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Abstracts

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Structure

Short talks: Tongue base & nose (ID 1–9) ................................................................. 1
Symposium 4: The role of the nose in the upper airway (ID 10)................................. 12
Symposium: Sleep surgery in Asia, past and now (ID 11–14) ...................................... 14
Short talks: Upper airway stimulation (ID 15–23) ..................................................... 17
Short talks: General OSA (ID 24–32) ..................................................................... 27
Symposium 8: Surgical modifications of the soft palate in OSA (ID 33) ....................... 36
Short talks: Diagnostic in sleep apnea & drug-induced sleep endoscopy (DISE) I (ID 34–42) ....... 38
Symposium 10: Oral appliance & maxillomandibular advancement (MMA) (ID 43) ............... 47
Short talks: Drug-induced sleep endoscopy (DISE) II & nose (ID 44–52) ..................... 48
Short talks: Soft palate I (ID 53–61) ........................................................................ 60
Short talks: Multi-level surgery (ID 62–70) .................................................................. 69
Symposium 12: Pediatric sleep disordered breathings (SDB) – role of conservative and surgical therapies (ID 71)................................................................. 80
Short talks: Soft palate II & pathophysiology (ID 72–78) ............................................... 81
ePoster session

Combined treatments, CPAP, Nose (P01–P07) ............................................................. 89
Diagnostics in sleep (P08–P14) .................................................................................. 96
General OSA & drug-induced sleep endoscopy (DISE) (P15–P22) ............................... 105
Soft palate & tongue base (P23–P29) ......................................................................... 114
Upper airway stimulation & pediatrics (P30–P37) ....................................................... 123
Role of static versus dynamic tongue base evaluation in decision making in tongue base surgery in Obstructive Sleep Apnea patients

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Introduction:
Multilevel surgery for sleep apnea patients is gaining popularity among sleep surgeons. Palatal level collapse remains the commonest, but tongue base collapse is not uncommon. Drug induced sleep endoscopy is the best to detect dynamic tongue base collapse either high or low. In our view the main criticism of this evaluation tool is neglecting static tongue position.

Sleep surgery is a practice of limitations. what we are trying to do is to attack these limitations to get a better surgical outcome and a more confidential patient counselling. Sometimes we see bulky tongue with high friedman stage during office examination and when we do sleep endoscopy we find this tongue is not sharing obstruction. The question is that will management of this bulky tongue improve outcome??? This what we tried to answer.

Material & Methods:
We compared mean AHI reduction for two groups of patients who were diagnosed as obstructive sleep apnea patients based on level one sleep study and who failed or refused CPAP. All these patients had friedman tongue position three or two during office examination but had no tongue base collapse during sleep endoscopy. The first group (20 patients) (retrospectively collected) were managed according to sleep endoscopy findings by palatal surgery alone. The second group (20) patients were managed by palatal surgery and midline glossectomy. All surgeries were done by the author in Mansoura university hospital. Sleep study was repeated 6 months postoperatively.

Results:
Mean AHI reduction was 74% for the first group and 84% for the second group

Discussion:
Midline glossectomy improves outcome of sleep surgery in patients with friedman tongue position two or three even if tongue base collapse is not evident during sleep endoscopy. This can be explained by tongue palate interaction which is difficult to detect while looking at the airway from behind during sleep endoscopy.
Corrective procedures of the tongue base using Shaver and plasma-PK techniques in the treatment of snoring and sleep apnea – own experience

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Introduction:
A special group of patients with sleep apnea and snoring are people with a large mass of tongue, which is an obstacle to proper sleep breathing.

In this group of patients, after radiological examination and endoscopic examination of the lower throat during a pharmacological sleep, a technique involving the reduction of muscle tissue with a Shaver was used, simultaneously with plasma generator PK.

Material & Methods:
The study material included 36 men with confirmed obstructive sleep apnea, aged 32 to 57 years.

Surgery was performed under general tracheal anesthesia. By introducing a 4 mm diameter Shaver in the midline, the muscle mass of the tongue was reduced using plasma coagulation at the same time.

The efficacy of the treatment was evaluated on the basis of the questionnaire survey and radiological diagnostics (computed tomography) and polysomnographic examination.

Results:
There was a subjective improvement. In the questionnaire survey, all the patients also experienced improvement. The radiographic examination of the tongue and lower throat areas performed 90 days after surgery revealed a reduction in its mass and an increase in the distance from the posterior wall to the root of the tongue in the study group. In the polysomnographic study, improvement of respiratory parameters was observed in 90% of treated patients. In the remaining patients the results were the same as before surgery. In one patient a complication in the form of haemorrhage from the arterial vein was observed. Embolisation was used.

Discussion:
The technique of using Shaver/PK in the reduction of the tongue root may be complementary to the method of fibrinolysis/RF/harmonic/laser and can extend the scope of otolaryngology, especially where other treatments have not yielded the expected results. In addition, it is worth noting that the expected therapeutic effect and convalescence of patients after surgery is much faster.
A novel surgical procedure for Obstructive Sleep Apnea by adjustable lingual septum suspension

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Introduction:
A novel surgical procedure adjustable lingual septum suspension was applied for patients with moderate to severe obstructive sleep apnea who were intolerant to CPAP.

Material & Methods:
Patient selection: Moderate to severe obstructive sleep apnea, tonsil 0°~ II°, tongue levels I °~ III°, tongue relaxation and falling as the main cause. The lingual septum suspension ribbon is 5mm wide and 0.5mm thick. Small skin incision about 1.5cm below the jaw was made direct to the mandible. Separated the mandible surface, hemostasis. A special hook was inserted through the lingual septum into the tongue base, and then forward into the tongue back submucosa. The two ends of the ribbon are pull out from the tongue septum. Then the ribbon was fixed on a titanium plate and adjust the appropriate tension, The titanium plate was fastened to the mandible with titanium screws, suture incision. In case of severe OSA patient, the procedure should be combined with modified UPPP.

Results:
12 cases of moderate to severe OSA patients received single lingual septum suspension or plus multilevel surgery. The procedure is relatively simple, minimally invasive. The ribbon traction is firm and reliable. The patient had a mild postoperative reaction. The short-term efficacy was better, subjective symptoms and PSG results improved significantly. No serious adverse reactions or complications occurred.

Discussion:
The lingual septum mainly composed of dense fibrous tissue, within few nerve and blood vessels, can bear larger pulling force. Adjustable lingual septum suspension alone or combined with modified UPPP may be a safe and effective surgical procedure for the CPAP intolerant OSA patients. Further research is needed to confirm promising long-term results.
Adjustable tongue suspension combined with uvulopalatopharyngoplasty for treatment of severe obstructive sleep apnea

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Introduction:
A new surgical technique, “adjustable tongue suspension combined with uvulopalatopharyngoplasty” was applied for patients with severe obstructive sleep apnea (OSA) who were intolerant to CPAP.

Material & Methods:
Adjustable tongue suspension technique include: a tongue suspension plate made of titanium which implanted below the tongue back mucosa; an adjustable device fixed at the mandible; and 4 tongue suspension sutures connected from adjustable device to tongue suspension plate. By means of this technique, the oro-pharyngeal space could be significant enlarged. With the approval of Medical ethics committee, 56 cases with severe OSA and Friedman Stage II or Stage III were received this procedure. All patients had both preoperative subjective assessment of daytime sleepiness and snoring level and objective assessment of polysomnogram (PSG). Follow-up continued for 6~12 months.

Results:
Since 2009, more than 100 cases of severe OSA patients with Friedman Stage II or Stage III received the modified tongue suspension surgery. Follow up time is 6~12 months. The complete follow up information of 36 patients are gathered. The initial 36 patients achieved significant subjective improvement. The preliminary follow-up data shows 78% surgical cure rate (surgical cure was defined as a>50% reduction in the AHI and a postoperative AHI of

Discussion:
Adjustable tongue suspension combined with UPPP may be a safe and effective surgical method for the CPAP-intolerant severe OSA patients. Further research is needed to confirm promising long-term results.
Figure 1

Figure 2
Role of endoscopic midline glossectomy in obstructive sleep apnoea management

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Introduction:
The base of the tongue has been recognized as a frequent site of obstruction in patients with obstructive sleep apnea (OSA). This study evaluates the role of endoscopic midline glossectomy in multilevel surgery by assessing the postoperative improvement in sleep parameters.

Material & Methods:
In this retrospective study, 40 patients underwent Coblator assisted EMG between December 2015 and June 2017. As part of multilevel surgery, along with EMG expansion sphincter pharyngoplasty (ESP), barbed relocation pharyngoplasty (BRP) and thyrohyoidopexy were also done in 10, 11 and 17 patients respectively.

Physical profile and pre and six months post-operative snoring (VAS score), day-time somnolence (ESS) and polysomnography were recorded. Retroglossal obstruction was identified by nasopharyngoscopy with Muller's manoeuvre / drug-induced sleep endoscopy. 22 patients with complete pre and post operative assessment are included in this analysis.

