITION (25)

It gives an idea about obstruction at the hypopharyngeal level.

a. FTP 1 visualises uvula and tonsils
b. FTP 2A visualises most of the uvula but not the tonsils or pillars
c. FTP 2B visualises the entire soft palate till the uvula base
d. FTP 3 visualises some of the soft palate
e. FTP 4 visualises only the hard palate

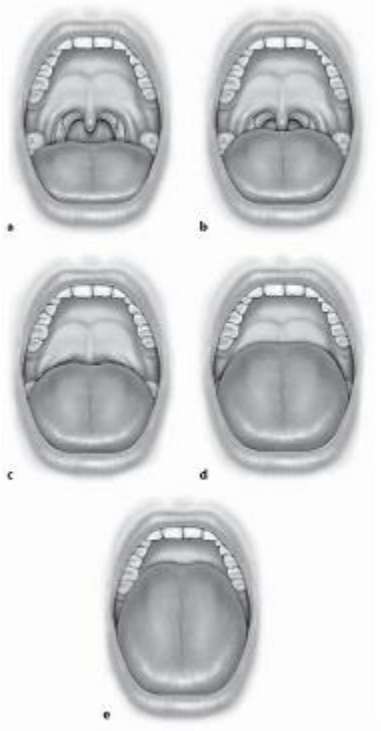


Fig 5: Friedman's Tongue Position

X RAY LATERAL CEPHALOMETRY (3)

It is the analysis of dental and skeletal relationship of the human skull.

Parameters looked for in OSAS patients:

1. palatal length normal < 4 cm
2. distance between the mandibular plane and the most anterosuperior point on the hyoid normal < 2 cm
3. posterior air space should be more than 1 cm in normal subjects
4. retropalatal space normal > 1 cm

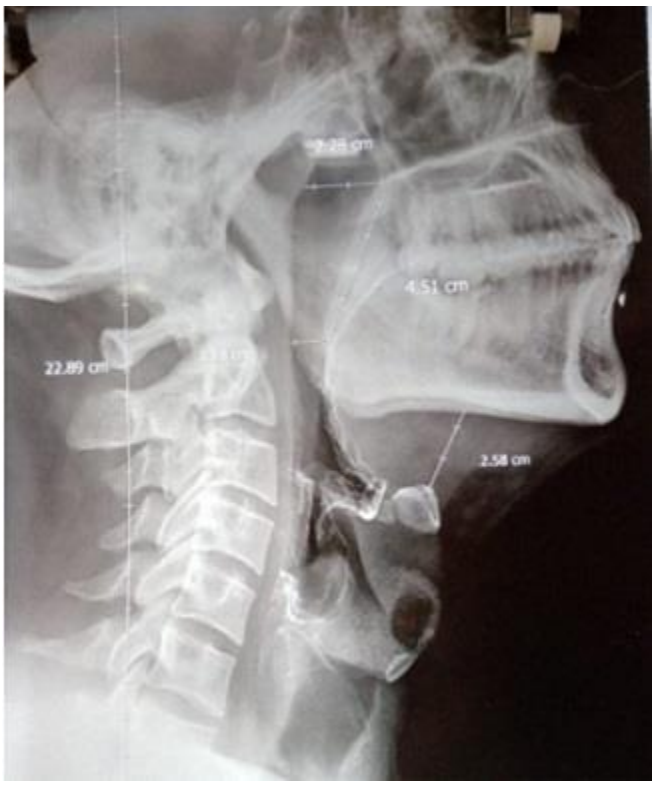


Fig 6: X ray lateral cephalometry

MULLER'S MANOUVER

An attempt at inspiration is made with closed mouth and nose may lead to collapse of upper airway. The findings are documented by introducing a flexible nasopharyngoscope.

It is not done now a days as its reliability is questionable and it cannot simulate natural sleep.

CT IMAGING

Compared to x ray lateral cephalometry CT scanning significantly improves soft tissue contrast and allows precise measurement of cross sectional areas at different levels as well as three dimensional construction and volumetric assessment.

DYNAMIC MRI

It is better than CT imaging and offers good soft tissue assessment and 3D assessment of tissue structures. Its advantage is that it lacks ionising radiation.

MRI taken in three positions

- awake
- mullers manoeuver
- normal sleep

Axial, sagittal images of upper airway at the level of velum, oropharynx , tongue base and hypopharynx are obtained at all levels

The main disadvantages of dynamic MRI being

- cost
- availability
- claustrophobia

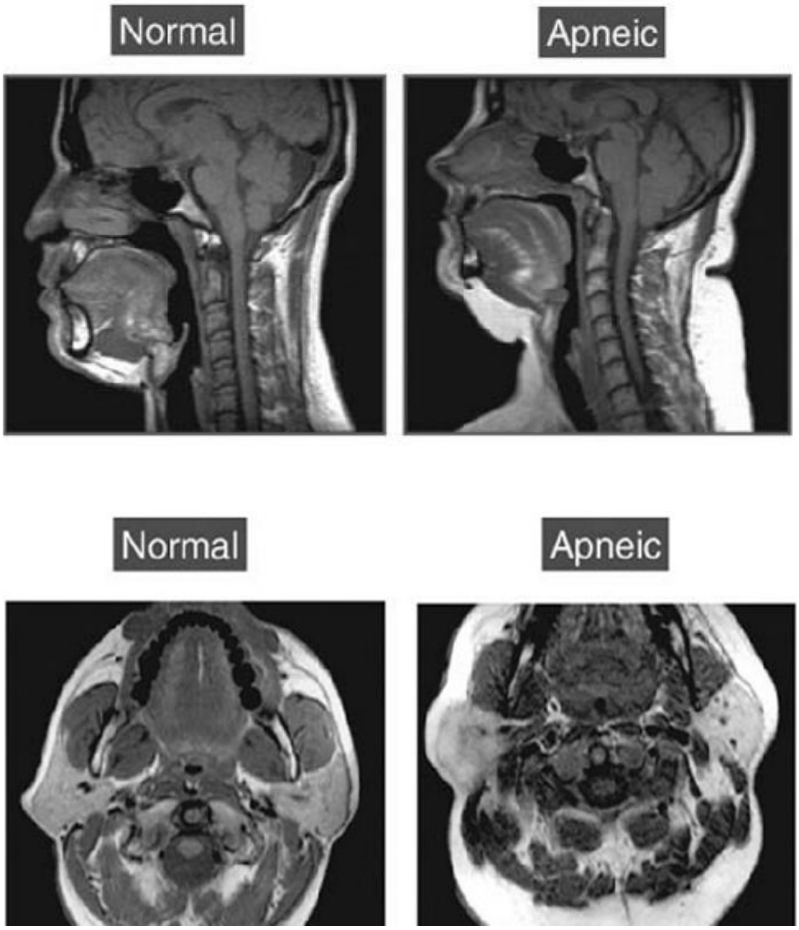


Fig 7: Dynamic MRI

POLYSOMNOGRAPHY

The term polysomnography was first introduced by Holland et al. in 1974. It comprises the recording, analysis and interpretations of multiple , simultaneous physiologic parameters that are used in the diagnosis of sleep disorders.(37)

PSG is a summary output of electrophysiological signals, integrating sleep signals, respiratory signals, cardiovascular signals and movements.

The recording of sleep state requires acquisition of three main measures EEG, EOG, EMG.

Respiration is monitored by oronasal flow, respiratory efforts, movements, snoring, pulse oximetry and sometimes carbondioxide monitoring.

ECG to record heart rate and rhythm

Movements are recorded using EMG on the tibialis muscles and the body position sensor.

There are four subtypes in this sleep monitoring procedure

TYPE 1

Gold standard, in-laboratory, technician-attended, overnight PSG

Minimum of seven channels, including EEG, EOG, chin EMG, ECG, oxygen saturation, airflow, respiratory effort

TYPE 2

Unattended PSG PM Minimum of seven channels including EEG, EOG, chin EMG, ECG, oxygen saturation, airflow, respiratory effort

TYPE 3

Minimum of four channels, including ventilation or airflow(at least two channels of respiratory movement or respiratory movement and airflow), heart rate or ECG, and oxygen saturation

TYPE 4

One or two channels, typically including oxygen saturation or airflow

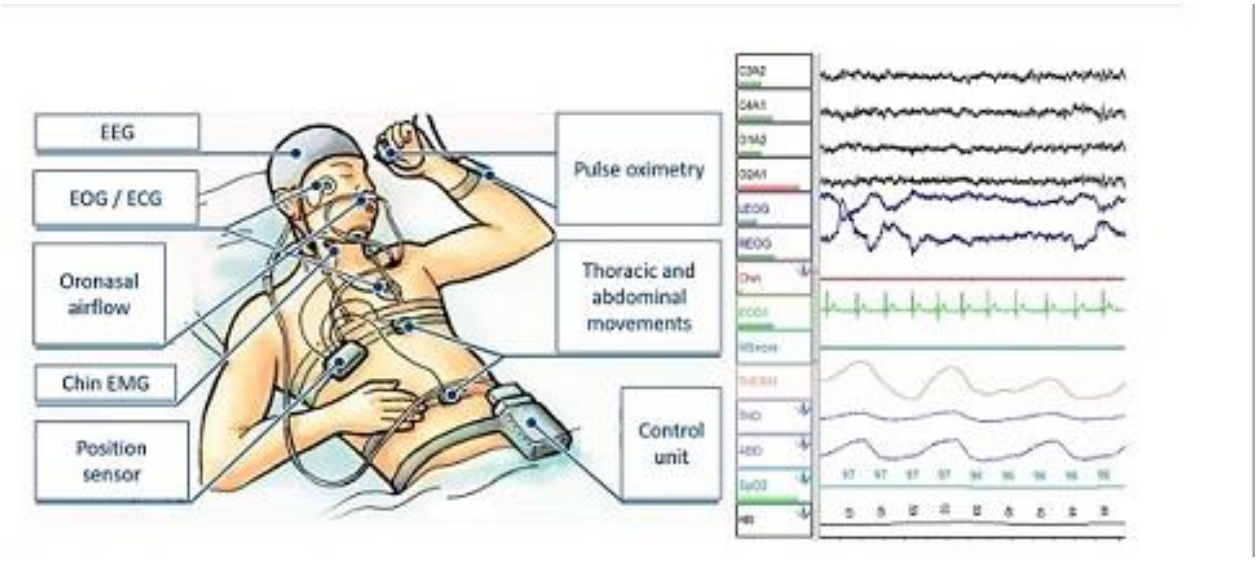


Fig 8: Polysomnography

SIGNIFICANT PARAMETERS OF SLEEP STUDIES ACCORDING TO AASM

1. AHI – number of apnoea and hypopnoea in relation to one hour of total sleep time.
2. RERA - Series of breaths characterised by flow limitation associated with increased respiratory effort lasting >/= 10 seconds plus arousal at the end of event
3. RDI – Numerical value describing respiratory disturbances per hour of TST, including apnoea, hypopnoea, and RERA

   RDI = AHI + RERA
4. Lowest spo2- lowest saturation value during recording time. Artificial influences need to be excluded carefully

Diagnostic criteria for OSA

Apnoea- hypopnoea index (AHI) is the hourly rate of apnoea plus hypopnoea

- AHI < 5 – normal
- AHI 5-15 – mild OSAH
- AHI 16-30 – moderate OSAH
- AHI > 30 – severe OSAH

DRUG INDUCED SLEEP ENDOSCOPY

Croft and Pringle introduced the technique of sleep nasendoscopy use in the assessment for snoring to aid proper case selection for surgical intervention.

Drug induced sleep endoscopy or sleep nasendoscopy is an investigation which provides dynamic visualisation of anatomical areas responsible of generation of noise (snoring) or site of obstruction under condition which mimic sleep and aids in proper case selection for surgical management of OSAS.

IDEAL PATIENT FOR DISE

- Patients diagnosed with OSAS by sleep study
- Patients with patent nasal airway
- DISE could be carried out in simple snorers too

ABSOLUTE CONTRAINDICATIONS

- Pregnancy
- ASA class 4
- History of allergy to sedatives that are used
- Morbid obesity- relative contraindication

THE DEGREE OF OBSTRUCTION IS CATEGORISED AS FOLLOWS(38)

- **Simple palatal snoring**. In this group, the noise arises from the vibration of the soft palate, walls of velopharyngeal sphincter and upper oropharynx.
- **Lateral wall collapse**. The obstruction involves the oropharyngeal area (palatine tonsil when present).
- **Tongue base/epiglottis**. The velopharyngeal sphincter remains patent but the obstruction is at the tongue base level as a consequence of lower jaw regression or tongue base or lingual tonsil hypertrophy. The epiglottis may contribute to noise and/or obstruction in combination with tongue component or in isolation.
- **Multi-segmental collapse**. The obstruction appears to arise from all the areas above.