Results:
Mean age was 42.9 yrs and M:F ratio 1:1. 13 patients had moderate and 9 had severe OSA. Most frequent sites of obstruction were retropalatal and retroglossal regions. Postoperative evaluation at six months, showed improvement in ESS from 14.72 to 6.27 VAS score reduction from 8.05 to 3.05, Apnoea-Hypopnoea Index (AHI) reduction from 27.67 to 10.88 and lowest oxygen saturation rise from 74.64% to 89.86%. Overall surgical success (final AHI <20 and reduction of >50% of the preoperative value) was 77.2%. Subjective improvement in snoring and daytime somnolence was experienced by all.

Perioperative (first two weeks) complications were pain & dysphagia 81%, foreign body sensation 22.7% and secondary bacterial and fungal infections 13.6%. One patient had persistent decreased taste sensation. None had any serious complications.

Discussion:
Coblator assisted EMG as part of multilevel surgery significantly improves the success rate in surgical management of OSA. Identification of the levels of obstruction by endoscopy is the key to success. EMG combined with lateral pharyngoplasty procedures (ESP & BRP) effectively deals with the common sites of obstruction.
Feasibility trial of a novel device, the LinguaFlex Tongue Retractor (LTR), for tongue base suspension to treat Obstructive Sleep Apnea (OSA)

Introduction:
The LTR is a minimally invasive tongue implant inserted with a single needle puncture. At the tongue base a small disc rests against the mucosa to resist posterior tissue displacement. A flexible shaft extends through the tongue to exit at the frenulum to connect to an adjustable anchor. The disc is hypothesized to prevent the tongue base from collapsing during sleep. The device works continuously requiring no effort by the patient.

Material & Methods:
The primary goals of this study were to demonstrate safety and efficacy of the LTR at 180 days. Sixteen subjects were enrolled and evaluated with in-lab PSG, endoscopy, questionnaires and x-ray at baseline and at 1, 2 and 3 months after implantation. Three subjects were withdrawn from the study: 2 were referred for tonsillectomy, and 1 was withdrawn for non-compliance. A 13th subject missed the 6-month follow-up. Twelve subjects returning at 6-m had the following mean and ranges: age 39 (29-64), BMI 33 (23-59), AHI 26.5 (11.6-54.4), ESS 13.9 (6-21) and O2 <90% of 16.8 min (1.3-55).

Results:
Subjects had insertion of the LTR under propofol in an average of 4.7 minutes without any adverse events (AE). Subjects were monitored overnight and discharged the next morning. Subject pain was rated as 1.7 out of 10 the day following the procedure and decreased to .1 at day 30. Twelve mild AEs were reported. At 180 days the AHI improved 58% (p <.006) with 7 of 12 having 50% improvement and an AHI <20. Time of O2 <90% improved 48% (p<0.2). ESS improved 46% (p <.0001); 8 of 9 subjects with ESS scores >10 were reduced to ≤10. Subjects had no sensation of the device and no impairment of speech or swallowing. Snoring was rated as having decreased by 10 of 12 subjects. All subjects chose to retain the LTR.

Discussion:
The feasibility study was considered a success as safety, efficacy and patient acceptance of the LTR were high. Efficacy seems unrelated to OSA severity or BMI however, decreased efficacy was seen with tonsillar hypertrophy and nasal congestion. Further study is needed to understand the ideal subject phenotype and to demonstrate persistent efficacy and safety over time.

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Introduction:
Hyoid suspension has been mostly performed as fixation technique to thyroid cartilage in case of hypopharyngeal collapse in obstructive sleep apnea patients. The aim of this study is to review the outcomes of hyoid myotomy and suspension to mandible without mandibular screw anchoring device.

Material & Methods:
This study includes a cadaver dissection and a consecutive case series of patients undergoing hyoid myotomy and suspension to mandible as a part of multilevel surgery of OSA. Outcomes of interest included complications, change in daytime sleepiness scores, and change in apnea-hypopnea index(AHI)

Results:
Three men with a mean age of 38 years(range, 37-39) underwent hyoid myotomy and suspension to mandible without anchoring device. No patients experienced complications. Average Preoperative and postoperative Epworth sleepiness scores were 11.7 and 8. One patients showed preoperative AHI 27.7, postoperative AHI 3.2 and preoperative minimal SaO2 76%, postoperative minimal SaO2 92%.

Discussion:
Hyo-mandibular suspension may be another surgical option in case of hypopharyngeal collapse in OSA. This procedure can be performed with a small incision, minimally invasive approach with minimal complications and patient morbidity.
Biomechanical and Stress Distribution Effects of Maxillary Expansion Methods (SARPE, MARPE, DOME) using finite element modeling

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Introduction:
Maxillary expansion is an effective treatment for naso-respiratory obstruction and sleep disordered breathing. There are three main methods of maxillary expansion for the older adolescent and young adult: 1. Micro-implant assisted rapid palatal expansion (MARPE), 2. Surgical assisted rapid palatal expansion (SARPE), and 3. Distraction osteogenesis maxillary expansion (DOME). This study compares the biomechanical stress distribution of the craniofacial complex using finite element method (FEM).

Material & Methods:
CT images of a skull were reconstructed using the software AVIZO (VSG Inc., Burlington, MA, USA). Subsequently the reconstructed geometry was exported to the software Solidworks (Solidworks Corporation, USA) for the construction of finite element (FE) models. Anatomical structures including teeth, skull, periodontal ligaments, intermaxillary, zygomatic- maxillary, frontal-zygomatic suture and zygomatic-temporal suture were modeled. The verification of FE models were done by comparing the outcomes from FE activation and clinical cases (n=4 for MARPE and SARPE; n=6 for DOME).

Results:
Results from FE correlate significantly with clinical outcome, with regards to maxillary transverse expansion. (The correlation coefficient: SARPE: R²=0.998; MARPE: R²=1.00; DOME: R²=0.859). Under the same amount of expansion (10mm), MARPE shows the highest stress distribution over the pterygoid plates (35.62MPa) and nasal-maxillary suture (67.434MPa). Zygomatic complex widening was observed in the model of MARPE with the peak stress of 7.941MPa. Nasal floor expansion accompanying maxillary expansion was the greatest in DOME (13 mm), followed by SARPE (10 mm) and MARPE (8.6 mm). There were less unfavorable dentoalveolar changes like teeth tilting or uneven dental arch expansion as compared to nasal floor changes in DOME.

Discussion:
Using finite element analysis, distraction osteogenesis maxillary expansion (DOME) demonstrate lower stress distribution over key sutures, while showing the most expansion at the nasal floor, with the least changes in naso-maxillary complex, particularly the dentoalveolar segment. Distraction osteogenesis maxillary expansion can be an effective surgical modality to solve nasal obstruction.
9

How OSAHS patient looks like

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Introduction:
The aim of this study was to describe the phenotype of obstructive sleep apnea/hypopnea syndrome (OSAHS) patients in which OSAHS surgery can be an option.

Material & Methods:
Design: descriptive study

Participants: patients suffering from OSHAS with AHI < 35 and BMI < 35 and whose deserve surgery.

Results:
250 Patients suffering from OSAHS were evaluated in our hospital between October 2016 and February 2017. 77 patients were included in our study. The mean patient age was 48.68 ± 10.1 years, and the majority of the patients were men (66%). The average BMI at the time of the exploration was 28.44 ± 3.46; The mean epworth escale was 10.32 ± 4.66 and most of them were non using CPAP (59,74%) despite the mean AHI was 18.96 ± 9.18. At the office we confirmed that most of the patients had nasal respiratory failure (89.6%). In the oropharynx half of the patients had a normal uvula (51.9%) and almost half of them had no palatal tonsils hypertrophy (48%), the same with lingual tonsils that were normal in 57% of the patients; also epiglottis was normal in 86%. Muller maneuver at palatal level and base tongue level was positive in 74% and 17% respectively.

Discussion:
The OSAHS patient who is a potential surgical candidate is a male of about 50 years, overweight, with AHI around 20 who does not use CPAP and whose exploration is anodyne because it does not show a large tonsil hypertrophy, large uvula or abnormal epiglottis.
Symposium 4: The role of the nose in the upper airway

Is the evaluation of the nose really important in OSA? Literature review and clinical experience

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Introduction:
Multilevel anatomic obstruction is often present in snoring and OSA. The nose and pharynx begin the upper airway system and represent a continuum. This is the biologic basis for the mutual influences of nasal obstruction and obstructive sleep apnea. Most people have experienced sleeping difficulty during episodes of nasal obstruction (allergic, viral, etc.). As the nose is the first anatomical boundary of the upper airway, nasal obstruction may contribute to sleep-disordered breathing.

Material & Methods:
The consequences of daily nasal obstruction (allergic or viral rhinitis, septal deviation, etc.) on sleep quality have been well demonstrated, resulting poor sleep quality, daytime fatigue and day-to-day discomfort. In order to better understand the relationships between snoring, OSAS and nasal obstruction, we performed an analysis of the medical literature relating to this subject performing a systematic review (epidemiological and physiological studies) in which the effects of treating nasal obstruction on snoring and OSA were investigated.

Results:
Searches of bibliographical databases revealed several trials with randomised controlled design. Nasal congestion is a risk factor for snoring and OSA. The use of intranasal steroids, nasal dilators and decongestants has shown beneficial effects on sleep architecture, but only minor improvement of OSA symptoms or severity. The potential effects of surgical treatment of chronic nasal obstruction on snoring and OSA have been investigated: the impact of intranasal surgery on objective measurements in OSA patients is still unclear. Data from studies by using topical drugs suggest that pharmacologically induced improvement of nasal patency in patients with OSA and chronic nasal obstruction has some beneficial effects on the frequency of apnoeas and on sleep architecture. There’s not a linear correlation between the degree of nasal obstruction and the severity of SDB, while nasal obstruction is not the main contributing factor in the majority of patients with moderate to severe OSA.

Discussion:
Although a linear trend between decreased nasal airflow and greater AHI was not observed, habitual snoring is often associated with decreased nasal airflow. A number of pathophysiological mechanisms can potentially explain the role of nasal pathology in SDB: the Starling resistor model, the unstable oral airway, the nasal ventilatory reflex and the role of nitric oxide. When dealing with a patient with sleep apnea, it’s not adequate to ascertain the severity of the disease with a sleep test alone; it’s mandatory to assess the patient’s upper airway from the nose to the laryngeal inlet, bearing in mind that the most of time, where there’s a reported obstruction of the nose, the nasal surgery is pivotal in the entire multi-level surgical treatment of OSA.
Symposium: Sleep surgery in Asia, past and now

11

History of Asian Sleep Surgery

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Introduction:
Snoring and the diagnosis of obstructive sleep apnea (OSA) was a life-threatening medical condition with no available treatment until the late 20th century. The only surgical procedure for OSA was permanent tracheostomy, but patients suffered from the visible stoma and complications such as tracheal granulomas and tracheitis.

Material & Methods:
Looking back on the history of sleep surgery in the 1950s to 1960s, most research focused on the treatment of snoring. Ikematsu first described uvulopalatopharyngoplasty (UPPP) as an alternative surgical treatment of "snoring," with a reported cure rate of 81\% in 1961. UPPP was introduced in the USA as an alternative to permanent tracheostomy by Fujita in 1981. Since then, multiple surgical approaches and combinations of approaches have surfaced, with variable success rates. With this session, we aim to characterize and analyze trends of sleep surgery in Asia. A literature search was performed using PubMed and Embase databases.

Results:
Over past ten years, our databases research demonstrated that surgical OSA literature reached a plateau without significant increase in yearly surgical literature output.

Discussion:
Our analysis showed that surgical literature represents a small fraction of existing evidence. Investigation using images or other technology may be necessary to overcome this issue. In recent years, combined multilevel surgery and Drug–induced sleep endoscopy (DISE) pose a promising and potentially curative approach to treating adult OSA. Furthermore, warranting greater attention and further research efforts focusing on surgical outcomes.
Transoral robotic surgery in Asian

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Tongue base obstruction in OSA patients is common. Surgical reduction of the tongue base as part of multilevel surgical treatment for these patients can improve surgical result. Transoral robotic surgery in Asian patients require special consideration. Patients selection, surgical anatomy, exposure and technical consideration will be discussed. We will discuss surgical results and potential complications.
Skeletal surgery in Asia

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In human, craniofacial development commences as early as 2 weeks after conception. The process could be disturbed by genetic defects, inherited or mutated, and intrauterine stress by environmental factors, resulting in failure of fusion in maxillary shelf, premature fusion of synchondrosis, or underdevelopment of maxillofacial structures. Subsequent craniofacial anomalies may come along the birth with cleft lip/palate, hemifacial microsomia, Pierre-Robin sequence, or craniosynostosis and others. Neonates with underdevelopment of craniofacial region can be accompanied by small skeletal framework, disproportion between structures, and narrowed pharyngeal airway, which may mandate treatment immediate after birth.

Responding to environmental allergen, adenoids and tonsils may outgrow to an extent that the pharyngeal airway cannot tolerate. Whenever nasal passage is blocked, mouth breathing habit and hyperdivergent facial growth pattern may appear. Early treatments including adenotonsillectomy, antiallergy, radiofrequency to turbinates, maxillary expansion, oral device and myofunctional therapy are recommended.

Even with aggressive management, the maxillofacial struture may not grow up to normal. Septal deviation, hypertrophic turbinates, maxillary retrusion, high and narrow palatal vault, or mandibular retrognathism may remain throughout puberty to adulthood. At the end of puberty, maxillomandibular advancement combining with extrapharyngeal surgical procedures would be the treatment of choice to make up for the development incompeled.

Segmental Maxillomandibular Rotational Advancement (SMMRA) is designed specifically for Far-East Asian OSA patients with underdeveloped maxillomandibular skeleton, featured by narrow maxilla with crowded upper dental arch, high mandibular plane angle, mandibular retrognathism, retruded chin and a generally narrowed pharyngeal airway. SMMRA advances maxilla by two segments, counterclockwisely rotates the maxillomandibular complex to improve the mandibular plane angle, advance the mandible to the optimal extent, and forward the anterior inferior mandible including chin and genioglossus tubercle. The surgery may normalize the airway, facial skeleton, occlusion, and facial aesthetics at the same time.
Future perspective of surgical treatment strategy in Asia

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Before we talk about the surgical treatment strategy, history of treatments for SDB must be considered.

Although UPPP was originally introduced in Japan in 1950’s, early 1980’s was great milestone for the treatment of SDB because two important treatments for SDB, UPPP and CPAP, were introduced worldwide. Since then, 30 years have passed and CPAP is recommended as the first line treatment for moderate and severe OSA in adult. During same time, surgical treatments including UPPP have not performed as frequently as in 1980’s, mainly because postoperative results were unpredictable and SDB symptoms and sings might recur as times goes by.

But many advancements were shown in the fields of sleep surgery, like new surgical techniques and instruments, new surgical methods, multi-level surgery, imaging techniques to detect obstruction sites and so on.

So the success rates of various surgeries for SDB were improved but still lower than those of PAP therapy.

Our surgical success criteria like Sher’s regards both cure and improvement as success, which might be weak points many physicians have criticized.

Our ultimate goals of sleep surgeries are not cure or improvements of SDB by only sleep surgery but the cure or improvements of SDB whether sleep surgery will be all or a part of multiple strategy for SDB.

CPAP, as known well, has many weak points for the treatments of SBD, such as initial acceptance, compliance, and so on. Many physicians have emphasized education, encouragement, CBTI, follow-up strategy to cover weak points of PAP therapy, the results of which are still not conclusive from a long term point of view.

In general, the goals of sleep surgery are as follows;

1) Cure of sleep disordered breathing(SDB) by sleep surgery itself
2) Improvement of SDB symptoms and signs
3) Aid of other treatments or a component of multiple treatment plans for SDB

On the basis of thorough evaluation of upper airway, the order of SDB treatments must be carefully selected.

If patients have mild anatomical abnormalities in the upper airway to make it difficult to try CPAP or MAD, such as nasal septal deviation or turbinate hypertrophy, nasal surgery will be recommended first and then CPAP or MAD will be tried.

If patients have typical anatomical abnormalities, such as big tonsils, SDB surgeries must be first recommended and, after confirming postoperative results, other treatment options would be considered.

But if not, CPAP or MAD will be considered.

Patients with severe anatomical abnormalities, such as facial deformities, must be given treatment options, such as skeletal surgery or PAP therapy, and their wishes considered.

In conclusion, sleep surgeons must take a more important position to decide the initial treatment for SDB because thorough evaluation of upper airway must be the first step of SDB treatments, and must be able to give patients 3 main treatment options, sleep surgery, PAP therapy, and MAD.
Short talks: Upper airway stimulation

15

The role of UPPP in outcomes of Upper-Airway Stimulation therapy in patients with Obstructive Sleep Apnea.

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Introduction:
Upper airway stimulation (UAS) is a second line therapy for CPAP intolerant patients with OSA. Despite individualized settings optimization options, therapy response varies. If the underlying cause is due to insufficient opening of the soft palate, soft palate surgery and tonsillectomy (UPPP-TE) might provide a remedy.

Material & Methods:
Ten patients who did not sufficiently respond to UAS after 2 years post hypoglossal nerve stimulation (HNS) implant surgery, despite several attempts of therapy optimization, underwent repeat drug induced sleep endoscopy (DISE) with activated UAS. After confirmed inadequate soft palate opening these patients underwent UPPP-TE. The patients were assigned to a follow up group 1 and the outcomes were compared to patients who underwent palate surgery prior to UAS implant, group 2 (n=10), and to patients who never had palatal procedures and demonstrated good UAS response, group 3 (n=6).