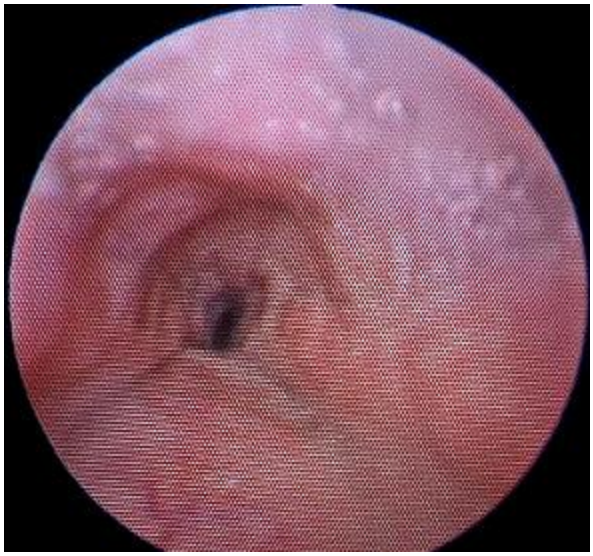


Fig 9: Partial circumferential collapse at velum

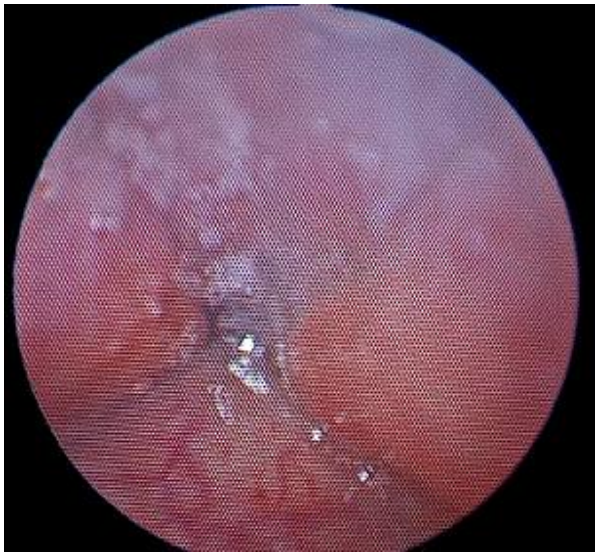


Fig 10: Complete collapse at velum

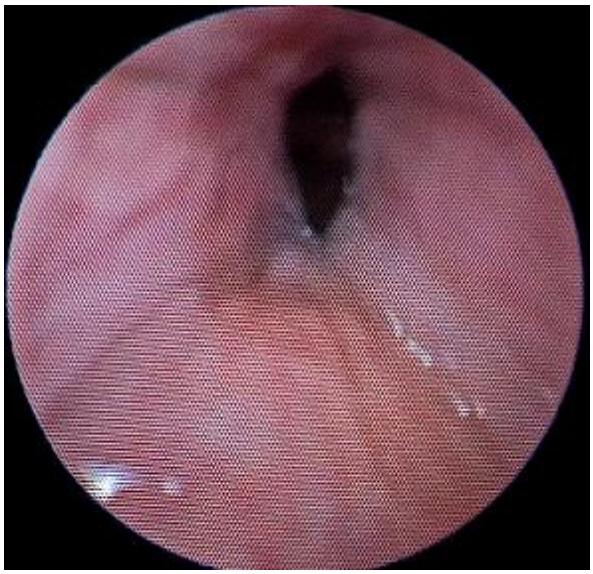


Fig 11:Partial lateral wall collapse oropharynx

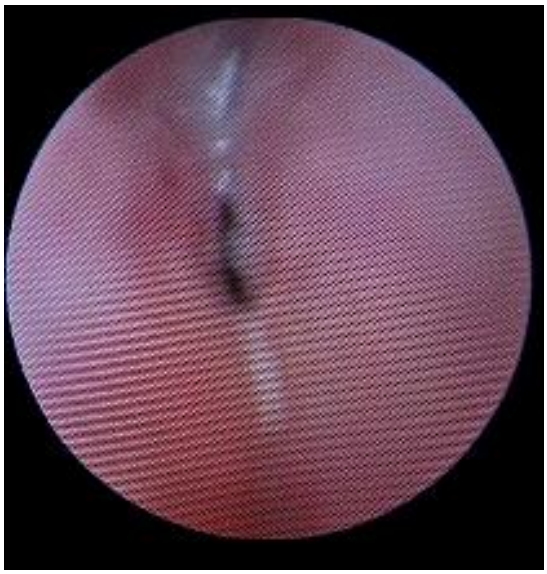


Fig 12: complete lateral wall collapse oropharynx

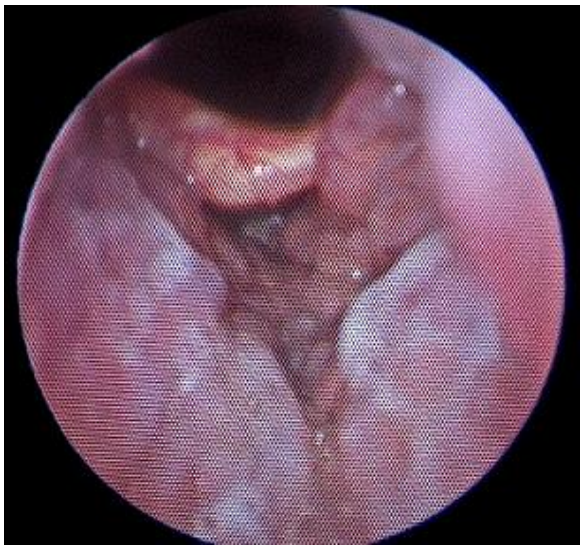


Fig 13: Partial collapse tongue base

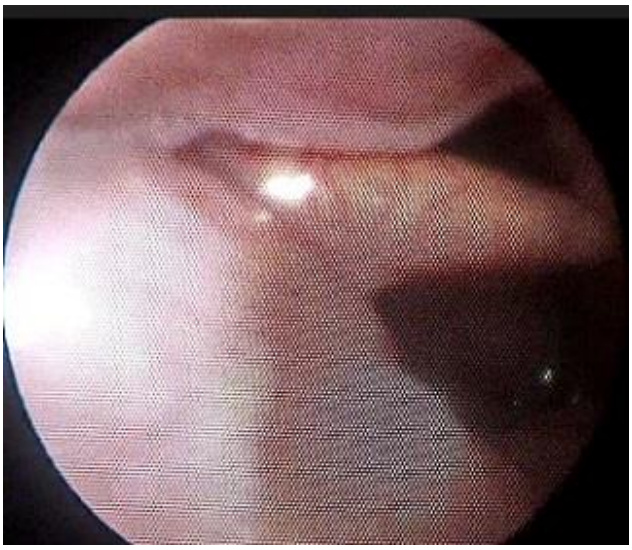


Fig 14: Lingual tonsil hypertrophy

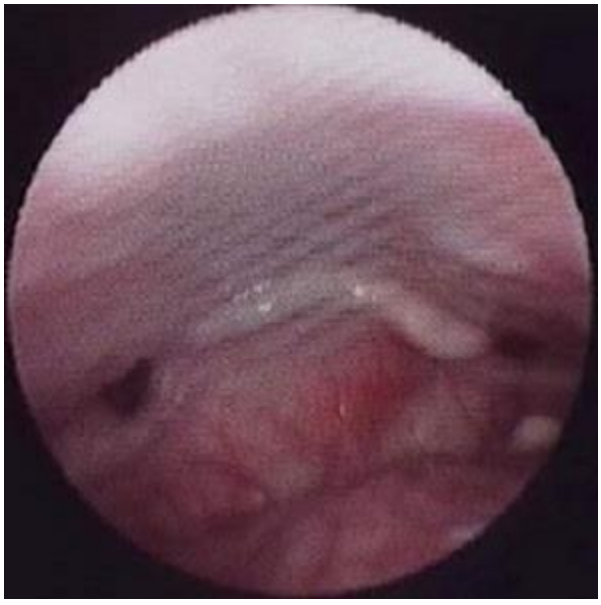


Fig 15:complete epiglottis AP collapse

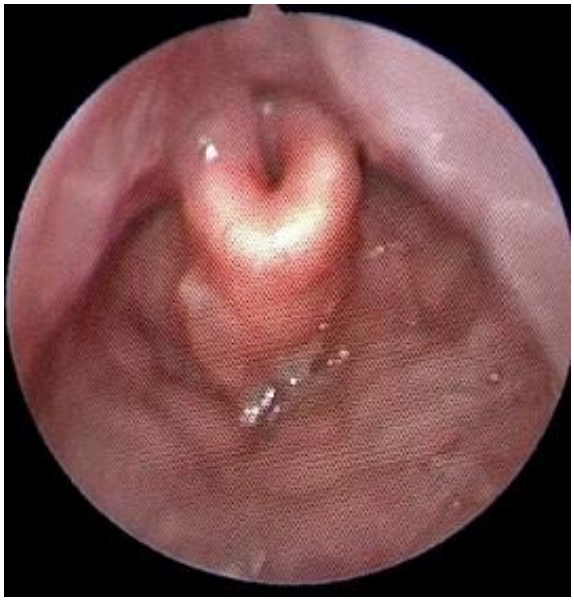


Fig 16: Lateral epiglottis collapse

PROCEDURE

- Premedication with glycopyrrolate administered 15 minutes prior to procedure
- Positioning of patient as comfortable for the patient to mimic sleep
- Anaesthetist should be on the left side
- Otorhinolaryngologist on the head end of the patient
- BIS MONITOR connected
- DEXMEDATOMIDINE infusion 1 mcg/kg administered
- Flexible nasopharyngoscope introduced
- Findings documented at BIS value >80 and at BIS value 60-80

There are various scoring systems used to report findings during DISE in adults and children (16)

21 scoring system s studied till date of which commonly used were

- VOTE
- PRINGLE AND CROFT SYSTEM
- NOHL
- BACHAR
- DISE INDEX

VOTE CLASSIFICATION (17)

STRUCTURE	DEGREE OF OBSTRUCTION[a]	CONFIGURATION[c]		
		A-P	LATERAL	CONCENTRIC
Velum				
Oropharynx lateral walls[b]				
Tongue Base				
Epiglottis				

DISE INDEX (46)

Gillespie et al 2013 in

One such system is DISE INDEX which classifies the degree of anatomical collapse of upper airway on ordinal scale from 0 (no collapse) to 12 (multilevel complete collapse)

The anatomical sites includes

1. Palate
2. Lateral wall of hypopharynx
3. Tonsils
4. Tongue base
5. Epiglottis

Gillespie, 2013 [34]		0	1	2	3	4
	DISE index					
	Palate AP	No collapse	Partial collapse	Complete collapse	NA	NA
	Hypopharynx LPW	No collapse	Partial collapse	Complete collapse	NA	NA
	Tonsils	No collapse	Partial collapse	Complete collapse	NA	NA
	Tongue base	No collapse	Partial collapse with lingual tonsils	Partial collapse without lingual tonsils	Complete collapse with lingual tonsils	Complete collapse without lingual tonsils
	Epiglottis	No collapse	Partial collapse	Complete collapse	NA	NA

COMPLICATIONS OF DISE ENCOUNTERED

1. Severe apnoea
2. Laryngospasm
3. Aspiration

BISPECTRAL INDEX

The bispectral monitoring system was introduced for clinical use in oct.1996, as a technique of measuring the depth of anaesthesia induced by hypnotics and sedatives.(13)

In 2004 bispectral index (BIS) was approved by FDA (Food and Drug Administration of United states)

The BIS index derives data from a complex EEG parameter where several variables are analysed in real time

The variables analysed from EEG are broadly classified under two domains

1. Frequency domain: Power spectrum, Bispectrum, Beta ratio, Sync fast slow
2. Time domain : burst suppression

These data from EEG are processed using a proprietary algorithm, with advanced artifact detection, developed using data from normal EEG from individuals correlating to corresponding states of hypnosis.

The BIS index is a continuous processed multifactorial EEG parameter denoted by a dimensionless number with a range from 0 to 100

BIS index values and clinical state

100	awake, responds to normal voice
80	light/ moderate sedation , may respond to noxious stimuli
60	general anaesthesia, low probability of recall
40	deep hypnotic state/ deep sedation
20	burst suppression
0	isoelectric EEG

EQUIPMENTS IN BIS MONITORING

1. BIS index sensor
2. BIS index –X device
3. BIS monitor
4. Patient interface cable (PIC) and Monitor interface cable(MIC)

BIS index sensor

Replicable single use self- prepped multi electrode component

It has four electrodes which can be applied to patient forehead

The three leads corresponds to the International Standardised System for location of EEG scalp electrodes

The lead 4 measures the electromyography (EMG) signal of the frontalis muscle

The BIS sensor connects to the BIS device through the PIC (Patient interface cable)

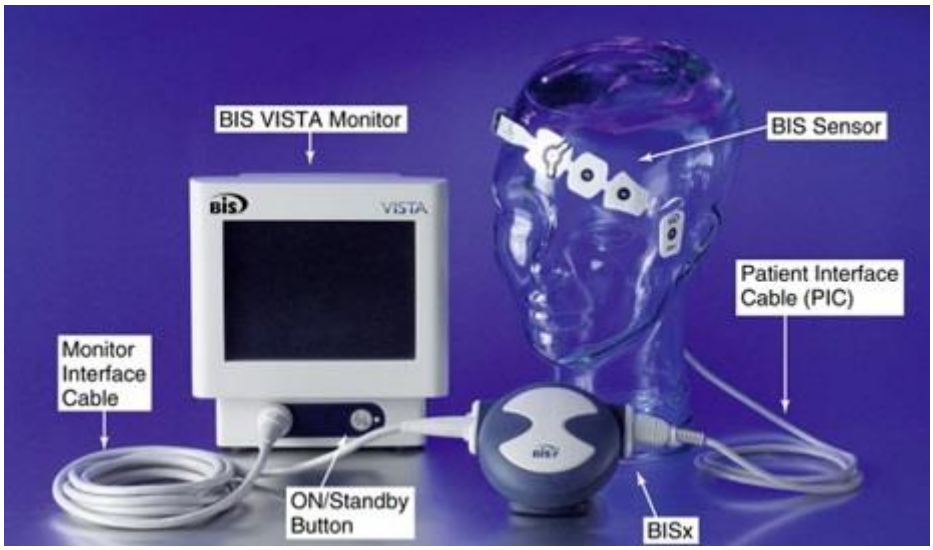


Fig 17: BIS monitor

BIS index –x device

Consists of a digital signal converter, which continuously receives and processes the patients EEG signal

It computes the data based on BIS algorithm while at the same time filtering detected artifacts to calculate BIS

It also calculates other parameters such as Signal Quality Indicator (SQI), EMG, burst count and suppression ratio

This device is placed close to the patient head to prevent interface of EEG signal from other medical equipment

The device also stores the EEG parameters and BIS value

The data derived from this device are transferred and displayed on the BIS monitor through the Monitor Interface cable (MIC)

BIS index monitor

Displays BIS value, SQI, EMG, burst count, suppression ratio

Parameters are continuously updated to display the value in real time

SQI- Signal quality indicator

It is a measure of quality of EEG signal, calculated based on impedance data, artefact and other variables. It is displayed in bar form or numerically.

Higher the SQI numbers indicate a more reliable and accurate BIS value.

EMG indicator

It is a bar graph, displays the power of muscle activity, uses frequency range 70-110 Hz. The EMG scoring ranges from 30-80.

Apart from muscle activity it also indicates other high frequency artifacts like oscillating ventilators, oscillating air mattress, fluid warmers, warming blankets which may cause fine vibrations over BIS sensor.

A high EMG may occur because of pain or other noxious stimuli, lightening of sedation, eye movements, wearing off of neuromuscular blocking agents.

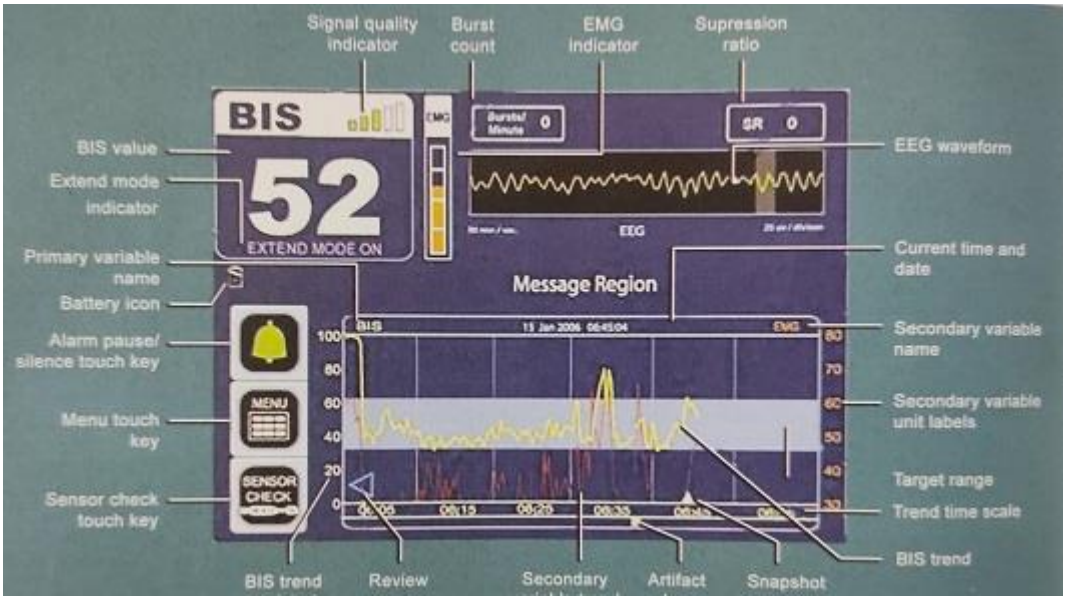


Fig 18 : Parameters measured in BIS monitor

FACTORS AFFECTING BIS INDEX VALUE (20)

1. Equipment related factors:

    a. Erroneous placement of BIS sensor

    b. EMG activity: often low frequency EMG signals may interfere with the EEG signals, causing false elevation in the BIS reading.

Clinically, this indicates that the patient may be more deeply sedated than what is displayed as BIS value

    c. Newer versions of BIS: as newer BIS algorithms has reduced interferences, these give lower readings than older ones

2. Anaesthetic agents

Equipotent concentrations of different anaesthetics reflect different BIS values

3. Clinical factors:

Noxious stimuli like pain during surgery

5-10% population exhibit a normal low voltage EEG variant.