Results:
The average AHI of group 1 was reduced from 46.1/h to 35.2/h after HNS implantation. After UPPP-TE, AHI decreased to 23.7/h at 12 months and to 11.9/h at 24 months. In group 2 and 3, average AHI decreased from 26.6/h to 8/h and from 27.5/h to 6.5/h respectively at one year follow-up. Results remained consistent at two year follow-up. Average initial AHI and BMI were higher in group 1 than in both comparison groups.

Discussion:
In case of insufficient UAS response and confirmed persistent soft palate obstruction, UPPP-TE can provide long-term therapy improvement. However, the evidence does not support that UPPP-TE should be performed beforehand to guarantee UAS therapy success. DISE with active upper airway stimulation and long-term care are important in this context.
Upper airway stimulation for OSA treatment – potential benefits on metabolism

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Introduction:
Obstructive Sleep Apnea (OSA) is clearly linked to metabolic disorders. Nevertheless, data on metabolic recovery after treatment with Positive Airway Pressure therapy (PAP) is conflicting. Upper Airway Stimulation (UAS) of OSA is a meanwhile well studied alternative in selected patients after PAP failure.

In this trial, we studied the impact of UAS on metabolic changes.

Material & Methods:
In a prospective study, patients with implanted UAS (Inspire Medical), were assessed at baseline, month 6 and month 12 follow up for relevant anthropometric (body mass index (BMI), waist-to-hip ratio (WHR)) and metabolic measures (HbA1c and oral glucose tolerance testing (OGTT)). Metabolic outcome measures were correlated to therapy responding using Sher’s criteria.

Results:
A total of 31 patients were enrolled with basal and month-12-results for respiratory parameters as following: Apnea-hypopnea index decreased from 25.4/h to 10.0/h and Oxygen-Desaturation-index improved from 14.5/h to 8.0/h. Daytime sleepiness (Epworth Sleepiness Scale) improved from 14 to 6.5 points. BMI, WHR, and neck circumference did not change within one year. Blood glucose at 120 minutes in OGT testing was significantly lower while HbA1c, fasting glucose, total cholesterol, HDL, and LDL cholesterol remained stable during follow up period. Interestingly, metabolic effects were not determined by UAS therapy response. BMI in general was higher in UAS non-responders while frequent co-morbidities as hypertension and diabetes as well as age, smoking status and WHR did not differ.

Discussion:
Acute metabolic control as displayed by glucose tolerance significantly improved during 12 months of UAS treatment. In line with PAP studies in OSA patients, anthropometrics as BMI and WHR did not change during UAS therapy. Considering the delayed activation and treatment adjustment in well-titrated UAS therapy, a follow up period of 12 months might be too short to detect significant changes in anthropometrics. Further research on the potential metabolic benefits of UAS is clearly needed during long-term follow up and in patients without previous PAP failure.
Upper airway stimulation in Obstructive Sleep Apnea – can radiological cuff control predict tongue movement?

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Introduction:
Recently upper airway stimulation (UAS) has become established as a second-line therapy to treat obstructive sleep apnea, for a selected patient clientele. It is known that certain tongue movement patterns under stimulation are associated with a better response to therapy. In our monocentric study, we wanted to investigate whether the position of the stimulation cuff in the postoperative X-ray control, allows a prediction of the tongue movement.

Material & Methods:
Since to date, there are no validated guidelines for a description of the position of the cuff, various aspects such as proximity to the mandible or distance to the hyoid have been investigated dichotomously. Three different raters were utilised for this evaluation. 12 months postoperative, a follow-up was made to exclude the effects of healing. Here, the categorized tongue movement in the electrode configuration, with the smallest electric field, was used.

Results:
All three raters, with different amounts of experience in UAS therapy, evaluated the cuff position in 36 patients similarly and with good decision-making reliability. From the five categories used however, no good prediction about the tongue movement was possible.

Discussion:
From the postoperative radiological control, no prediction of tongue movement in a bipolar configuration could be made, with a comprehensible assessment catalog. This aspect can therefore not be used to predict a particularly good or even critical recruitment process, especially with regard to increasingly networked patients. The clinical control has its unchanged significance in order to be able to assess dislocations as a starting point for possible problems.
18

Tips, Tricks and Tunneling: What we've learned doing XII implant surgery

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**Introduction:**
XII Cranial Nerve Stimulator implant surgery is complex and requires skills the Otolaryngologist do not often use.

Using our surgical experience in several different types of Implants, multiple techniques specific to these procedures including tunneling, require a review of anatomy, physiology and surgical techniques

**Material & Methods:**
Doing surgery for 2 distinctly different XII implant, with different physiological activity, we documented the mistakes and lessons learned using a team approach, review of anatomy and physiology, and incorporated ideas generated from experience

**Results:**
We will review tunneling techniques, implant electrode applications, microscopic nerve identification, sensor placement techniques, suturing and anchoring techniques, bleeding issues and how to avoid and improve your surgical results.

**Discussion:**
Over an period of 2 years we have dramatically reduced our surgical time as well as improved techniques with several different types of XII implants. Demonstration of these techniques will be an advantage for surgeons throughout the world.
Multi-institutional case series: hypoglossal nerve stimulation in three adults with Down syndrome and severe Obstructive Sleep Apnea

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Introduction:
Obstructive sleep apnea (OSA) occurs in up to 60% of individuals with Down Syndrome (DS). Midface hypoplasia, narrow nasopharynx, hypotonia, and adenotonsillar hypertrophy are common DS features that predispose to OSA, and consequently increase risk for cardiovascular and metabolic morbidities. The efficacy of hypoglossal nerve stimulation (HGNS) has been shown in adults with OSA, however its effect in those with DS is unexamined. This series presents 3 adults with DS and OSA treated with HGNS.

Material & Methods:
Between June 2015 and July 2017, three adults with DS and severe OSA underwent HGNS implantation at three academic sleep centers: New York-Presbyterian/Weill Cornell Medical College, Cincinnati Children’s Hospital Medical Center, and Thomas Jefferson University Hospital. These individuals underwent preoperative sleep studies, confirming severe OSA, as well as preoperative drug-induced sleep endoscopy ruling out the presence of concentric or circumferential upper airway collapse. All patients underwent device activation approximately 1-2 months after implantation and postoperative polysomnography and device optimization approximately 3-6 months after implantation.

Results:
The first patient is a 31-year-old male who was intolerant of continuous positive airway pressure (CPAP) therapy. Pre-implantation apnea-hypopnea index (AHI) was 35.6 events/hr. Postoperative treatment AHI approached zero in the lateral position. Average device usage was 61 hours/week. The second patient is a 32-year old male who had failed multiple interventions such as a 50-lb weight loss, CPAP, and transoral robotic surgery of the tongue base. Pre-implantation AHI was 48.4 events/hr. Treatment AHI was 15 events/hr with a significant component of central events. Average device usage was 57 hours/week. The third patient is a 49-year old male with severe OSA who was intolerant of CPAP. Pre-implantation AHI was 62 events/hr. Treatment AHI improved to 37.4 events/hr with complete resolution of lateral OSA. Average device usage is 32 hours/week. All three patients reported subjective improvement in sleep quality and duration, along with decreased hypersomnolence during the daytime.

Discussion:
The safety and efficacy of HGNS in the adult population has been well demonstrated. However, the growing body of literature lacks outcomes in adults with DS, who are predisposed to OSA and its consequent cardiopulmonary comorbidities. DS patients have low CPAP compliance and often remain untreated. This case series presents preliminary results in three adults with DS and severe OSA who have failed prior medical and surgical treatments. Results indicate that HGNS therapy was effective in relieving upper airway obstruction, morbidity is low, and the device is generally well tolerated, with excellent patient adherence. Repeat device optimization sessions and sleep studies are ongoing. Larger population studies with long-term follow-up are needed to determine efficacy and safety over time.
Prevalence and clinical significance of positional Obstructive Sleep Apnea in patients treated with upper airway stimulation therapy

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³OLVG, Otorhinolaryngology, Head & Neck Surgery, Amsterdam, Netherlands
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Introduction:
Positional obstructive sleep apnea (POSA) has a prevalence of approximately 60% in a general population, as described in literature. The prevalence and evolution of POSA after starting upper airway stimulation (UAS) for the treatment of OSA is not yet described in literature. The first purpose of this study is to assess the prevalence of POSA before and under UAS therapy. Second, the conversion rate from non-POSA to POSA during UAS therapy is evaluated.

Material & Methods:
The definition used for POSA in this study that patients with an apnea/hypopnea index (AHI) in a supine position that is at least twice as high as the AHI in a non-supine position, suffer from POSA, added with a percentage of supine sleep of a minimum of 10% and a maximum of 90% of the total sleep time. Forty-one patients (age 52 ± 9 years; male/female ratio 39/2; AHI 36.2 ± 11.5 events/h; BMI 27.1 ± 2.7 kg/m²) starting UAS therapy were included.