Any pathological state like seizures

Other clinical factors that affect BIS value includes hypovolemia, hypothermia, hypoglycaemia, decreased cerebral perfusion, alzheimers disease, cerebral palsy

4. Electrical or mechanical factors:

Different electrical equipments in the operating room can affect BIS values. Examples include ECG signals, electrical scalpels, pacemakers, oscillations from endoscopic shavers, electromagnetic fields created by an ENT positioning system around the head, fine vibrations of warmer blankets against the BIS sensors

Recent modifications in BIS algorithm decreased the probability of these interferences. Also clinical monitoring and SQI bar can help in detecting them.

DRUGS USED IN DISE

Although a standard DISE sedation protocol is not available Propofol and Dexmedetomidine are the drugs commonly used in DISE. Other drugs such as Midazolam, ketamine, remifentanyl can be used as adjuvants.

DEXMEDETOMIDINE (31)

Selective alpha2 receptor agonist, which acts on the locus coeruleus, thereby inducing a state of unconsciousness similar to natural sleep

Sedative action can be reached by means of infusion technique with starting dose 1mcg/kg over ten minutes followed by maintenance infusion rate of 0.75mcg/kg /hr

Compared to propofol, (28)

Produces state of sedation closer to natural sleep

Almost no effect on respiratory depression

Lesser upper airway muscle relaxing effect

Better hemodynamic stability

Additional analgesic and sympatholytic property

No dose dependency for the BIS value

Drawbacks:

Slower onset, longer time to recover

Dryness of mouth

May cause bradycardia

LINE OF MANAGEMENT

Mild (5 < AHI < 15)

- No symptoms

  Behavioural modification

- Symptoms

  Behavioural modification

  Consider oral appliance

  Consider PAP

  Consider surgical intervention

Moderate (15 <AHI < 30)

- No symptoms

  Behavioural modification

  Consider PAP

  Consider oral appliance

  Consider surgical intervention

- Symptoms

Behavioural modification

PAP

Surgical intervention for PAP failures

Consider oral appliance

Severe (AHI > 30)

- Symptoms or no symptoms
- Behavioral modification (rarely sufficient alone)
- PAP
- Surgical intervention for PAP failures
- Consider tracheotomy if other treatments fail and significant symptoms or co-morbidities exist.
- Co-morbidities should also be taken into account
- Patients with BMI >35 and co-morbidities or BMI >40 should be considered for bariatric surgery.

MANAGEMENT OPTIONS

- Medical management
- Positional therapy
- Surgical

MEDICAL MANAGEMENT includes

- Diagnosis and treatment of any associated systemic disorders
- Weight reduction
- Avoid alcohol
- Review the drugs patient is taking (sedative medication should be avoided)
- Nasal medication (intranasal steroid spray can be given)
- Nasovent (a silastic splint that dilates nasal valve and reduces nasal resistance)
- Topical decongestants and monteleukast in children
- Modafinil- It is a drug that acts as a central stimulant of post synaptic alpha1 adrenergic receptors. It thus plays a role in promoting alertness

CPAP

- It is gold standard treatment for OSA. (49)
- Patient wears a mask, which is connected to a pump which blows air at pressures at 7 -15 cm of water. It acts as a pneumatic splint and holds the walls of upper airway apart thus preventing collapse and obstruction.

PROBLEMS

- Mask discomfort ; poor patient compliance; claustrophobia;
- Air leak- drying of eye; loud noise; sore throat
- Facial skin abrasions, discomfort
- Nasal dryness and congestion
- Difficult expiration

ORAL APPLIANCES

- NON-TITRATABLE TYPE
- Esmarch appliance
- Nocturnal airway patency appliance (NAPA)
- Mandibular repositioner

- Snore guard
- TITRATABLE TYPE
- Klearway
- Thornton adjustable positioner (TAP)
- Herbst

SURGICAL INDICATION

- Apnoea/Hypopnea Index (AHI) 20* events/per hour of sleep
- Oxygen desaturation nadir > 90%
- Oesophageal pressure more negative than –10 cm H 2 O
- Cardiovascular derangements (arrhythmia, hypertension)
- Neurobehavioral symptoms (excessive daytime sleepiness [EDS])
- Failure of medical management
- Anatomical sites of obstruction (nose, palate, tongue base)

CONTRAINDICATION FOR SURGERY

- Severe pulmonary disease
- Unstable cardiovascular disease
- Morbid obesity
- Alcohol or drug abuse
- Psychiatric instability
- Unrealistic expectations

DEFINITION FOR SURGICAL RESPONDERS

- Apnoea/Hypopnea Index (AHI) > 20 events/per hour of sleep
- Oxygen desaturation nadir 90%
- Excessive daytime fatigue (EDS) alleviated
- Normalization of sleep architecture
- Response equivalent to CPAP on full-night titration
- OSAS or non-responders to devises or phase I surgery include a diminished PUA posterior to base of tongue (PAS <5 mm),
- Increased soft palate length and bulk,

- Glossomegaly,
- An inferiorly displaced hyoid bone (MP-H >24 mm; hyoid bone below the C3-megonium line),
- retrognathia (SNB angle less than 70°)
- narrow skull base angle (S-N-Ba <125°)
- long pharynx (posterior nasal spine to vallecula or hyoid body; being dolichofacial).

SURGICAL MANAGEMENT

Tracheostomy was the first done procedure for OSA which is now a days done as a temporary procedure following OSA surgeries for risk of post op airway compromise.

Nasal surgeries are performed as a component of multi -level surgical approach for treatment of OSAS. Includes,

- Nasal septoplasty- septal deviation
- Radiofrequency volumetric reduction of hypertropic turbinates
- Adenoidectomy
- Nasal tumor or polyp reduction

- Nasal valve reconstruction-fixed and inspiratory nasal valve collapse .

Palatal surgeries are considered when the predominant site of obstruction is the velum or oropharynx

For AP collapse at velum – anterior palatoplasty / uvuloplatal flap

Lateral collapse – lateral pharyngoplasty/ expansion sphincter palatoplasty

Circumfrential collapse – combination of lateral and AP collapse techniques, z palatopharyngoplasty

PALATAL SURGERIES

May be uvula sparing or uvula sacrificing surgeries

Uvula sparing surgeries

- Injection snoroplasty-for simple snorers due to palatal flutter.
- Palatal implants- simple snoreres
- Modified uvulopalatopharyngoplasty- for lateral collapse at velum and oropharynx
- Transpalatal advancement pharyngoplasty – severely decreased retropalatal airway space due to AP collapse at velum.

- Lateral pharyngoplasty- mild OSA /UARS with lateral pharyngeal collapse

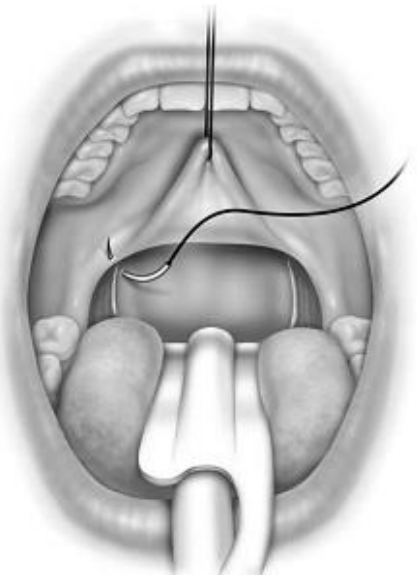


Fig 18:Uvulopalatal flap

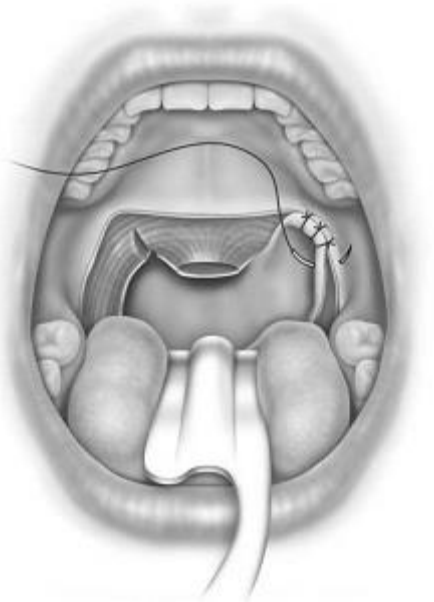


Fig 19:Fairbank's technique

Uvula sacrificing procedures

- Uvulopalatal flap – For AP collapse at velum
- Expansion sphincter palatoplasty- for lateral pharyngeal wall collapse
- Zetapalatopharyngoplasty – for circumferential complete collapse at velum and oropharynx.
- Laser assisted uvulopalatoplasty – isolated velum collapse
- Snare uvulectomy – UARS with elongated and edematous uvula.

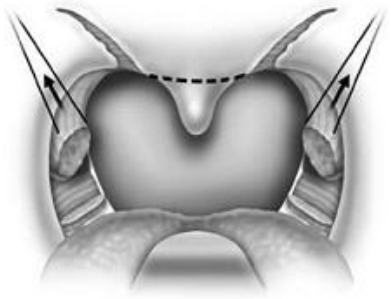


Fig 20:Expansion sphincteroplasty

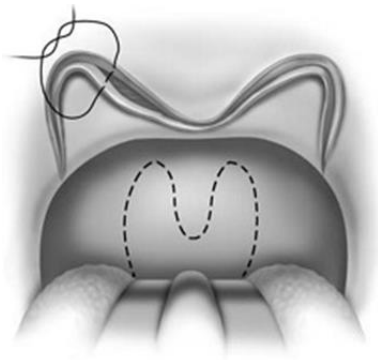


Fig 21:Zetaplasty

- Cautery assisted palatal stiffening procedure – mild OSA/ primary snorers
- Uvulopalatopharyngoplasty – AP collapse at velum with marked reduction in PAS with tonsillar hypertrophy without tongue base collapse.
- Fairbanks technique- UPPP – for lateral collapse at velum or oropharynx
- Submucosal UPPP- for AP collapse at velum and oropharynx Expansion sphincter palatoplasty- for lateral pharyngeal wall collapse
- Zetapalatopharyngoplasty – for circumferential complete collapse at velum and oropharynx.

Other palatal surgeries

- Barbed palatoplasty
- Alianza technique
- Reconstruction pharyngoplasty
- Adenotonsillectomy for paediatric OSA

HYPOPHARYNGEAL SURGERIES

- Tongue base surgeries
- Maxillofacial surgeries
- Surgeries of epiglottis

TONGUE BASE SURGERIES

May be minimally invasive or open

Minimally invasive tongue base surgeries

- SMILE- submucosal intra oral lingual excision
- Intraoral submucosal midline glossectomy
- Intaoral submucosal lingualplasty
- Percutaneous submucosal glossectomy
- Radiofrequency tongue base reduction
- Minimally invasive tongue base stabilisation

- Endoscopic coblation lingual tonsillectomy- for lingual tonsil hypertrophy

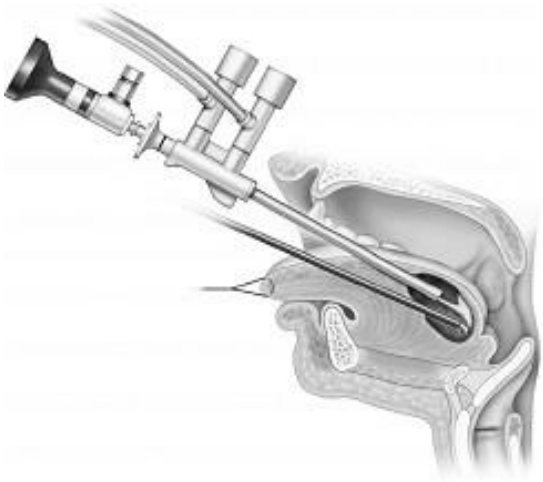


Fig 22:SMILE

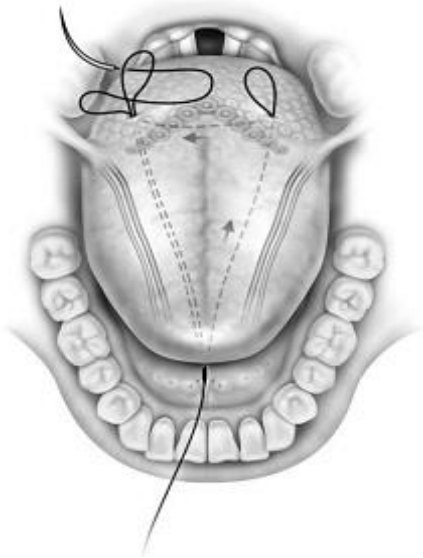


Fig 23:Tongue suspension

Open surgeries for macroglossia / low tongue base causing hypopharyngeal collapse

- Open tongue base reduction
- External submucosal glossectomy

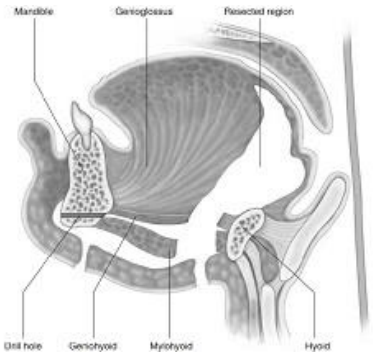


Fig 24:External submucosal glossectomy

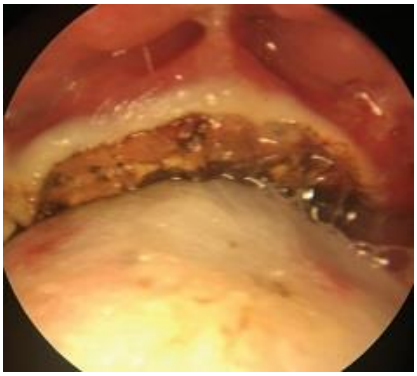


Fig 25:Epiglottectomy

- Genioglossus advancement- for hypopharyngeal obstruction
- Hyoid suspension- to improve PAS at hypopharyngeal level

SURGERIES FOR EPIGLOTTIS COLLAPSE

- Supraglottoplasty for redundant epiglottic, aryepiglottic or arytenoid mucosa.
- Vertical midline suprahyoid epiglottic split.
- Horizontal epiglottic transection.

Posterior cordotomy for bilateral abductor palsy resulting in osa

MAXILLOFACIAL SURGICAL TECHNIQUE FOR HYPOPHARYNGEAL OBSTRUCTION

- Mandibular osteotomy with genioglossus advancement
- Hyoid myotomy with suspension
- Maxillomandibular advancement osteotomy

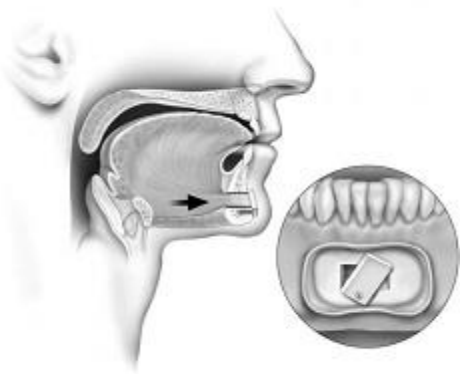


Fig 26:Genioglossus advancement

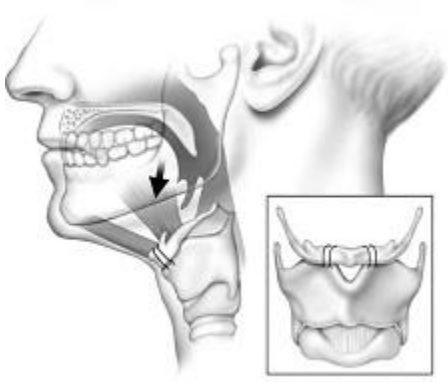


Fig 27:Hyoid suspension

Distraction osteogenesis for maxilla facial skeletal deficiency

ONE STAGED MULTILEVEL PHARYNGEAL SURGERY FOR OSA

Includes

- hyoid suspension
- mandibular osteotomy with tongue advancement
- tongue suspension

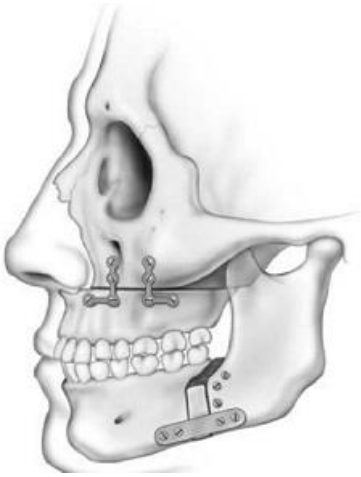


Fig 28:MMA

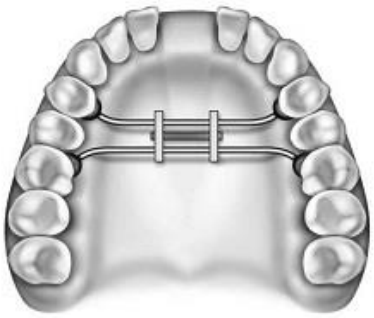


Fig 29:Distraction osteogenesis

Trans oral robotic surgery for surgical treatment of OSA is an evolving option especially for tongue base reduction and epiglottoplasty.