Results:
The prevalence of POSA before the start of UAS therapy was 61%. The prevalence of residual POSA under UAS therapy in this study remained the same but it has to be mentioned that some patients shifted from POSA to non-POSA and vice versa. The conversion rate from non-POSA to POSA was 15%.

Discussion:
The results of this study indicate that the prevalence of persistent POSA under UAS therapy is high, being 61%. Only few patients shift from non-POSA to POSA or from POSA to non-POSA when using UAS therapy. Overall, these findings suggest that the therapeutic efficacy of UAS could be improved by combination therapy with positional therapy.
Selective upper airway stimulation effective in upper and lower obstructions

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Introduction:
Selective upper airway stimulation (sUAS) is an effective new therapeutic option for OSAS patients. Selective stimulation of hypoglossal nerve leads to breathing dependent protrusion of tongue at night and thereby preventing lower obstructions. Upper obstructions are thought to be impeded by palatoglossal coupling as well. However, the effect of upper airway stimulation on upper obstructions has not been proven with manometry so far.

Material & Methods:
10 patients with OSA received manometry measurements with ApneaGraph (NMP Neuwirth Medical Products, Obernburg, Germany) during one night of sleep prior to implantation with selective upper airway stimulation. Effect of upper airway stimulation was measured with polysomnography or ambulant polygraphy at least two months after implantation.

Results:
Median Respiratory Disturbance Index (RDI) of patients (1 female, 9 male) was 38.8 and ranged from 18.0 – 69.7. Manometric measurements detected 2 patients (20%) with predominantly upper obstructions, 7 patients (70%) with mixed obstructions and 1 patient (10%) with predominantly lower obstruction. RDI was markedly reduced to median 15.2 (range 5 – 48.6) also in patients with relevant upper obstructions.

Discussion:
Selective upper airway stimulation is effective in upper and lower obstructions. Occurrence of a high proportion of upper obstructions does not seem to be a contraindication for selective upper airway stimulation.
Comparison of TORS multilevel surgery versus hypoglossal nerve stimulator: a new treatment paradigm

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Introduction:
Treatment options for patients with obstructive sleep apnea (OSA) who have failed continuous positive airway pressure (CPAP) therapy are rapidly evolving. Surgeons may offer multilevel soft tissue surgery, including transoral robotic surgery (TORS), skeletal framework surgery, and more recently hypoglossal nerve stimulation (HGNS) to overcome neuromuscular hypotonia during sleep. There have been no in-depth comparisons of patients who have undergone traditional multilevel surgery to HGNS.

Material & Methods:
In this retrospective cohort study, adult patients who underwent TORS multilevel surgery by a single surgeon from 2010 to 2013 for moderate to severe OSA were analyzed. Patient selection was based on the STAR trial (Apnea-Hypopnea Index (AHI) >15, Body Mass Index (BMI) <32, <25% central apnea, and no concentric velum collapse) as well as by the Lin et al criteria (AHI <60, BMI <30, no lateral collapse in oropharynx). Pre- and post-operative polysomnograms (PSG) were analyzed to assess improvement, success, and cure. The primary outcomes assessed included AHI and Epworth Sleepiness Scale (ESS). Improvement was defined as any decrease in AHI, success as an AHI <20 with a decrease >50% (Sher criteria), and cure as an AHI <5. Demographic information and complication rates were recorded. Each group was compared to historical STAR trial results to compare TORS multilevel surgery with the Inspire™ implantable hypoglossal nerve stimulation system.

Results:
Of 228 patients who underwent TORS multilevel surgery, 91 met STAR criteria and 121 met Lin criteria. Reduction in median AHI from baseline was 57% in STAR criteria patients, 62% in Lin criteria patients, and 68% (at 12 months) in HGNS patients. Compared with a 66% (83/126) success rate for HGNS, STAR criteria and Lin criteria patients achieved success rates of 51% and 53% (p = 0.048), respectively (Fig. 1). Cure rates were 44% (43/98) for HGNS patients at 36 months and 18% (16/74) and 20% (15/74) for STAR criteria and Lin criteria patients, respectively (p<0.001). Normalization of ESS occurred in 77% (75/98) of HGNS patients at 36 months while STAR criteria and Lin criteria patients achieved 71% (35/49) and 75% (30/40) (p = 0.8), respectively (Fig. 2). The serious adverse event rate was 1.58% (2/126) in HGNS patients compared with 6.6 % (11/166) in patients who underwent TORS multilevel surgery.

Discussion:
HGNS appears to outperform TORS multilevel surgery based on historical controls. This suggests that HGNS should be considered first line surgical therapy in this specific subset of patients as it provides better outcomes with fewer short and long term postoperative morbidities. Both the STAR and Lin criteria when applied to multilevel TORS surgery show a significant reduction in AHI and ESS, but not as great as can be achieved with HGNS. For patients with moderate to severe sleep apnea and BMI < 32, HGNS outperforms TORS multilevel surgery and offers patients an exciting alternative solution to traditional therapy. This success of HGNS invites further investigation into patient populations currently outside criteria described by Lin and the STAR investigators.
Figure 1

Post Intervention Success Rate

% of patients All < 20 with > 50% decrease

<table>
<thead>
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<th>Criteria</th>
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<td>Star Criteria</td>
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Figure 2

Normalization of Epworth Sleepiness Scale

<table>
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<th>Criteria</th>
<th>% Patients</th>
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</thead>
<tbody>
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$p = 0.8$
The ADHERE registry: Clinical outcome, adherence and safety of selective Upper Airway Stimulation in 12 centers worldwide

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Introduction:
The ADHERE study is the largest real-world data collection of selective upper airway stimulation (UAS) for treatment of obstructive sleep apnea (OSA). The aim of the study is to characterize safety, effectiveness and adherence in more than 2500 UAS patients in implantation centers at Europe and US.

Material & Methods:
Data are collected prospectively and retrospectively. At baseline the apnea-hypopnea Index (AHI), comorbidities and the Epworth sleepiness scale (ESS) were measured. Treatment outcome data were collected at 2 to 6 months and 12 months after implantation, including AHI, ESS, adherence, new comorbidities, comparison to CPAP therapy and adverse effects of therapy use.

Results:
Till December 2017 the registry has enrolled 430 patients of 12 centers (3 Germany, 9 USA) (sex: 343 male, 87 female; age: 59.5 ± 11.2 years; BMI: 29.3 ± 3.9 kg/m²). The baseline AHI was significantly reduced from 36.5 ± 15.7/h to 10.6 ± 12.0/h after 12 months. According to the success criteria by Sher (AHI≤20/h and ≥50% reduction) 80% of the patients met the requirements. The overall patient satisfaction with UAS was high. After 12 months (n=184) 94% gave very good positive feedback and 93% considered it to be much better than CPAP therapy. The nightly usage duration was 5.7 ± 2.1 h at 12 months (n=270).

Discussion:
Selective upper airway stimulation is a safe and effective therapy to treat patients with UAS in routine clinical practice. The stimulation leads to significant reduction of AHI and improved patient-reported outcome. The high patient satisfaction is reflected by the maintained high therapy adherence after 12 months.
Role of transpalatal advancement pharyngoplasty in management of lateral pharyngeal wall collapse at the hypopharyngeal level in OSA patients

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Introduction:
Lateral pharyngeal wall collapse and splinting possibilities at the hypopharyngeal level is one of the limitations in sleep surgery. Options to splint include hyoid suspension which gives temporary improvement, maxillary mandibular advancement which is aggressive and technically difficult and expansion sphincter pharyngoplasty with limited effect at this level gained by superolateral traction on lateral pharyngeal walls. We propose to gain benefit from maximal anterior traction on the soft palate in transpalatal advancement pharyngoplasty in gaining maximal tension on the lateral pharyngeal walls including the hypopharyngeal level.

Material & Methods:
Thirty patients (out of 563 patients in the duration between 2012 and 2015) were diagnosed to have OSA on basis of level one sleep study and who refused CPAP or had CPAP failure were subjected to propofol induced sleep endoscopy and the levels of collapse were both the retroplalatal space and the lateral pharyngeal wall including the hypopharyngeal level. These patients were managed by transpalatal advancement pharyngoplasty. Sleep study was repeated 6 months later.

Results:
We had 70 percent cure rate (AHI below 5). All the remaining cases did improved but had residual events more than five and managed by oral myo functional therapy. We had three cases complicated by oronasal fistulae; two managed conservatively and one managed by palatal flap.

Discussion:
Transpalatal advancement pharyngoplasty is an effective method to splint the lateral pharyngeal walls at the hypopharyngeal level.
High dependency care for patients after sleep apnea surgery: Is it necessary?