COMPLICATIONS OF SURGERIES

Palatal surgeries

- Haemorrhage; infection ; palatal incompetence
- Velopharyngeal insufficiency
- Pharyngeal dryness
- Foreign body sensation
- Taste alterations
- Nasopharyngeal stenosis
- Airway compromise

Complications of Tongue base surgeries

- Injury to neurovascular bundle
- Haemorrhage
- Hematoma
- Tongue abcess
- Tongue oedema causing airway obstruction necessitating intubation or tracheostomy.

MATERIALS AND METHODS

STUDY PLACE: Rajiv Gandhi Government General Hospital, Chennai - 600003.

STUDY DESIG : Retrospective and Prospective, non-interventional study

STUDY PERIOD: November 2020 to November 2021

SAMPLE SIZE: 36

ETHICAL CLEARANCE: obtained

INCLUSION CRITERIA:

1) Patients diagnosed with OSA i.e., AHI(apnoea hypopnoea index)>5 in polysomnagraphy
2) Age 18 to 60 years
3) BMI < 40

EXCLUSION CRITERIA:

1) Age group: <18 years and > 60 years
2) Craniofacial abnormalities
3) Previous upper airway surgery

4) Neuromuscular disorders

5) Patients with high surgical risk according to classification of the American society of anaesthesiologists (ASA) i.e., greater than ASA class III

DATA COLLECTION

1) Complete history taking and clinical examination
2) Clinical examination
3) Polysomnography
4) DISE finding
5) BIS monitoring

ETHICAL COMMITTEE APPROVAL

SELECTION OF PATIENTS ACCORDING TO INCLUSION CRITERIA

INFORMED AND WRITTEN CONSENT

COMPLETE CLINICAL HISTORY TAKING AND EXAMINATION

POLYSOMNOGRAPHY

DISE

DATA COMPILATION

STATISTICAL ANALYSIS

CONCLUSION

REVIEW OF LITERATURE

1. **H.Babar- Craig et al, validation of sleep nasendoscopy for assessment of snoring with bispectral index monitoring**, Eur Arch otorhinolargngol (2012) Conducted prospective study in 30 patients with snoring undergoing sleep nasendoscopy with BIS monitoring was conducted. The study concluded that combining SNE with BIS monitoring allows more accurate assessment of sedation induced snoring **(6).**

2. **Hong et al, Change in obstruction level during drug induced sleep endoscopy according to sedation depth in obstructive sleep apnea**, published in laryngoscope 2013, conducted the study in 31 adult snoring or OSAS patients and concluded that the degree of upper airway narrowing can be aggrevated according to sedation depth and monitoring of sedation depth during DISE is critical. **(3)**

3. **Abdullah et al , Sleep endoscopy with midazolam sedation level evaluation with bispectral analysis** published in feb. 2013, study conducted with 43 OSA patients BIS analysis levels recorded in natural sleep in PSG compared with BIS levels recorded during DISE and results were BIS value for being wake and the N1, N2,

N3 stages of sleep was > 82, 81-76, 75-63 and < 62 respectively. Moreover they reported that most obstructive activities occurred in BIS range from 63 to 81. They have documented a increase in degree of collapse at velum, oropharynx and tongue base during DISE compared to awake state by Mullers manoeuver.(29)

4. **Lo et al. Bispectral index in evaluating effects of sedation depth on drug induced sleep endoscopy.** Published in Journal of clinical sleep medicine in 2015. This literature investigated the effect of sedation on DISE and found that deep sedation levels(BIS levels of 50 to 60) resulted in greater airway collapsibility and more complete collapse at multiple sites than did evaluation at light sedation levels (BIS levels 65 to 75.(5)

5. **Patrick et al, Depth dependent changes of obstruction patterns under increasing sedation during drug induced sedation endoscopy**, results of a German monocentric clinical trial published on 2016. The study conducted DISE in 60 patients with SDB under monitoring of depth of sedation by BIS concluded that the collapsibility of structures of upper airway increases under DISE in a sedation dependent manner.(4)

6. **Lechner et al, Review on Drug Induced Sedation Endoscopy-technique, grading system, and controversies,** suggested BIS monitoring to ensure that they have achieved the required sleep state where OSA symptoms are more prevalent in a patient, even when using different anesthetic agents and also the collapsibility profile to be viewed in the context of the sleep state in which it was produced(9)

7. **Ravesloot et al**, laryngoscope 2011, reviewed **one hundred consecutive patients undergoing Drug induced sleep endoscopy**, concluded that DISE is a valid investigation when surgical treatment is planned. Multilevel collapse, a complete collapse and a tongue base collapse are statistically significantly associated with higher AHI. Complete concentric collapse is statistically significantly associated with an increased BMI(10)

8. **Sung Jae Heo et al, Time dependent changes in obstruction pattern change during DISE.** In this study 42 patients diagnosed with OSA underwent DISE, concluded that obstructive patterns change during DISE depending on the duration of procedure. More

obstruction sites and configuration of velum were observed with longer procedure duration(8)

9. **Dijemeni E et al, Drug induced sedation endoscopy classification systems:a systematic review and metaanalysis**, conducted a systematic view to identify new and significantly modified DISE classification systems. The study concluded VOTE classification system is the most widely accepted system for devising treatment plan due to its simplicity and insisted further research on a universally accepted objective DISE assessment is critically needed (16)

10. **M.B.Gillespie et al, A trial of drug induced sleep endoscopy in the surgical management of sleep disordered breathing**, proposed a new classification system for DISE reporting. DISE INDEX and proposed DISE scoring from 0-12 (46)

11. **Keziriam et al, proposed VOTE classification** for reporting DISE finding based on analysis of the severity and configuration of obstruction at four levels. (17)

12. **Byung-woo Yoon et al** in their study **A comparison of dexmedetomidine versus propofol during drug induced sleep endoscopy in sleep apnea patients** published in the laryngoscope in 2016, compared dexmedetomidine and propofol during DISE and found both the drugs gave excellent DISE results but preferred dexmedetomine for its safety profile. (28)

STATISTICAL ANALYSIS

Table-1

Age Details of the study Groups

Age Group (in Years)	Male		Female		Total	
	N	%	N	%	N	%
≤ 19	1	3.33	0	0	1	2.78
20 - 29	3	10.00	2	33.33	5	13.89
30 - 39	12	40.00	1	16.67	13	36.11
40 - 49	10	33.34	3	50.00	13	36.11
≥ 50	4	13.33	0	0	4	11.11
Total	30	100	6	100	36	100
Mean	39.43		34.50		38.61	
Sd	8.93		10.62		9.26	

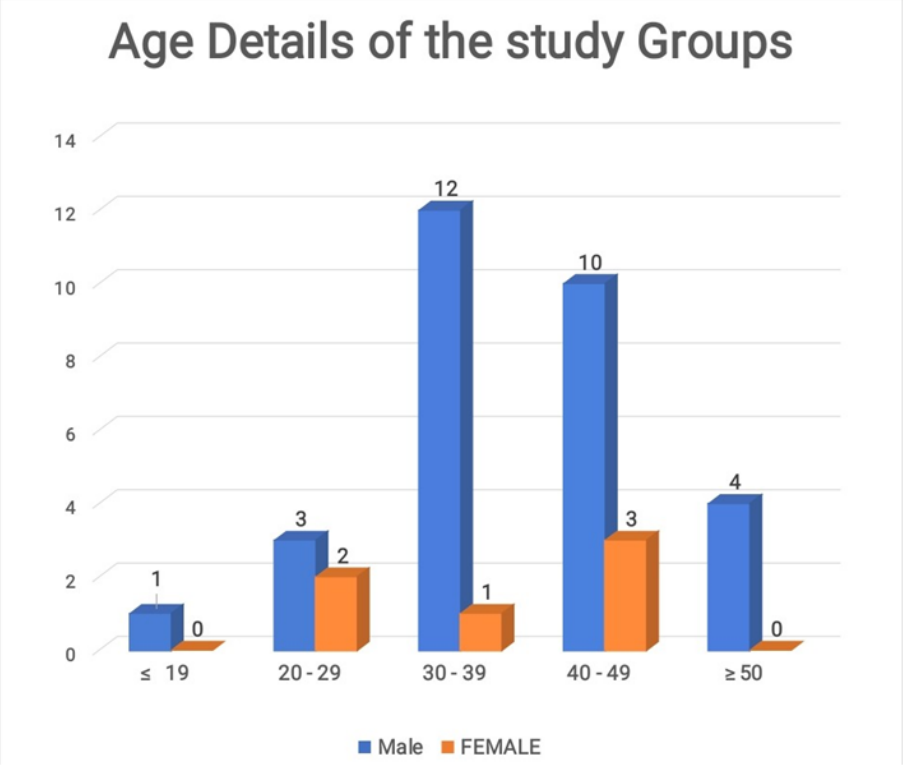


Table-2

BMI

BMI	Number	Percentage
25 – 29.9 (Over Weight)	15	41.66
30 - 34.9 (Obese)	15	41.66
≥ 35 (Extremely Obese)	6	16.68
TOTAL	**36**	**100**
Mean	**31.27**	
sd	**4.67**	

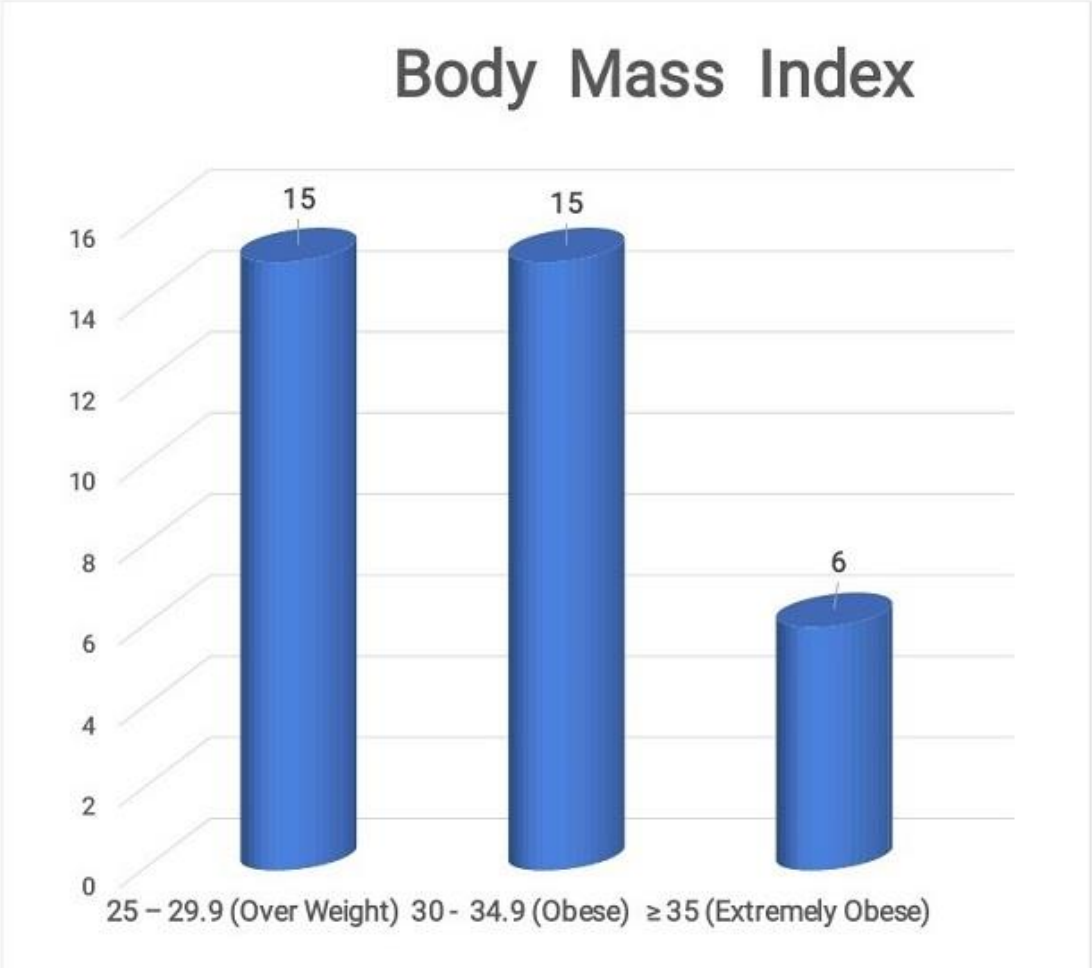


TABLE 3

Comparison of Demographical variables with Diagnosis

Variable		MODERATE OSA N=14	SEVERE OSA N=22	t /Chi-square Value	P-value	Significant
Age		42.07 ± 8.53	36.41 ± 9.21	1.85	0.07	Not Significant
SEX	**Male**	11 (78.57 %)	19 (86.36 %)	0.37	0.66	Not Significant
	Female	3 (21.43 %)	3 (13.64 %)			
BMI		29.59 ± 2.81	32.33 ± 5.33	2.02	0.05	Significant

Table-4

Complaints

COMPLIANT	Mean	Sd
SNORING	6.03	3.24
DAYSLEEP	1.84	1.18

Table 5 Comparison of complaints with Diagnosis

Variable	MODERATE OSA N=14	SEVERE OSA N=22	t - Value	P-value	Significant
Snoring in Years	6.89 ± 3.54	5.48 ± 2.98	1.29	0.21	Not Significant
Excessive Day Sleep in Years	2.48 ± 2.04	1.00 ± 0.64	2.37	0.02	Significant

Table-6

STOP_BANG_SCORE & ESS_SCORE

	Mean	Sd
STOP_BANG_SCORE	4.89	1.30
ESS_SCORE	15.89	3.47

Table 7 Comparison of STOP BANG with Diagnosis

Variable	MODERATE OSA N=14	SEVERE OSA N=22	t - Value	P-value	Significant
STOP BANG	4.64 ± 1.60	5.05 ± 1.09	0.73	0.47	Not Significant
ESS Score	15.36 ± 3.08	16.23 ± 3.73	0.90	0.47	Not Significant

Table-8

CO MORBIDITIES

MORBIDITIES	Number	Percentage
NIL	15/36	41.67
SHTN	15/36	41.67
T2DM	6/36	16.67
HYPOTHYROIDISM	3/36	8.33
HYPERCHOLESTROLEMIA	1/36	2.78
COPD	1/36	2.78
BRONCHIAL ASTHMA	1/36	2.78

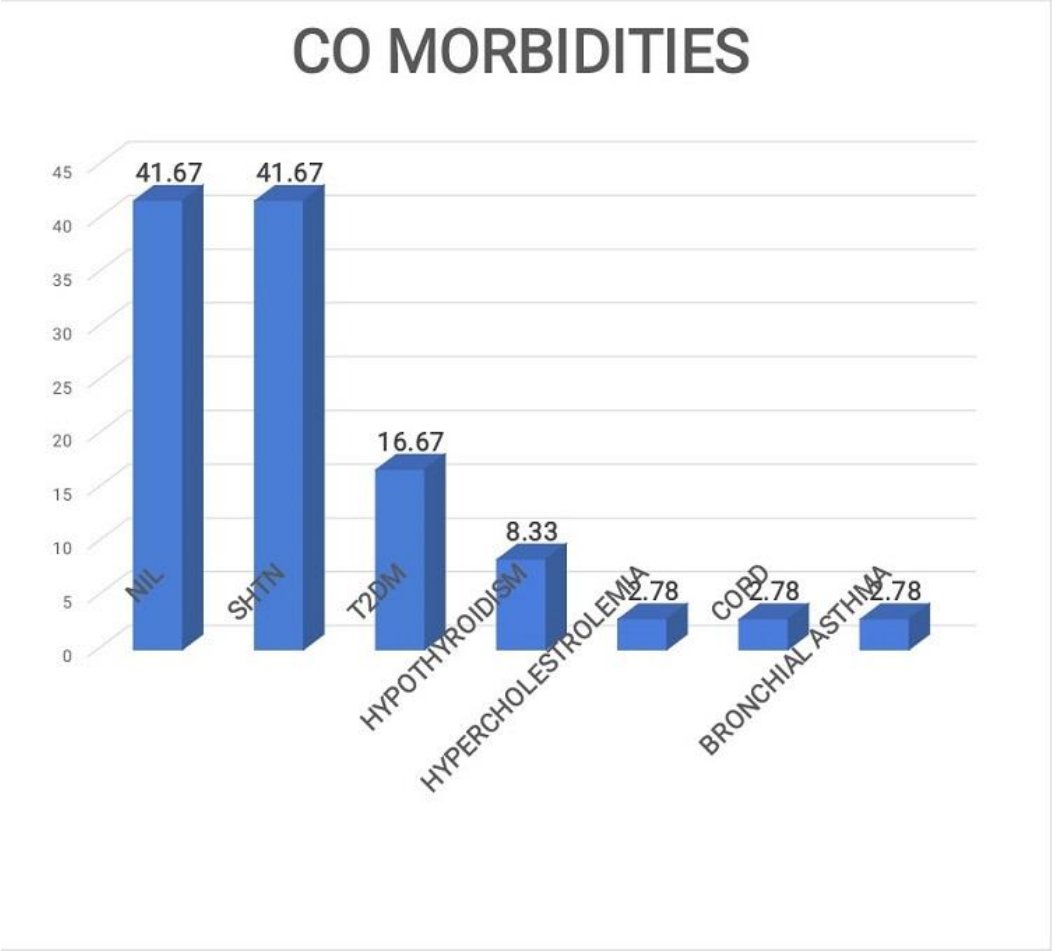


Table -9

Neck circumference

Gender	maximum	minimum	mean	sd
male	48	39	42.4	8.5
female	48	37	42.8	16.9

Gender	Chi sq	P value
male	0.4621	0.49
female		

Table-10

MMS

	Number	Percentage
CLASS 2	14	38.89
CLASS 3	22	61.11
TOTAL	**36**	**100**

Table-11

FTP

FTP	Number	Percentage
2A	7	19.44
2B	16	44.45
3	13	36.11
TOTAL	**36**	**100**

Table-12

PSG AHI , OAI, CAI and LOWEST SPO2

	Mean	Sd
PSG AHI	42.18	20.85
OAI	32.40	17.15
CAI	8.75	5.75
LOWEST SPO2	73.97	9.66

Table-13

DIAGNOSIS

DIAGNOSIS	**Number**	**Percentage**
MODERATE OSA	14	38.89
SEVERE OSA	22	61.11
TOTAL	**36**	**100**

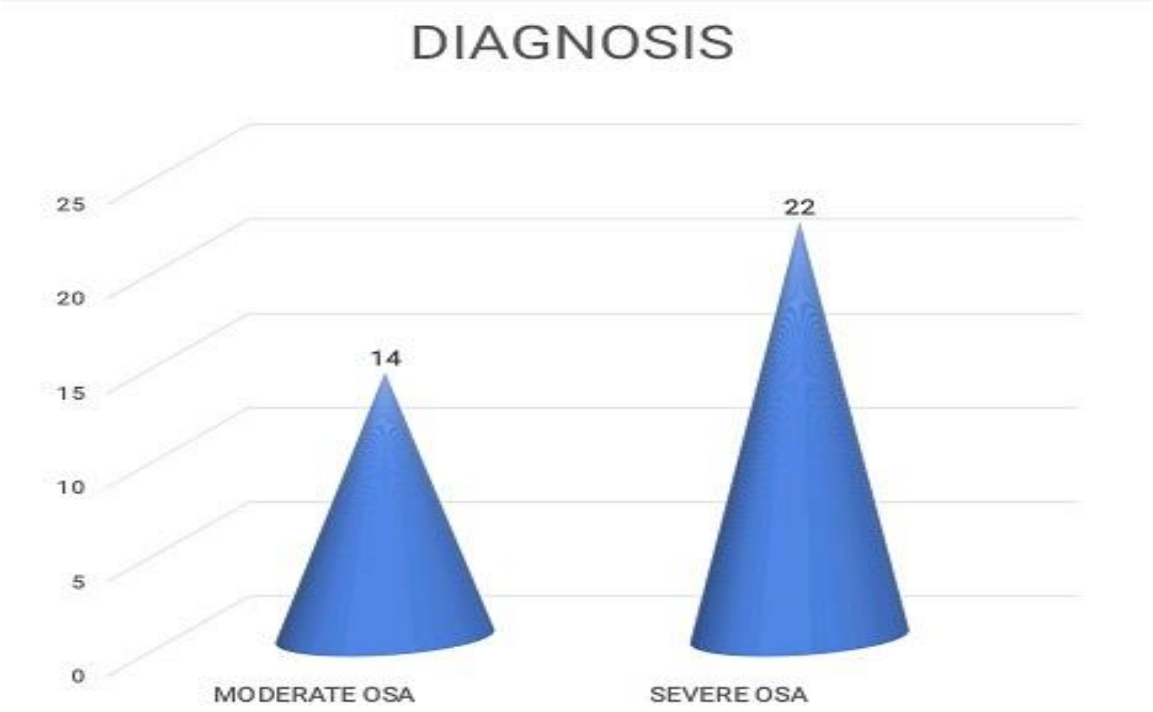


TABLE 14 Levels involved in collapse at BIS >80

LEVELS INVOLVED	NUMBERS	PERCENTAGE
ONLY V (VELOPHARYNX) INVOLVED	2	5.56
ONLY O (OROPHARYNX) INVOLVED	0	0
ONLY T (TONGUE BASE) INVOLVED	3	8.33
ONLY E (EPIGLOTTIS) INVOLVED	0	0
V AND O INVOLVED	16	44.44
V AND T INVOLVED	2	5.56
T AND E INVOLVED	1	2.78
V, O, T INVOLVED	8	22.22
VOTE involved	4	11.11
TOTAL	36	100

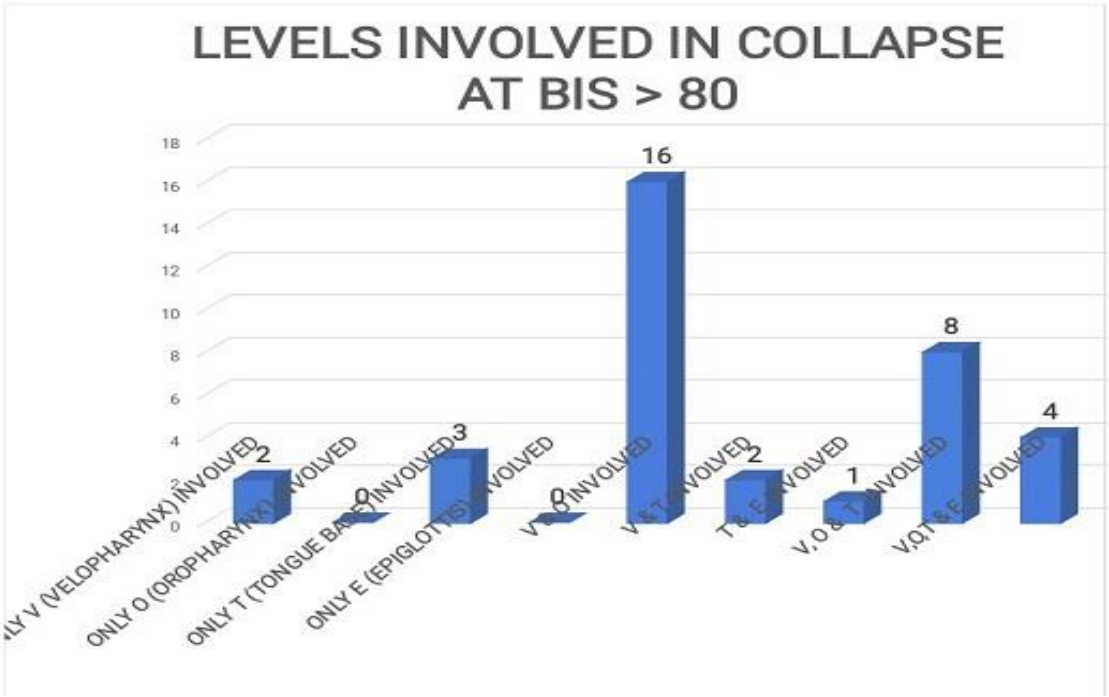


TABLE 15

Levels involved in collapse at BIS 60 – 80

LEVELS INVOLVED	NUMBER OF PATIENTS	PERCENTAGE
Only V	0	0
Only O	0	0
Only T	2	5.56
Only E	0	0
V and O	9	25.00
V and T	0	0
T and E	1	2.78
V , O , T	12	33.33
V, O, T, E	12	33.33
TOTAL	36	100

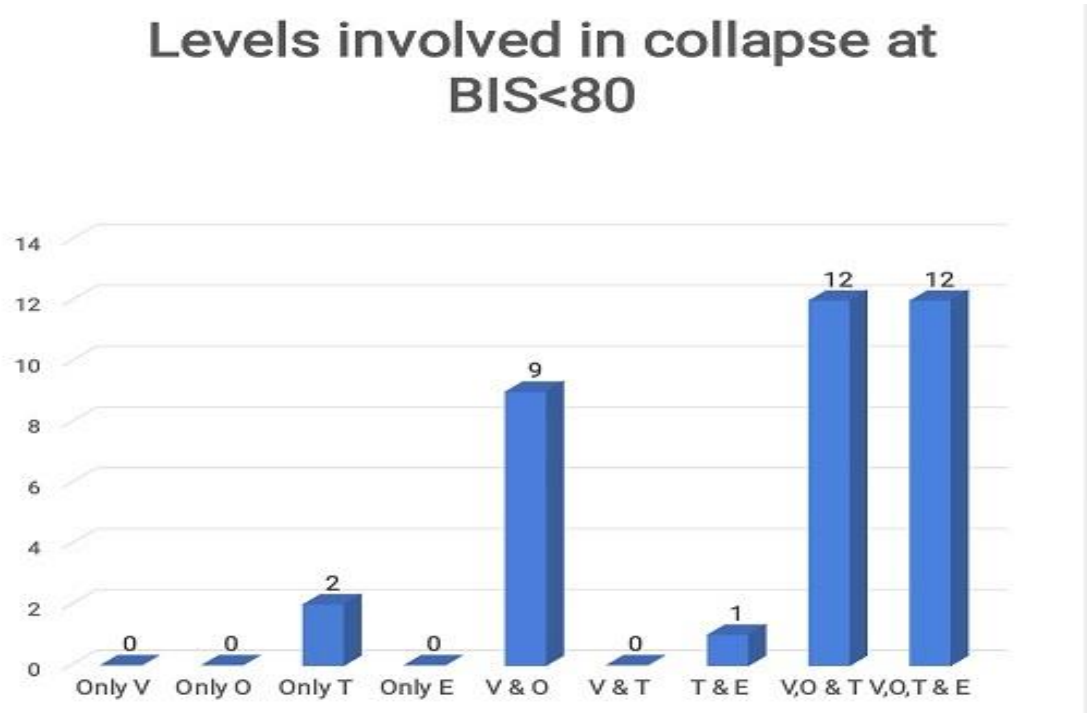
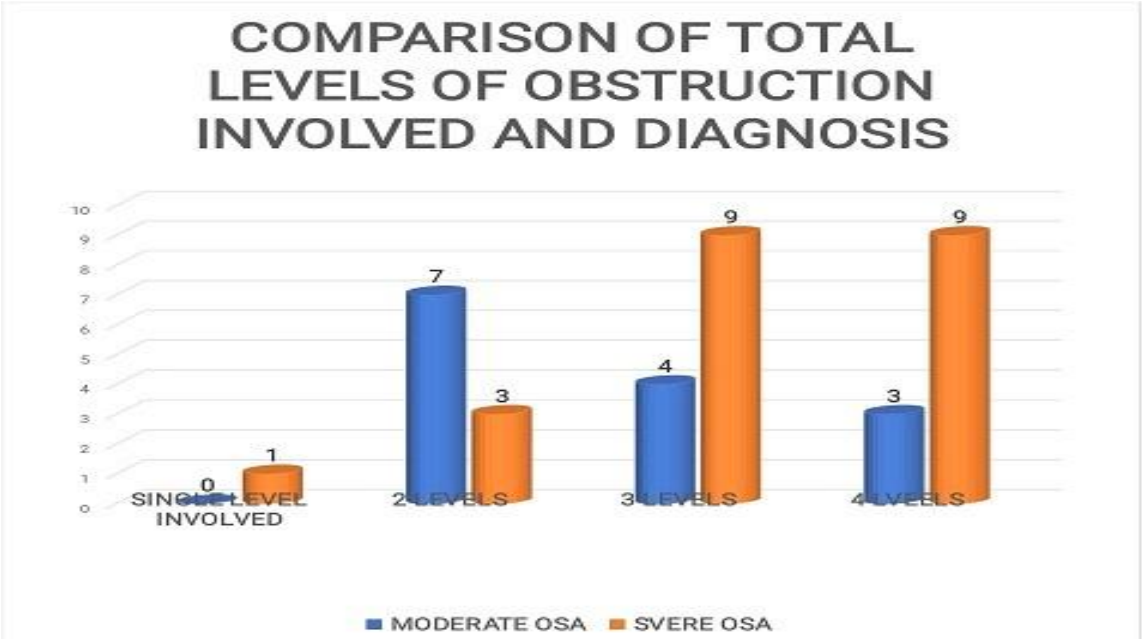


TABLE -16 Levels involved in collapse at BIS >80 and 60 - 80

LEVELS INVOLVED	BIS > 80	BIS 60- 80	Chi-square	p-value	Significant
ONLY V (VELOPHARYNX) INVOLVED	2	0	36.00	0.06	Not Significant
ONLY O (OROPHARYNX) INVOLVED	0	0			
ONLY T (TONGUE BASE) INVOLVED	3	2			
ONLY E (EPIGLOTTIS) INVOLVED	0	0			
V AND O INVOLVED	16	9			
V AND T INVOLVED	2	0			
T AND E INVOLVED	1	1			
V, O, T INVOLVED	8	12			
VOTE involved	4	12			
TOTAL	36	36			



From the above cross tabulation it is inferred that there is no statistically significant changes in the levels involved in obstruction at BIS between>80 AND 60-80 however there was increase in degree of obstruction.

Table-17

DISE INDEX AT BIS > 80 and 60-80

	Mean	**Sd**	**t-value**	**p-Value**	**Significant**
DISE INDEX AT BIS > 80	2.69	1.22	6.10	0.001	Significant
DISE INDEX AT BIS 60 - 80	4.61	1.44			

The mean DISE index at BIS> 80 is 2.69 and that at BIS 60-80 is 4.61.