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Introduction:
Obstructive sleep apnea (OSA) patients undergoing surgery have been reported in the literature to be at a higher risk of developing post-operative cardiorespiratory complications. Authors have recommended intensive care monitoring for patients after sleep apnea surgery. We present our experience in a newly set up OSA surgical service in a tertiary referral centre, where the primary choice of patient placement after sleep apnea surgery was to high dependency (HD) care.

Material & Methods:
The aim was to determine if HD care is required in OSA patients after sleep apnea surgery. Retrospective review was conducted on all patients who underwent sleep apnea surgery by the unit from July 2015 to August 2017. Nasoendoscopy and a level 1 polysomnography (PSG) was performed in all patients to diagnose and quantify the severity of OSA pre-surgery. Patients with psychiatric problems, severe cardiovascular comorbidities, BMI > 35, those with predominant central sleep apnea or parasomnias were excluded from surgery. Age, body mass index (BMI), apnea-hypopnea index (AHI), PSG lowest oxygen saturation, surgical procedures (single level or multilevel upper airway surgery), post-operative oxygen saturations and early post-operative complications were documented and analysed.

Results:
45 patients were included. Mean age was 34 ± 12 years, mean BMI was 29.3 ± 5.6, mean pre-operative AHI was 32.4 ± 24.6, and mean PSG lowest oxygen saturation was 82.1 ± 10.7%. 32 patients underwent multilevel upper airway surgery which included nasal, palatal and tongue surgery. No patients experienced significant desaturations in the post anaesthesia care unit or high dependency care. Mean lowest oxygen saturation in the post anaesthesia care unit was 97 ± 2.4%. 1 patient with severe OSA (AHI 76.4, lowest oxygen saturation 53%, BMI 35) experienced an asymptomatic desaturation to 87% 12 hours post nasal surgery. He was treated with supplemental oxygen and recovered well. 1 patient experienced primary hemorrhage from the tonsillar fossa which was managed conservatively. All patients were discharged on post-operative day two.

Discussion:
In our study, the rate of post-operative significant desaturations and early post-operative complications for patients after sleep apnea surgery was low. High dependency (HD) care maybe necessary for patients with severe OSA, gross obesity and severely low oxygen saturation on PSG. We propose that HD care for patients after sleep apnea surgery may not be necessary even when multi-level upper airway surgery is performed.
Can we improve epworth sleepness scale with an additional question

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Introduction:
Epworth sleepiness scale (ESS) is a simple questionnaire and widely used system of quantifying sleepiness among patients suspected of obstructive sleep apnoea. ENT Surgeons rely heavily on ESS in patients with snoring and excessive sleepiness and refer for sleep studies if the score is above 10. We found that many patients had scored zero to question on ‘Sitting and Reading’ and ‘Sitting and Talking to someone’. We propose modifying ESS to include ‘Power Nap’ to the questionnaire.

Material & Methods:
All the patients with excessive sleepiness/snoring attending ENT department past 6 years were considered for this retrospective analysis. The study was carried out at Kings College and at Ashford and St Peters Hospital NHS Foundation trust. All these patients filled out an ESS questionnaire. Apart from usual ESS with eight questions, another question was added on ‘Power nap’ and were asked to grade the additional question like the rest of the ESS questionnaire. Score of 10 and above were considered for sleep study. OSA was diagnosed if the Apnea-Hypopnea Index (AHI) was more than 5 events per hour, 167 patients had positive sleep apnoea. There were 127 men and 40 female patients with age ranging from 29 to 56, with a mean of 39.

Results:
167 Patients were included in the study, 127 (76.1%) patients were male and 40 (23.9%) were female patients with their BMI ranging from 25 to 52. All the 167 patients ESS questionnaire was analysed. To the question on ‘Sitting and Reading’, 10 (5.9%) answered as ‘Moderate chance’ and 145(86.8%) said ‘Never’ and for question on ‘Sitting and Talking’ only 10 (5.9%) answered as ‘Moderate Chance’ and 151(90.4%) patients said ‘Never’. 26 (15.6%) patients ticked ‘Slight Chance’ of Power Nap, 15 (8.9%) patients said ‘Moderate chance’, 101 (60.5%) patients rated ‘High Chance’ and 25 (14.9%) patients said ‘Never’ for power nap. ESS score was less than 10 in 35 (21%) patients but became more than 10 if we considered power nap thus qualifying for Sleep study. All these 35 patients had moderate to severe sleep Apnoea requiring treatment with CPAP. Patients who had power nap were seen by neurologists to exclude causes for excessive sleepiness.

Discussion:
M. W. Jonhs of Sleep Lab, Epworth Hospital, Melbourne, Australia described ESS Questionnaire. ESS has eight questions and each question has 3 possibilities giving a maximum score of 24. In UK, ENT Surgeons rely heavily on ESS and score of above 10 are referred for sleep study. Many patients who had Sleep Apnoea scored zero to questions ‘Sitting and Talking to someone’ and ‘Sitting and Reading’. Power Nap is another indication of excessive sleepiness. 85% of patients said they experienced power nap while as a driver or passenger in car for an hour requiring stopping in service area. This was statistically highly significant. 35 patients would have missed having sleep study if power nap was not considered in the ESS questionnaire and hence could have had serious consequences such as traffic.
Laryngeal Obstructive Sleep Apnea

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**Introduction:**
Obstructive sleep apnea (OSA) is a disorder characterized by repetitive collapse of the upper airway during sleep, with consequences of nocturnal hypoxemia and recurrent arousals from sleep. The prevalence of OSA is significant and increasing with greater obesity and aging of populationsthere exists an increased risk of fatal and nonfatal cardiovascular events as well as all-cause mortality in patients with severe OSA.

**Material & Methods:**
Laryngeal obstructive sleep apnea (OSA) is a rare condition occurring in adults as well as children. The endolarynx warrants consideration in the pathophysiology of OSA, particularly as it relates to sensory dysfunction and epiglottic obstruction. Laryngeal OSA has to be diagnosed endoscopically during sleep or sedation.

**Results:**
In children, laryngeal OSA is caused by malformations, tumors, and laryngomalacia; the latter especially in preterm infants. Classical findings being long and curled up epiglottis (Omega shaped), short aryepiglottic folds and bulky arytenoids. Treatment is either Arytenoidplasty, Aryepiglottoplasty, Epiglottoplasty and Epiglottopexy alone or in combination.

**Discussion:**
In adults, laryngeal OSA mainly occurs in elder men due to a floppy epiglottis apart from laryngeal and hypopharyngeal tumors and other disorders in this anatomical region. Various techniques have been described as being effective depending upon the underlying illness, right from Partial or complete epiglottidectomy to supraglottopasty or aryepiglottoplasty. Bilateral Vocal fold paralysis is the most common acquired cause of adult laryngeal OSA and shows promising results with coblation or radiofrequency assisted posterior transverse cordotomy.
Safety of ambulatory surgery in patients with Obstructive Sleep Apnea

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Introduction:
Many procedures previously performed in a hospital setting are now done on an outpatient basis at ambulatory surgery centers. With this study, we aim to evaluate the safety of ambulatory surgery in patients with comorbid obstructive sleep apnea (OSA).

Material & Methods:
We conducted a retrospective chart review of all patients undergoing ambulatory surgery at our institution’s outpatient surgery center over a 3-month time period. We recorded, demographic data, prior diagnosis of OSA, use of CPAP, procedure performed, type of anesthesia, and comorbidities. Our primary outcome measures were anesthesia complications, hospital admission, and emergency department (ED) presentation after discharge.

Results:
Data was collected on 771 patients, including 299 men and 472 women. We compared a cohort of 157 patients with previously diagnosed OSA (“OSA”) to 614 patients with no prior history of OSA (“no OSA”).

The OSA cohort consisted of 85 men and 72 women, with a mean age of 53.18 years, 104 of which had an otolaryngologic procedure. 1 patient had an anesthesia complication, 4 were admitted, and 7 presented to the ED. The no OSA cohort consisted of 214 men and 400 women, with mean age of 48.41 years, 260 of which had an otolaryngologic procedure. One patient had an anesthesia complication, 6 were admitted, and 13 presented to the ED.

We found a significant difference in the mean age and gender breakdown between groups (p=0.001, p<0.0001). There was no difference in the rate of anesthesia complications, hospital admission, or ED presentation.

Discussion:
Ambulatory surgery can be safely performed in patients with comorbid obstructive sleep apnea.
Automated sleep stage, apnea, and hypopnea scoring using deep learning

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Introduction:
Polysomnography (PSG) scoring suffers from considerable inter- and intra-rater variability. Inaccurate or biased scoring pre- or post-operatively may affect patient management and interpretation of obstructive sleep apnea surgical outcomes. Deep learning is a form of machine learning that uses layers of perceptrons (probabilistic classifiers) to learn hierarchical structures and dependencies within the data. Deep learning can build accurate classifiers out of noisy, real-world datasets.