The above cross tabulation suggests a statistically significant change in level and degree of obstruction involved.

Table-18 CONFIGURATION OF COLLAPSE

CONFIGURATION OF COLLAPSE	**Number**	**Percentage**
Anteroposterior collapse	8	22.22
Circumferential collapse	17	47.22
Lateral wall collapse	11	30.56
TOTAL	**36**	**100**

Table 19 Comparison of Configuration of Collapse with Diagnosis

Variable	MODERATE OSA N=14	SEVERE OSA N=22	Chi-square	P-value	Significant
Anteroposterior collapse	3 (21.43 %)	5 (22.73 %)	0.73	0.96	Not Significant
Circumferential collapse	7 (50.00 %)	10 (45.45 %)			
Lateral wall collapse	4 (28.57 %)	7 (31.82 %)			

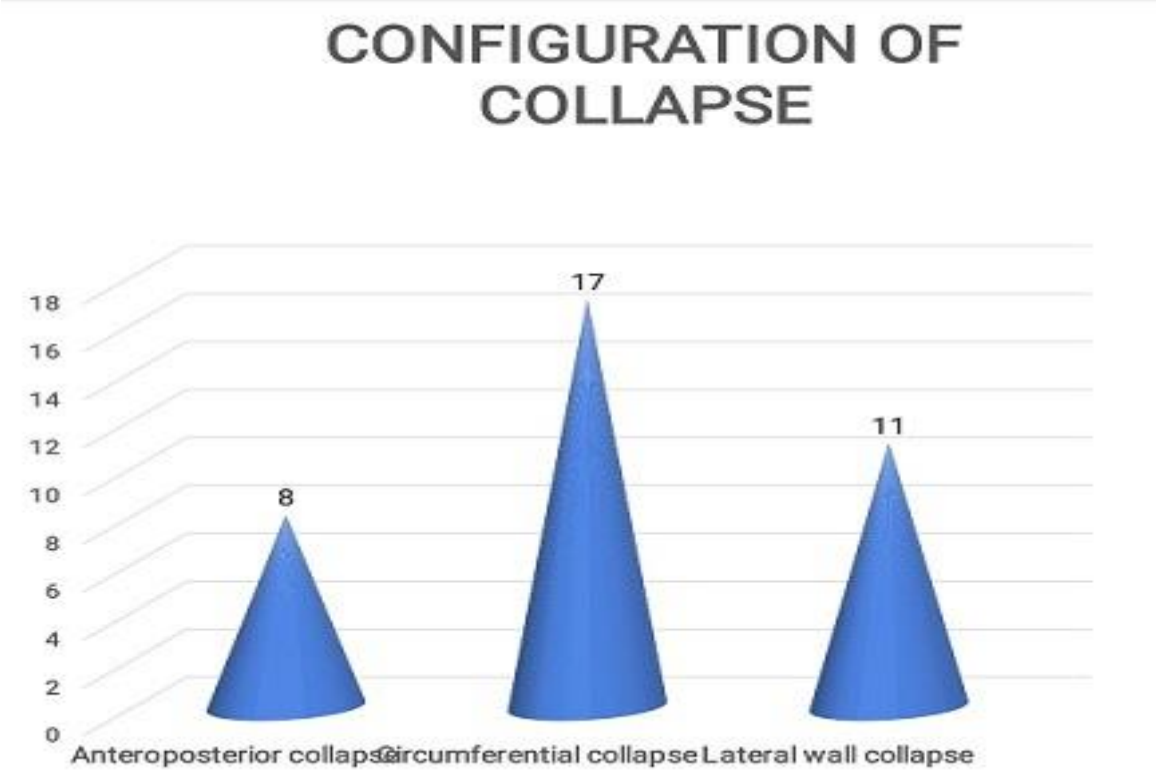


TABLE 20

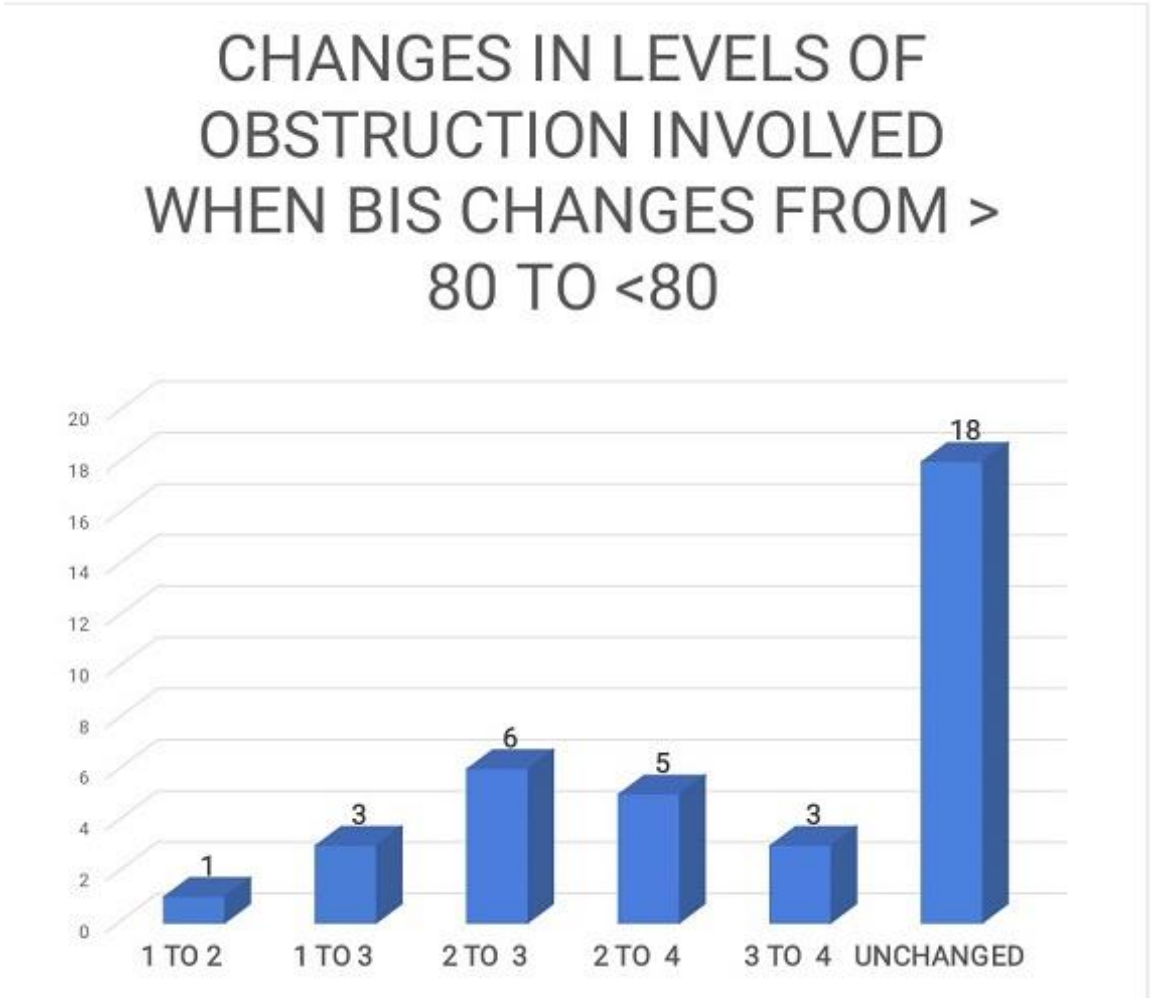
COMPARISON OF TOTAL LEVELS OF OBSTRUCTION INVOLVED AND DIAGNOSIS

Total levels of Obstruction	Moderate osa	Severe osa	Chi-square	P-value	Significant
SINGLE LEVEL INVOLVED	-	1	6.00	0.11	Not Significant
2 LEVELS	7	3			
3 LEVELS	4	9			
4 LVEELS	3	9			
TOTAL	14	22			

TABLE 21

CHANGES IN LEVELS OF OBSTRUCTION INVOLVED WHEN BIS CHANGES FROM >80 TO 60-80

CHANGES IN NUMBER OF LEVELS	NO OF PATIENTS	PERCENTAGE
1 TO 2	1	2.78
1 TO 3	3	8.33
2 TO 3	6	16.67
2 TO 4	5	13.89
3 TO 4	3	8.33
UNCHANGED	18	50.00
TOTAL	**36**	**100**



INFERENCE : 50% OF PATIENTS HAD INCREASE IN LEVELS OF COLLAPSE INVOLVED WHEN BIS CHANGES FROM >80 TO 60-80) WHILE 50% HAD NO CHANGE

TABLE 22

MOST COMMON SITE OF OBSTRUCTION

SITE	NO OF PATIENTS	PERCENTAGE
VELOPHARYNX **V**	34/36	94.44
OROPHARYNX **O**	34/36	94.44
TONGUE BASE **T**	24/36	66.67
EPIGLOTTIS **E**	13/36	36.11

The above table shows that in our study population, velopharynx and oropharynx are the most common site causing obstruction.

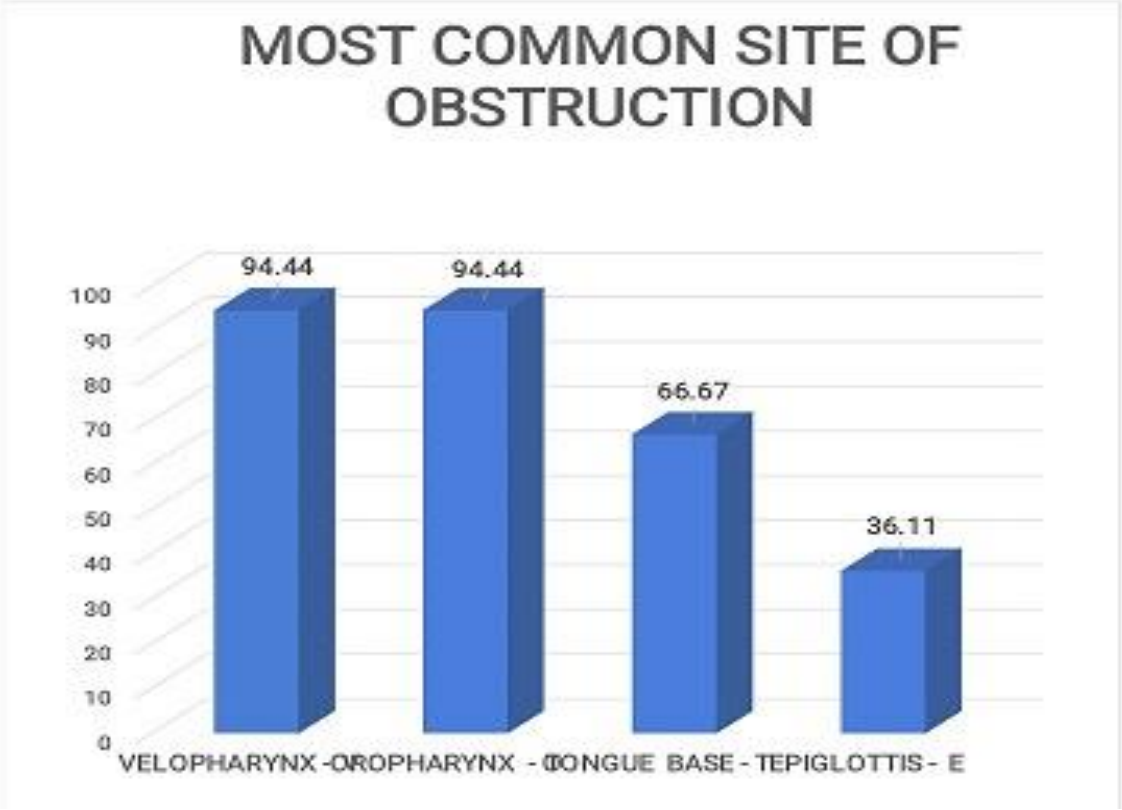


Table-23

LOWEST BIS SCORE REACHED

Minimum	**Maximum**	**Mean**	**Sd**
47	69	58.81	6.27

Table-24

TIME TAKEN TO REACH LOWEST BIS IN MINUTES

Minimum	**Maximum**	**Mean**	**Sd**
8	21	13.14	2.75

Table – 25

LOWEST SATURATION REACHED DURING DISE

MINIMUM	**MAXIMUM**	**MEAN**	**Sd**
69	**32**	**48.3**	**9.57**

Table – 26

EMG SCORE AT LOWEST BIS

MINIMUM	MAXIMUM	MEAN	Sd
32	69	48.3	9.5

Table-27

SURGICAL PLAN

SURGICAL PLAN	NUMBER OF PATIENTS	PERCENTAGE
Expansion sphincter palatoplasty	**10**	**27.7%**
zetapalatopharyngoplasty	**9**	**25%**
Coblator assisted lingual tonsillectomy	**4**	**11.1%**
Anterior palatoplasty	**3**	**8.3%**
uvulopalatopharyngoplasty	**1**	**2.7%**
Genioglossus advancement	**1**	**2.7%**
Tongue base reduction	**1**	**2.7%**
Zetaplasty + tongue base reduction	**2**	**5.5%**
Expansionsphincteroplasty+ tongue base reduction	**2**	**5.5%**
Expansionsphincteroplasty+ hyoid suspension	**1**	**2.7%**
Zetaplasty+ hyoid suspension	**1**	**2.7%**
Bariatric surgery+ zetaplasty+ base of tongue reduction	**1**	**2.7%**
TOTAL	**36**	**100**

RESULTS

Age distribution

In the above table the total number of study population is 36 with a age distribution between 19 and 62.

Mean age being 38.61 years.

The incidence of OSAS is common among age group 30-49.

Sex distribution:

Of the study population 83.3% were males and 16.6% females.

It is inferred that significant incidence of OSAS occurs in males and the common age group being 30-39 and in females common age group involved 40-49 years.

Body mass index

Our study shows 58.2% of the study population are obese with BMI above 30. The remaining population were overweight indicating a strong correlation between increased BMI and OSA.

55.17% of males were obese and 44.8% were overweight.

57% of females were obese and 42.8% were overweight.

Inference: females showed a slight increase in association of OSA and obesity compared to males.

Also our study showed significant association of BMI and severity of disease with a p value of 0.05.

Presenting symptom

In our study population, patients presented with the most common symptom of snoring. However there is significant association between excessive day time sleepiness and severity of the diseases

STOP BANG Score and Epworth sleepiness scale

In general Stop bang scoring of 5-8 indicates high risk of developing severe OSAS.

ESS Scoring of 15 -17 indicates moderate sleepiness.

Our study also correlates with the same scoring levels with a mean STOP BANG score of 4.89+/- 1.30 and a mean ESS score of 15.89+/-3.47.

Associated co-morbidity

In our study population, 58.3 % had co-morbidities in which the most common being systemic hypertension suggesting the high probability of developing hypertension in OSA patients.

Neck circumference

In our study we found that 72.8% of males and 71.4% of females had a neck circumference > 40 cm.

It is inferred that irrespective of gender , neck circumference plays a major role as a risk factor for OSA.

Modified mallampatti scoring

The above shows 61.1% of our patients class 3 MMS scoring indicating higher prevalence of difficult airway in OSA patients

Friedman tongue position

Friedman's tongue position gives an idea about obstruction at the hypopharyngeal level. In our study population majority of our patients had significant obstruction at hypopharyngeal level (2B and 3 included 80.5% of study population)

Polysomnography

The mean AHI in our study is 42.18, suggesting majority of patients had severe disease and obstructive component was the predominant event in polysomnography.

The mean lowest saturation recorded in PSG was 73.97 with a range of 48 to 96.

Diagnosis

Out of 36 patients, 61.11% of patients diagnosed with severe OSA with AHI >30 and 38.89% of patients diagnosed with moderate OSA with AHI 15-30.