Material & Methods:
This study performed a retrospective evaluation of scored PSG data from the Sleep Heart Health Study. A deep learning sleep staging classifier was developed using convolutional and recurrent layers. The training set used 1,900,000 30-second PSG epochs from randomly selected patients. A hold-out set of 200,000 PSG epochs from non-training patients was used for testing. Electroencephalography (EEG), electrooculography, and electromyography data were passed to the classifier. Two deep learning airway event classifiers were also developed using convolutional layers. The training set used 10,000 PSG epochs with apnea or hypopnea events from 100 randomly selected patients. Ten non-training patients were used for testing. The abdominal and thoracic respiratory effort and thermistor channels were input to the classifiers. The hypopnea classifier additionally used the EEG and oxygen saturation channels. The airway classifiers calculated the apnea-hypopnea index (AHI) for each patient.

Results:
The neural network classifier demonstrated an F1-score of 0.86. Accuracy for the model based on the manual scores was calculated for the W (93.3%), N1 (44.0%), N2 (91.4%), N3 (80.6%), and R (93.5%) stages. The agreement between the model and manual scores was calculated using Cohen's Kappa at 0.8. The convolutional neural network classifier for apnea events demonstrated an area under the curve of the receiver operating characteristic curve (AUC ROC) of 0.93 and accuracy of 97%. The convolutional neural network classifier for hypopnea events demonstrated an AUC ROC of 0.80 and accuracy of 80%. The mean squared error for the model's predicted AHI for the patients in the hold-out set was 3.541.

Discussion:
The deep learning sleep stage classifier demonstrates excellent accuracy and agreement with expert sleep stage scoring. It achieves the best overall F1-score, accuracy and Cohen's Kappa compared to literature for automated sleep stage scoring of PSG epochs. The deep learning sleep classifiers for apneas and hypopneas demonstrated excellent accuracy for apnea detection and fair accuracy for hypopnea detection. They achieve comparable results to studies performed in literature for automated sleep event detection with models that do not require hand-engineered features. Accurate automated scoring of PSG events may eventually allow for fully automated PSG scoring without the variability and bias inherent in human scoring.
Surgical versus conventional weight loss therapy for Obstructive Sleep Apnea, a randomized controlled trial: quantitative and qualitative outcome

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Introduction:
Prevalence of obstructive sleep apnea (OSA) among obese patients was reported more than 80% of the Asian population. Surgical and conventional (non-surgical) therapy for obesity and OSA were associated with comparable outcomes. This study aims to compare the conventional and surgical therapy in treating obesity and OSA, also to explore patients’ willingness on participating in such randomized controlled trial in Malaysia.

Material & Methods:
A prospective, single-center randomized controlled trial on 28 obese patients, with individual interviews.

Results:
28 out of 36 interviewees were randomized into the surgical and conventional group. Surgical group achieved a statistically significant greater reduction in BMI. The median change in BMI was 7.7kg/m² (5.5, 10.9) and 0.9kg/m² (-2.2, 2.2) in surgical and conventional group respectively (P=0.001). Both surgical and conventional groups had significant changes in AHI. The median change in AHI was 8.1 and 13.5 events/hour respectively in the conventional and surgical group. However, the surgical group did not show statistically better outcome (P=0.286). 42.9% of the surgical group and 30.8% of the conventional group achieved cure in OSA (AHI < 5 events/hour) at the end of this study (P=0.695). Difficulties in recruitment were mainly due to patients’ anxiety and strong preferences over one therapy than the other.

Discussion:
Bariatric surgery led to greater weight loss as compared to conventional weight loss therapy; however, it did not show greater improvement in AHI, as well as subjective evaluation of daytime somnolence. A multicenter study or a patient preference trial may improve the recruitment hence the number of participants in future trials.
Sexual quality of life and sexual health in OSA patients

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Introduction:
OSA and other Sleep Disorders have been known to be probable risk factors for Sexual health disorders. There have been several studies regarding Sexual function of OSA patients, but the evaluation of Sexual Quality of Life using verified objective instruments, its relationship to OSA patient symptoms and understanding the effect of OSA treatment is lacking.

Material & Methods:
Through verified, evidence based QOL instruments we studied new patients and clinical study patients to identify the relationship, correlation, and risk factors for urologic and sexual health in men and women with Sleep Disorders and OSA.

The Sexual Health Inventory for Men (SHIM), a verified Sexual Quality of life questionnaires in men and the Female Sexual Function Index (FSFI)questionnaires in women, along with the SNORE-25 and ESSS were used to evaluate patients who had OSA and were seeking therapy. It was also used post therapy as a means to evaluate the efficacy of therapy. The severity of OSA (AHI, AI), OSA Symptoms, and BMI among other metrics were then correlated with the QOL questionnaires.

Results:
Using the SHIM and FSFI, along with the SNORE 25 and ESS, we found and will demonstrate the correlation and lack of risk factors for changes in Sexual Quality of Life and Sexual Health in OSA patients and the direct and variable relationship to AHI, AI, BMI, CPAP usage, Surgery and OSA Symptoms.

Discussion:
This baseline can now be used for evaluation of treatment efficacy regarding Quality of Life and Sexual Health in OSA patients and the direct and variable relationship to AHI, AI, BMI, CPAP usage, Surgery and OSA Symptoms.
Which subgroup of patients with Obstructive Sleep Apnea should be screened for depression?

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Introduction:
Numerous population studies have identified the increased incidence of depression in patients with obstructive sleep apnea (OSA). Recognizing and addressing symptoms of depression may improve motivation and compliance with patient-initiated management of OSA (i.e. CPAP, weight loss) in addition to overall psychosocial disease burden. The objective of this study was to review current literature to identify the characteristics of patients with OSA at highest risk of developing depressive symptoms.

Material & Methods:
A literature review was conducted using MEDLINE and Cochrane databases with the MeSH keywords "sleep apnea, obstructive" and "depression". Articles only published in English were reviewed and no date limit was set. Reference lists of identified relevant publications were also searched. Abstracts and full-text articles were reviewed by the authors and a selection of the most relevant and highest quality papers were chosen by consensus.

Results:
Recent large population studies from Taiwan and the United states demonstrate a temporal relationship between OSA and developing depression (Pan et al., 2016; Wheaton et al., 2012). Lang et al. found a significantly higher prevalence of depressive symptoms in men with comorbid insomnia compared to OSA alone (2017) whereas Ishman et al. found that severity of sleepiness was the strongest predictor of depressive symptoms (2010). In 2016, Dai et al. found a significant association between depression in OSA and female gender, single status, perceived social support, hypoxemia and apnea-hypopnea index. Both medical and surgical management of OSA have been shown to improve depression. After treatment with CPAP or mandibular advancement devices, Povitz et al. found the greatest reduction of depression in patients with baseline depressive symptoms. In treatment with single or multi-level surgery, decrease in depression was highly associated with reduction in sleepiness (Ishman et al., 2014).

Discussion:
The need for depression screening in patients with obstructive sleep apnea is well established and this review identifies the most high risk subsets of patients. Patients with comorbid insomnia, self-reported sleepiness and demographic factors such as gender, marriage status and social support should be prioritized for depression screening. There is mixed evidence regarding the association between OSA severity and developing depression. However, the overlap of depressive and sleep apnea symptoms in most validated depression screening tools is a major confounder that must be considered. Further research should examine the improvement in non-sleep related depressive symptoms after management of OSA with psychiatric versus medical or surgical management.
A new level specific classification of the lateral pharyngeal wall collapse in OSA patients

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Introduction:
Lateral pharyngeal wall collapse and splinting possibilities is still an incompletely answered question in sleep surgery. Sixty three percent of our revision cases in the last six years was due to failure to properly splint the collapsing lateral pharyngeal walls especially at the hypopharyngeal level. To improve our outcome we thought about level specific staging system of the lateral pharyngeal walls in OSA patient.

Introduction:
The pharyngeal airway collapses when inspiratory transpharyngeal pressure exceeds the action of pharyngeal dilator muscles (Li and Lee 2012). Upper airway collapse occurs in four levels; soft palate, tongue, lateral pharyngeal walls (Li and Lee 2012) and larynx (Vicci et al., 2012).

Material & Methods:
Our clinical diagnostic approach to OSA patients:
All patients undergo full ENT examination focusing on soft palate anatomy, tonsil grading and tongue volume. Then fiberoptic nasoendoscopy is performed with muller maneuver. Patients who are surgical candidates undergo DISE. We always use propofol as the sedating agent by the bolus method of infusion.

Our staging system:
Based on data gained from DIESE we classified lateral pharyngeal wall collapse into lateral pharyngeal wall collapse at the level of salpingopharyngeal folds (LS) figure 1, lateral pharyngeal wall collapse at the level of the velum (LV) figure 2 and lateral pharyngeal wall collapse at the hypopharyngeal level (LH) figure 3. Combination of 2 or three levels may occur (LSV) (LVH) (LSVH).