Levels and degree of collapse involved at BIS> 80 and BIS level 60-80

We found that the complete obstruction at velopharynx and partial obstruction at oropharynx was the common level and pattern at BIS> 80 and complete obstruction at velopharynx and partial obstruction at oropharynx was the common pattern at BIS 60- 80.

From the above cross tabulation it is inferred that there is no statistically significant changes in the levels involved in obstruction at BIS between>80 and 60-80 however there was increase in degree of obstruction

Configuration of collapse

Out of 36 patients in our study 8(22.22%) patients had anteroposterior collapse; 17 (47.22%) patients had circumfrential collapse; and 11 (30.56%) patients had lateral wall collapse.

Circumfrential collapse is the major configuration in our study however there is no statistical significance between moderate and severe OSA patients.

Number of levels involved versus severity of disease

Out of 22 patients with severe OSA, 9 patients had involvement of all four levels, 9 patients had 3 level, 3 patients had 2 level and 1 patient had single level obstruction.

Out of 14 patients with moderate OSA, 3 patients had 4 level, 4 patients had 3 level and 7 patients had 2 level obstruction.

Inference : Patients with severe OSA had multi level collapse compared to patients with moderate OSA.

Common site of obstruction

In our study population, velopharynx and oropharynx are the most common site causing obstruction.

Changes in number of levels involved when BIS value changed from >80 to BIS 60-80

Out of 36 patients in our study, for 18 patients the number of levels involved was unchanged whereas (18) 50% of patients had changes.

For 1 patient (2.78%) single level of obstruction changed to double level of obstruction; for 3 (8.33%) patients single level of obstruction changed to involve 3 levels; for 6 (16.67 %) patients, double level of obstruction changed to involve 3 levels ; for 5 (13.89%) patients, double level of obstruction has changes to involve 4 levels of obstruction and for 3 (8.33%) of patients, 3 levels of obstruction at BIS > 80 has changed to involve all four levels of obstruction at BIS 60-80.

INFERENCE : 50% patients had increase in level of collapse involved when BIS changed from >80 TO 60-80 while 50% had no change.

Change in DISE index when BIS changed from >80 to BIS value 60-80 :

The mean DISE index at BIS> 80 is 2.69 and that at BIS 60-80 is 4.61 which suggests a statistically significant change in level and degree of obstruction involved with a p value of 0.001.

Lowest BIS score

The average lowest BIS score attained in our study was 58.81+/- 6.27 with the lowest BIS recorded being 47.

Time taken to reach lowest BIS

The average time taken to reach lowest BIS in minutes was 13.14+/-2.75.

Lowest saturation reached during DISE

The mean lowest saturation reached during DISE was 48.3+/-9.57.

EMG scoring

The EMG scoring in BIS monitor ranges from 30-80.

The mean lowest EMG scoring in our study was 48.3+/- 9.5.

In our study we have documented the lowest EMG scoring recorded and the values compared with that of BIS scoring.

We found that out of 36 patients, 24 patients had low EMG score when the patient attained deep sedation indicated by low BIS score, whereas for 12 patients the low EMG score did not correspond to the low BIS score attained.

Also we found that the degree of collapse augmented with decreasing EMG scoring.

Therefore it is inferred that the BIS scoring is reliable when the lowest BIS score corresponds to low EMG score.

DISCUSSION

Sex distribution

In our study we found that the OSAS is more common among males which is consistent with the study conducted by **T. Young et al (24)** " estimation of clinically diagnosed proportion of osa in middle aged men and women" with a study population of 4925 of which he found prevalence in males was 10.82% and that in female was 4.08% .

Age distribution

The incidence of OSAS is common amoung age groups 30-49 with mean age group being 38.6 years. In the study conducted by **T. Young et al (24)**, the mean age group was found to be 49.

BMI as a causal agent

There was significant association between BMI and severity of disease with a significant p value 0.05 indicating overweight or obesity plays a major role as causal agent with a mean BMI of 31.27. The mean BMI of patients in the study conducted by **T. Young et** al (24) was found to be 32.3.

Symptoms

Excessive day time sleepiness was the major complaint in our study population which made patients to seek medical attention with a significant P value of 0.02 between moderate and severe OSA. In a study conducted by

V. Hoffstein et al (23)" Predictive value of clinical features in diagnosing OSA" with a study population of 275 osa and 219 non osa patients , excessive day time sleepiness was found to be presenting complaint in 57.4% of OSA patients.

STOP BANG score

The mean STOP BANG score in our study was found to be 4.89 1.30 and all of patients diagnosed with moderate and severe OSA. In a study conducted by **France Chung et al** (27) STOP BANG questionnaire A practical approach to screen OSA, concluded that the probability of moderate to severe OSA increases in direct proportion to STOP BANG score.

Co morbidity associated with OSA

The most common comorbidity associated with OSAS is systemic hypertension in our study consistent with the study conducted by **Edward O Bixler et al (22)** "association of hypertension and sleep disordered breathing" published in 2000 in American medical association which indicated an independent association between SBD and hypertension in young and middle aged individuals.

Most common site of collapse involved

The most common site of obstruction involved in our study was velopahrynx whereas in the study conducted by **Hong et al** (3)the most common site involved was retroglossal level; in the study conducted by **Sung Jae Heo et al** (8) the commonest site of obstruction was epiglottis and in the study conducted by **Abdullah et al (29)** the commonest site of obstruction being oropharynx.

Multilevel obstruction

We found that the increasing severity of the disease, the levels of collapse involved becomes more, that is it becomes a multilevel obstruction . Also with increasing depth of sedation indicated by BIS value the of collapse becomes multilevel which may be comparable to study conducted by **Sung Jae Heo et al(8)** where there was a significant increase in proportion of multilevel obstruction after 15 minutes of procedure in other words after deeper sedation levels were attained.

Bispectral index scoring

According to **Abdullah et al (29)** the values of BIS for being wake and N1, N2, and N3 stages of sleep was > 82; 81-76; 75-63; < 62 respectively. Moreover they reported that most obstructive activities occurred in the BIS value between 63 and 81.

Sleigh et al (13) found that light sleep was associated with BIS value 75-90 and that slow wave sleep was associated with BIS values of 20-70.

The average lowest BIS value in our study was 58.81+/- 6.27. in the study conducted by **Hong et al(3).,** the approximate BIS value for deeper sedation was 61.9+/- 6.9; in the study conducted by **H Babar Craig et al** (6) the lowest BIS value range from 50.72 to 61.2 which they determined according to that BIS value when the lowest saturation recorded during PSG was attained.

In the study conducted by **Patrick et al** (4) DISE was performed with a starting point of BIS 90 till BIS 40 or until the occurrence of apnea.

The average BIS value in the study conducted by **Abdullah et al** was 76.39 and the average lowest BIS value attained was 58.88+/- 2.59.

Configuration of collapse

In our study Circumferential configuration of collapse is associated with severe disease. we did not find any change in configuration of collapse with increasing sedation depth whereas **Sung Jae Heo et al (8)** documented a change in configuration of collapse , i.e., in 33% of their study population anteroposterior and lateral wall collapse change to circumfrential collapse with increasing duration of procedure.

Lowest saturation attained

The average lowest saturation attained in our study was 48.3%. in the study conducted by **Patrick et al** (4) the lowest saturation recorded during DISE was 65% and they had limited further sedation for fear of apnea and hypoxia.

Time taken to reach lowest BIS

The average time taken to reach lowest BIS value in our study was 13.14+/-2.75 minutes.

Sung Jae Heo et al (8) in their study documented changes in collapsibility of upper airway occurred between mean 10.6+/- 6.2 minutes.

Patrick et al (4) in their study found a negative linear correlation between cumulative time of DISE and BIS level indicating that when the duration of procedure increased the BIS levels decreased.

Changes in level of obstruction involved when BIS changes

There is a significant change in DISE index at BIS > 80 and BIS 60-80 with a p value of 0.001 indicating a strong association between the depth of sedation and degree and levels of collapse involved, that is, with increasing depth of sedation, we found that the degree (partial / complete), levels of collapse(single/ multilevels)involved increased.

In the study conducted by **Hong et al (3)** found that 37% of patients with retropalatal obstruction had higher grade of collapsibility with deep sedation and 44.8% of patients with retroglossal obstruction had increased grade of obstruction at deeper sedation.

In the study conducted by **Patrick et al (4).,** with a sample size of 50 patients found that grade 4 and grade 5 collapsibility at velum was predominantly found at BIS value between 60 and 40. Grade 4 and grade 5 pharyngeal collapsibility at tongue base was found between 60 and 40.

In the study conducted by **Abdullah et al** (29) with a study population of 43, in which they have compared degree of obstruction at velum, oropharynx and tongue base during awake state (Muller's manoeuver) and DISE and found 38.3% , 17.02 % and 34.88% patients had increase in degree of obstruction at velum, oropharynx and tongue base with increasing levels of sedation.

In our study 25% of the hypopharyngeal obstruction occurred only at a BIS level of 50-70 which were not evident at higher BIS levels which is hereby reported for the first time according to authours' knowledge.

Sedation regimen

In our study the sedation regimen followed was with Dexmedetomidine bolus followed by infusion for greater hemodynamic stability and less respiratory depression.

Byung-woo Yoon et al (28)in their study compared dexmedetomidine and propofol during DISE and found both the drugs gave excellent DISE results but preferred dexmedetomine for its safety profile.

Robson capasso et al(31) in their study of " variable findings for DISE in OSA with propofol versus dexmedetomidine" found significantly increased likelihood of demonstrating complete tongue base obstruction in patients undergoing DISE with propofol.

CONCLUSION

Drug induced sleep endoscopy is better indicated when the depth of sleep is between Bispectral index of 60 and 80. It is advisable not to look into the level of obstruction when BIS index is more than 80 and it is only between 60-80 we see maximum collapse.

When the patient goes in for hypotonia, due to sleep which is indicated by EMG score on the BIS monitor, augmented snoring and hypoxia occurs.

This study concludes DISE done along with BIS monitor gives a better evaluation of airway in OSAS patients.

At a critical point of BIS levels between 60-80 along with corresponding decrease in EMG scoring gives the best indicator for level of obstruction by improving chances of better surgical outcome after sleep surgery.

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PROFORMA

1. **NAME**

2. **AGE**

3. **SEX**

4. **IP NO.**

5. **HISTORY OF PRESENTING ILLNESS**

STOP BANG QUESTIONNARIES

- **SNORING**
- **TIREDNESS**
- **OBSERVED APNOEAS**
- **BLOOD PRESSURE**
- **BMI**
- **AGE**
- **NECK CIRCUMFRENCE**
- **GENDER**

EPWORTH SLEEPINESS SCORE

- **SITTING AND READING**
- **WATCHING TV**
- **BEING A PASSENGER IN AMOTOR VEHICLE FOR AN HOUR OR MORE**
- **LYING DOWN IN THE AFTERNOON**
- **SITTING AND TALKING TO SOMEONE**
- **SITTING QUIETLY AFTER LUNCH WITHOUT ALCOHOL**
- **STOPPED FOR FEW MINUTES IN TRAFFIC**
- **SITTING INACTIVE IN PUBLIC SPACE**

TOTAL SCORE

7.COMORBIDITIES

8.EXAMINATION

1. **HEIGHT**
2. **WEIGHT**
3. **BMI**
4. **NECK CIRCUMFRENCE**
5. **CHEST CIRCUMFRENCE**
6. **ABDOMINAL CIRCUMFRENCE**
7. **MALLAMPATTI SCORE**
8. **FRIEDMAN TONGUE POSITION**

9.INVESTIGATION

1. **LATERAL CEPHALOMETRY**

2. POLYSOMNAGRAPHY

a. **AHI**

b. **OAI**

c. **CAI**

d. **LOWEST DESATURATION**

e. **REI**

10.DISE FINDINGS

CONFIGURATION OF COLLAPSE

FIRST EVALUTION AT BIS 1(BIS>80)

(a) **VELOPHARYNX**

(b) **OROPHARYNX**

(c) **TONGUE BASE**

(d) **EPIGLOTTIS**

DISE INDEX AT BIS 1:

TOTAL NUMBER OF LEVELS INVOLVED AT BIS1:

SECOND EVALUTION AT BIS 2(BIS<80)

(a)VELOPHARYNX

(b) OROPHARYNX

(c)TONGUE BASE

(d)EPIGLOTTIS

DISE INDEX AT BIS 2:

TOTAL NUMBER OF LEVELS INVOLVED AT BIS 2:

LOWEST BIS VALUE REACHED:

TIME TAKEN TO REACH LOWEST BIS:

EMG SCORE AT LOWEST BIS:

11. SURGICAL PLAN

PATIENT CONSENT FORM

Title of the Project **:** "CHANGES IN THE FINDINGS OF DRUG INDUCED SLEEP ENDOSCOPY IN ACCORDANCE WITH DEPTH OF SLEEP MEASURED BY BISPECTRAL INDEX IN OBSTRUCTIVE SLEEP APNEA **"**

Institution : Upgraded Institute of Otorhinolaryngology,\
Madras Medical College,
Chennai – 600003.

Name :	Date :
Age :	IP No. :
Sex :	Project Patient No. :

The details of the study have been provided to me in writing and explained to me in my own language.

I confirm that I have understood the above study and had the opportunity to ask questions.

I understood that my participation in the study is voluntary and that I am free to withdraw at any time, without giving any reason, without the medical care that will normally be provided by the hospital being affected.

I agree not to restrict the use of any data or results that arise from this study provided such a use is only for scientific purpose(s).

I have been given an information sheet giving details of the study.

I fully consent to participate in the above study.

_____	_____	_____
Name of the subject	Signature	Date
_____	_____	_____
Name of the Investigator	Signature	Date

சுய ஒப்புதல் படிவம்

“CHANGES IN THE FINDINGS OF DRUG INDUCED SLEEP ENDOSCOPY IN ACCORDANCE WITH DEPTH OF SLEEP MEASURED BY BISPECTRAL INDEX IN OBSTRUCTIVE SLEEP APNOEA ”

நான் இந்த ஆராய்ச்சியில் விவரங்களை முற்றிலும் புரிந்துகொண்டேன். ஆய்வில் பங்குஎடுத்துபோது, சாத்தியமான அபாயங்கள் மற்றும் பயன்களை பற்றி நான் அறிந்துள்ளேன்.

நான் எந்தவொரு வேளையிலும் ஆய்வில் இருந்து திரும்பமுடியும், அதன்பின்னர், நான்வழக்கம் போல்மருத்துவ சிகிச்சை பெறமுடியும் என்று புரிந்து கொள்கிறேன்.

நான் ஆய்வில் பங்குஎடுத்து பணம் எதையும் பெறமுடியாது என்று அறிந்துள்ளேன். இந்த ஆய்வின் முடிவுகள் எந்த மெடிக்கல் ஜர்னலில் வெளியிடப்பட இருந்தால் நான் எதிர்க்கவில்லை, என் தனிப்பட்ட அடையாளத்தை வெளிப்படுத்தப்பட்டு இருக்ககூடாது.

நான் இந்த ஆய்வில் பங்கெடுப்பதன் மூலம் நான் என்ன செய்யபோகிறேன் என்று தெரியும்.`நான் இந்த ஆய்வில் என் முழு ஒத்துழைப்பையும் கொடுப்பேன் என்று உறுதியளிக்கிறேன்.

தன்னார்வளர் சாட்சி

பெயர்: பெயர்:

முகவரி

கையொப்பம்: கையொப்பம்

ஆராய்ச்சியாளராக கையொப்பம் மற்றும் தேதி:

INFORMATION SHEET

We are conducting **"CHANGES IN THE FINDINGS OF DRUG INDUCED SLEEP ENDOSCOPY IN ACCORDANCE WITH DEPTH OF SLEEP MEASURED BY BISPECTRAL INDEX IN OBSTRUCTIVE SLEEP APNOEA"**

at the Upgraded Institute of Otorhinolaryngology, Madras Medical College & Rajiv Gandhi Government General Hospital, Chennai – 600003.

In this study endoscopic management of pterygopalatine pathologies was done

At the time of announcing the results and suggestions, name and identity of the patients will be confidential.

Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.

The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of Investigator **Signature of Participant**

Date:

Curiginal

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INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI 600 003

EC Reg.No.ECR/270/Inst./TN/2013/RR-16
Telephone No.044 25305301
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CERTIFICATE OF APPROVAL

To
Dr.AISHWARYA C,
Post Graduate in MS ENT first year,
Madras Medical College,
Chennai-600 003.

Dear Dr. AISHWARYA C,

The Institutional Ethics Committee has considered your request and approved your study titled **"CHANGES IN THE FINDINGS OF DRUG INDUCED SLEEP ENDOSCOPY IN ACCORDANCE WITH DEPTH OF SLEEP MEASURED BY BISPECTRAL INDEX IN OBSTRUCTIVE SLEEP APNEA"- NO.11112020.** The following members of Ethics Committee were present in the meeting held on **17.11.2020** conducted at Madras Medical College, Chennai 3.

1. Prof.P.V.Jayashankar :Chairperson
2. Prof.N.Gopalakrishnan,MD.,DM., FRCP. Director, Inst.of Nephrology,MMC,Ch : Member Secretary
3. Prof. K.M.Sudha, Prof. Inst. of Pharmacology,MMC,Ch-3 : Member
4. Prof. Alagarsamy Jamila ,MD, Inst. of Patholoy, MMC, Ch-3 : Member
5. Prof.Rema Chandramohan,Prof.of Paediatrics,ICH,Chennai : Member
6. Prof.S.Lakshmi, Prof. of Paediatrics ICH Chennai :Member
7. Tmt.Arnold Saulina, MA.,MSW., :Social Scientist
8. Thiru S.Govindasamy, BA.,BL,High Court,Chennai : Lawyer
9. Thiru K.Ranjith, Ch- 91 : Lay Person

We approve the proposal to be conducted in its presented form.

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary – Ethics Committee

Dr.N.GOPALAKRISHNAN, M.D., DM., FRCP.
Member Secretary
Institutional Ethics Committee
Madras Medical College

S.No.	NAME	AGE/ SEX	IP NO	Complaints	CO MORBIDITIES	STOP BANG	ESS	BMI	MMS	FTP	PSG				DIAGNOSIS	DISE FINDING											SURGERY
											AHI	OAI	CAI	LOWEST Sp02		VOTE AT BIS >80	VOTE AT BIS 60-80	DISE INDEX AT BIS> 80	DISE INDEX AT BIS 60-80	LOWEST SPO2 in DISE	CONFIGURATION OF COLLAPSE	Levels of collapse involved at BIS > 80	Levels of collapse involved at BIS 60 - 80	LOWEST BIS SCORE REACHED	EMG SCORE AT LOWEST BIS	TIME TAKEN TO REACH LOWEST BIS IN MINUTES	
1	SATHIYAMOORTHY	29/M	12678	snoring*5 years ;excessive day time	NIL	5/8	17/24	31	CLASS 3	2b	46	40.1	5.9	53	Severe OSA	V1O1T0E0	V1O2T1E0	2/12	4/12	50	Lateral wall collapse	2	3	57	34	14	EXPANSION SPHINCTER PALATOPLASTY; tongue base reduction
2	MUMOORTHY	42/M	12547	snoring*6years; excessive day time	BRONCHIAL ASTHMA	5/8	11/24	29.7	CLASS 3	2b	40.2	38.4	1.8	73	Severe OSA	V1O1T0E0	V2O2T1E1	3/12	6/12	76	Lateral wall collapse	2	4	54	45	12	EXPHANTION SPHINCTER PALATOPLASTY
3	MARAN	62/M	13567	snoring*10 years	HYPERTENSION	7/8	12/24	32	CLASS3	3	21.3	18.1	3.2	72	Moderate OSA	V1O1T0E0	V2O1T1E0	2/12	4/12	70	Circumfrential collapse	2	3	68	42	8	ZETAPALATOPHARYNGOPLASTY; TONGUE BASE REDUCTION
4	SHANMUGAM	52/M	12689	snoring *4 years	HYPERTENSION	6/8	15/24	29.7	CLASS 3	2b	57.9	55.4	3.5	81	Severe OSA	V1O1T1E0	V1O1T2E1	3/12	6/12	75	Circumfrential collapse	3	4	49	54	13	ZETAPALATOPHARYNGOPLASTY
5	VIGNESH BABU	36/M	12745	snoring*6 years	nil	5/8	15/24	28.1	CLASS 2	2a	49.1	44.6	4.5	75	Severe OSA	V0O0T1E1	V2O1T2E2	2/12	8/12	70	Lateral wall collapse	2	3	62	47	9	EXPANSION SPHINCTER PALATOPLASTY; tongue base reduction
6	SIVA PRAKASAM	26/M	13678	snoring*3 years; excessive day time	nil	5/8	14/24	27.7	CLASS 2	2a	49.1	48.7	0.4	75	Severe OSA	V1O1T1E1	V2O1T1E2	4/12	4/12	76	Circumfrential collapse	4	4	60	60	10	EXPANSION SPHINCTER PALATOPLASTY
7	TAMILSELVI	46/M	13894	snoring*12 years; excessive day time	nil	6/8	21/24	37	CLASS 3	3	34.9	32.4	2.5	74	Severe OSA	V2O2T1E0	V2O2T2E1	5/12	7/12	70	Anteroposterior collapse	3	4	59	43	13	GENIOGLOSSUS ADVANCEMENT
8	ARUN KUMAR	44/M	7078	snoring* 7 years; excessive day time	HYPERCHOLESTROLEMIA	7/8	21/24	31.8	CLASS 3	2b	21.9	20.9	1	57	Moderate OSA	V2O1T1E1	V2O2T1E1	5/12	6/12	50	Lateral wall collapse	4	4	63	36	12	EXPANSION SPHINCTER PALATOPLASTY
9	MALAVIKA	24/F	8186	snoring*2 years	HYPOTHYROIDISM	2/8	15/24	25.1	CLASS 2	2a	24.9	22.5	2.4	90	Moderate OSA	V1O1T0E0	V2O1T0E0	2/12	3/12	80	Anteroposterior collapse	2	2	62	32	10	ANTERIOR PALATOPLASTY
10	THIYAGARAJAN	36/M	8062	snoring*7 years; excessive day time	NIL	4/8	15/24	29.4	CLASS 3	3	28.2	27.1	1.1	96	Moderate OSA	V1O1T0E0	V2O1T0E0	2/12	3/12	87	Circumfrential collapse	2	2	60	43	11	EXPANSION SPHINCTER PALATOPLASTY
11	ISREAL	30/M	17671	snoring*10 years; excessive day time	nil	6/8	16/24	31.4	CLASS 3	2b	34.9	30.2	4.7	74	severe OSA	V1O1T0E0	V2O2T1E1	2/12	6/12	63	Circumfrential collapse	2	4	57	56	14	tongue base reduction
12	ARUL	38/M	11562	snoring*12 years; excessive day time	HYPERTENSION	5/8	11/24	29.2	CLASS 3	2b	17.1	16.5	0.6	84	Moderate OSA	V1O1T0E0	V2O1T1E1	2/12	5/12	87	Circumfrential collapse	2	4	55	45	15	expasion sphincter palatoplasty
13	GOPINATH	19/M	10213	snoring*4 years; excessive day time	HYPOTHYROIDISM; HTN	7/8	21/24	50.2	CLASS3	3	34.4	30.9	3.5	59	Severe OSA	V2O1T1E1	V2O1T2E2	5/12	7/12	50	Circumfrential collapse	4	4	48	60	21	BARIATRIC SURGERY; ZETAPALATOPLASTY ; TONGUE BASE REDUCTION
14	KANNAN	42/M	11742	snoring*6 years	HTN	6/8	14/24	29.1	CLASS2	2a	24.8	23.6	1.2	54	Moderate OSA	V1O1T0E0	V2O1T1E0	2/12	4/12	58	Lateral wall collapse	2	3	61	47	14	ANTERIOR PALATOPLASTY
15	SRINIVASAN	33/M	12314	snoring *8 years	NIL	6/8	21/24	31.5	CLASS3	2b	37.1	31.7	6.4	68	Severe OSA	V2O1T1E0	V2O2T1E0	4/12	5/12	75	lateral wall collapse	3	3	49	54	18	EXPANSION SPHINCTER PALATOPLASTY
16	MAGESH BOOPATHY	36/M	11936	snoring*10 years	HTN	6/8	16/24	27.2	CLASS3	2b	24.7	24.2	0.2	72	Moderate OSA	V1O1T0E0	V2O2T1E1	2/12	6/12	65	Circumfrential collapse	2	4	57	52	14	ZETAPALATOPHARYNGOPLASTY
17	ANNAMALAI	40/M	81682	Snoring*10 years	SHTN	4/8	12/24	33.3	CLASS3	3	15.5	13.8	0.7	82	Moderate OSA	V1O0T1E0	V2O1T1E0	2/12	4/12	75	Circumfrential collapse	2	3	66	56	13	ZETAPLASTY
18	SRIDEVI	40/F	41682	snoring*12 years; excessive day time	NIL	3/8	17/24	32.9	CLASS 2	2b	16.21	15	0.21	77	Moderate OSA	V1O0T0E0	V2O1T1E0	1/12	4/12	70	Lateral wall collapse	1	4	54	43	15	Expansion sphincter palatoplasty
19	ECHAPPAN	39/M	16829	snoring*5 years ;excessive day time	SHTN	5/8	17/24	31.6	CLASS 3	3	42.4	24	18.4	81	Severe OSA	V1O0T1E0	V2O1T2E0	2/12	5/12	72	Circumfrential collapse	2	3	59	42	16	ZETAPLASTY; TONGUE BASE REDUCTION
20	DINAKARAN	37/M	37770	snoring*5 years ;excessive day time	NIL	5/8	16/24	30.9	CLASS 2	2a	80	73	7	84	Severe OSA	V2O2T1E0	V2O2T1E0	5/12	5/12	89	Lateral wall collapse	3	3	63	53	14	Expansion sphincter palatoplasty
21	RENGARAJ	43/M	56142	Snoring and day time sleepiness *6 years	T2DM; SHTN	5/8	11/24	25	CLASS2	2b	29.8	14.4	12.6	78	Moderate OSA	v0O0T1E0	V0O0T2E1	1/12	3/12	65	Anteroposterior collapse	1	2	69	56	12	Coblator assisted tongue base reduction
22	VIGNESH	27/M	37783	Snoring* 3 years	NIL	6/8	11/24	35.7	CLASS 2	2b	56.7	16.3	1.6	66	Severe OSA	V1O0T0E0	V2O1T0E0	1/12	3/12	60	Lateral wall collapse	1	2	67	43	11	Expansion sphincter palatoplasty
23	MOHAMMED SADIKH	44/M	13449	Snoring and apnoeic spells * 2 years	T2DNM;SHT	6/8	16/24	34.8	CLASS 3	3	80	66	7	77	Severe OSA	V1O1T1E0	V2O2T1E0	3/12	5/12	56	Circumfrential collapse	3	3	47	35	16	ZETAPLASTY
24	CHARLES	37/M	35426	Snoring and apnoeic spells * 7 years	NIL	5/8	21/24	32	CLASS 3	3	83.3	37.3	46	59	Severe OSA	V1O1T1E0	V2O1T2E1	3/12	6/12	79	Lateral wall collapse	3	4	62	38	13	Expansion sphincter palatoplasty; Hyoid suspension
25	PREMA	20/F	82173	Snoring*6 months	NIL	3/8	14/24	26.7	CLASS3	3	39	30	9	79	Severe OSA	V1O1T1E0	V1O1T1E0	3/12	3/12	83	Anteroposterior collapse	3	3	64	67	12	Coblator assisted tonsillectomy and lingual tonsil resection
26	MOSES	30/M	45567	Snoring*3 years	HYPOTHYROIDISM	5/8	12/24	36.8	CLASS3	3	52	44	4	82	Severe OSA	V1O1T0E0	V2O2T0E0	2/12	4/12	70	Anteroposterior collapse	2	2	54	48	16	Uvulopalatopharyngoplasty
27	SUNDHAR	50/M	11245	Snoring and excessive day time sleepiness*4	SHTN	5/8	17/24	30.9	CLASS2	2a	27.4	24	2	74	Moderate OSA	V2O1T0E0 V	V2O2T0E0	3/12	4/12	78	Circumfrential collapse	2	2	67	61	11	ZETAPLASTY
28	LAKEESH	36/M	43196	Snoring*6 years	NIL	4/8	20/24	28.5	CLASS3	3	76.6	41.4	15.2	66	Severe OSA	V1O1T2E1	V2O2T2E1	5/12	7/12	60	Circumfrential collapse	4	4	62	54	10	ZETAPLASTY;HYOID SUSPENSION
29	RAMAKRISHNAN	45/M	46128	Snoring*10 years	T2DM; SHTN;COPD	3/8	10/24	26.6	CLASS2	2a	60	23.1	6.9	79	Severe OSA	V1O1T0E0	V2O2T0E0	2/12	4/12	70	Circumfrential collapse	2	2	49	43	17	ZETAPLASTY
30	ELUMALAI	51/M	29618	snoring*5 years ;excessive day time	T2DM; SHTN	6/8	23/24	36.8	CLASS3	2b	47	23.6	13.4	69	Severe OSA	V0O0T2E0	V0O0T2E0	2/12	2/12	64	Anteroposterior collapse	1	1	50	45	14	COBLATOR ASSISTED LINGUAL TONSIL REDUCTION
31	KAMESH	39/M	36180	Snoring*3 years	NIL	5/8	18/24	29.1	CLASS3	3	44.5	19.6	4.9	72	Severe OSA	V0O0T1E0	V1O1T2E0	1/12	4/12	65	Anteroposterior collapse	1	3	65	67	15	COBLATOR ASSISTED LINGUAL TONSIL REDUCTION
32	RAJAVAMMA	40/F	89788	snoring*5 years ;excessive day time	SHTN	2/8	19/24	30.1	CLASS2	2b	23.9	20.7	0.9	75	Moderate OSA	V1O1T0E0	V2O1T0E0	2/12	3/12	70	Anteroposterior collapse	2	2	67	40	16	ANTERIOR PALATOPLASTY
33	RAVIKUMAR	46/M	34365	snoring*5 years	SHTN	5/8	17/24	32.1	CLASS 2	2b	18	15	2	82	Moderate OSA	V1O1T0E0	V2O1T0E0	2/12	3/12	76	Circumfrential collapse	1	2	52	42	11	ZETAPLASTY
34	SULTHAN	48/M	56789	Snoring and excessive day time sleepiness*6	T2DM; SHTN	4/8	18/24	26.2	CLASS 2	2b	23.7	19	3	71	Moderate OSA	V2O1T0E0	V2O1T0E0	3/12	3/12	86	Lateral wall collapse	2	2	56	51	9	EXPANSION SPHINCTER PALATOPLASTY
35	AMUDHA	48/F	76564	Snoring*10 years	T2DM; SHTN	3/8	15/24	27.9	CLASS2	2b	85.49	79	3.4	85	Severe OSA	V1O1T1E0	V2O2T1E0	3/12	5/12	84	Circumfrential collapse	3	3	61	36	12	ZETAPLASTY
36	JAMUNA	35/F	23441	Snoring* 3 years	NIL	4/8	13/24	37.8	CLASS3	3	70.4	62	6	68	Severe OSA	V2O2T0E0	V2O2T1E0	4/12	5/12	60	Circumfrential collapse	2	3	62	69	12	ZETAPLASTY