LS means that the collapse occurs at the level of the folds while the velum is patent, although we have seen only few cases with this pattern of collapse; it is essential to identify this rare pattern of collapse to avoid unnecessary palatal surgery while just fold reduction can sufficiently help the patient. LV means lateral wall collapse at the level of the velar segment of the soft palate not caused by hypertrophic folds; any tonsillar level collapse is also classified as LV. LH means collapse of the lateral pharyngeal wall distal to the tonsils sometimes causing 2ry epiglottic collapse by pushing the epiglottis from side to side.

Discussion:
Proper lateral wall splinting is still one of the limitations in sleep surgery. Better outcome usually starts with accurate evaluation. In our view it is unjust to describe the lateral pharyngeal as collapsing or not or even as partial or complet collapse. Lateral wall collapse should be thoroughly evaluated, segmentally classified and accordingly managed. Lateral pharyngeal level does not collapse as one unit, so it can't be managed in the same way. Many clinical diagnostic classifications for OSA patients are reported in literature by several authors like (Fujita, 1993; Sher, 2002; Friedman et al., 2002 and Kezirian et al., 2011). To our knowledge, our staging system is the first to segmentally evaluate the lateral pharyngeal wall in a separate manner and deal with it as a separate level of collapse.

Conclusion:
Our staging system is an easy and accurate method to evaluate lateral pharyngeal wall collapse in OSA patients. It must be part of surgical decision making to improve outcome.
References:

Figure 1

Figure 2
Short talks: Diagnostic in sleep apnea & drug-induced sleep endoscopy (DISE) I

34

Surgical indications for OSA: A respiratory pattern perspective

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Introduction:
By normal PSG, the respiratory event is classified as obstructive, mixed and central. However, there are a lot of events that a functional factor is associated with, even if it is a respiratory event to be diagnosed as an obstructive respiratory event. An effect of sleep surgery is expected only for an anatomical factor. Therefore, in the case of sleep surgery, we must diagnose a pure obstructive respiratory event precisely.

Material & Methods:
26 surgical patients (26 Pharyngeal surgeries including 11 GA) diagnosed as OSA by PSG + Pes measurements were enrolled. We distinguish respiratory event as Pure obstructive event (POE) or not, using Pes signal pattern and EEG arousal timing

Results:
Rate of pure obstructive event (%POE) of all respiratory event varied by an individual patient (mean %POE 57.3%). We find significant difference of AHI improvement rate between two groups which %POE shows more than 55% or less than 55%.

Discussion:
OSA is multi-factorial disease according to Wellman model, OSA is associated with the functional factor including loop gain and the ability of the upper airway to dilate associated with ventilatory drive, arousal threshold only other than the anatomical factor of the upper airway. OSA patients with aging, heart failure and neurologic disease, the effect with the surgical treatment is still low. In these OSA patients, it is a reason that a functional factor is associated as well as an anatomical factor. Similarly, without clear complications including Aging etc, there are a lot of the OSA patients whom a functional factor is associated with. we have to detect surgical responder including functional factor.
Polysomnography and sleep position, a Heisenberg phenomenon? – A large scale serie

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Introduction:
The severity of obstructive sleep apnea (OSA) in patients with position-dependent OSA depends on the AHI in supine and non-supine position as well as the time spent in supine position. One parameter, which could influence time spent in various body positions is polysomnography (PSG). Three previous small-scale studies suggested that through PSG patients are likely to spend more time in the supine position. We were interested to see whether we could confirm these findings in a larger scale study.

Material & Methods:
We performed a retrospective, single-center cohort study including a consecutive series of positional patients (PP), diagnosed through type II PSG, who were prescribed the Sleep Position Trainer (SPT) between January 2016 and June 2017. The SPT is a vibrotactile feedback device – new generation of positional therapy (PT). During the first two nights of treatment, the device is non-active but does record sleeping position.

Results:
The mean percentage of TST in supine position was 44.0% when wearing the PSG apparatus and 29.0% during the diagnostic phase of SPT, which is a significant decrease of 34.1% (p <0.001). During PSG, patients spent a median of 0.0% in prone position. This was significantly lower compared to TST in prone position during the diagnostic phase with the SPT, which was a median of 1.2% (p < 0.001).

Discussion:
This study shows that wearing PSG apparatus might influence body sleeping position. We found a significant decrease of time spent in supine and an increase in prone position during the diagnostic phase of SPT. This can lead to an increase of OSA severity measured by PSG in PP.
Unsupervised polysomnography in children: a technical and economic study

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Introduction:
Obstructive sleep apnea syndrome (OSA) in children is related to hypertrophy of the tonsils, adenotonsillectomy being the treatment of choice. However, perioperative risks are not well established, assessment of routine preoperative polysomnography not feasible.

The objective of the study was to evaluate the economic and technical viability (frequency of failure) of unsupervised polysomnography in children before adenotonsillectomy.

Material & Methods:
The prospective study was approved by the local research ethics committee. 146 children, 57 male, aged 3 to 11 years, with indication of adenotonsillectomy, were invited to preoperative polygraphic monitoring. We analyzed the frequency of failed exams, failures per sensor, its correlation to age of the children and compared costs to standard full-night polysomnography.

Results:
Overall failure rate was 28.08% (n = 41), with no difference between genders (χ²=0.0644 p=0.7997), but a greater risk for preschool children (RR =1.2386 (CI 95%: = 0.724 to 2.118). Failure of oximetry was observed in 14.3%, nasal cannula in 10.2%, combination of both in 4.1%, thoracoabdominal belt in none. Costs of the unsupervised PSG was estimated to be 63% of the standard PSG, even the high failure rate being more cost saving.

Discussion:
Unsupervised polysomnography was technically and economically feasible, its installation to be performed by trained professionals to avoid failure of sensors, mostly oximetry.
ST2: a valid biomarker for diagnosis and cardiovascular risk assessment in Obstructive Sleep Apnea?

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Introduction:
ST2 protein is a member of the interleukin 1 receptor family. It is encoded by the IL1RL1 gene and its increased serum level signals the presence and severity of adverse tissue remodeling and cardiac fibrosis. Its discrimination is shown to be independent of age, sex, body mass index, history of heart failure, anemia or impaired renal failure. In this study, we assessed the ability of ST2 as a valid biomarker in diagnosis and cardiovascular risk stratification in obstructive sleep apnea (OSA).

Material & Methods:
Between Jan 2015 and Dec 2017, 125 serum specimen of patients with OSA diagnosed from lab-attended full polysomnography (mean AHI 32.6 ± 22.4/h; BMI 30.6 ± 5.5 kg/m², ESS 9.5 ± 4.5, age 51.0 ± 11.7 y) were analyzed. A total of 88 individuals (mean BMI 24.9 ± 3.87 kg/m², age 43.0 ± 14.0 y) with no history of sleep related breathing disorder served as controls. Serum ST2 protein was quantified by enzyme-linked-immunosorbent-assay (ELISA). Statistical evaluation was performed using GraphPad PRISM.

Results:
OSA patients show highly significant (p<0.001) increased serum concentrations of ST2 (mean 18.1 ± 6.27 ng/ml) compared to the control group (mean 7.2 ± 4.85 ng/ml). In addition, a highly significant correlation between the ST2-serum-levels of the control group and the respective severity of OSA (mild, moderate, severe) could be demonstrated (p<0.001). In ROC curve analysis, a cut-off value of 10.7 ng/ml provides a diagnostic ability of 90.7% (CI 84.31% to 95.10 %) sensitivity and 84.3% (CI 75.02% to 91.12%) specificity. A positive likelihood ratio of 5.8 indicates a moderate increase of the post-test probability in our analysis.

Discussion:
Due to the fact that ST2 serum concentration in OSA increases significantly and a significant correlation to OSA severity can be demonstrated, the ST2-protein represents a potential biomarker for obstructive sleep apnea. As patients with high ST2 levels are known to have a consistently higher risk of cardiovascular mortality, ST2 may also help to identify high risk patients to initiate early treatment according to a personalized therapy.
Upper airway simulation for analysis of OSAS based on FEA

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Introduction:
For OSAS- treatment cPAP masks, protrusion splints and surgical intervention are used. The treatment methods often fail because the cause and location of the obstruction is not well known and, the interventions have a high side effect potential. In the project, a digital model of the upper respiratory tract is to be set up on the basis of 3D data acquisition. With Finite Element Analysis the individual airflow is analyzed.

Material & Methods:
The Dortmund Hospital carries out a targeted examination of OSAS patients in the sleep laboratory. Coupled with clinical examination and the evaluation of the patient-specific simulation of the respiratory tract, the local causes of OSAS are to be uncovered and used for diagnosis and targeted therapy. As a result of the project, a digital procedure is developed to analyze patient-specific the cause of snoring and OSAS. So far 12 patients have been examined before and after surgical intervention with this cloud-based software. The processing of the 3D data is based on a Finite Element Analysis (FEA) on the software platform ANSYS.

Results:
In all cases, specific therapeutic effects could be identified which lead to a change in the flow situation in the upper respiratory tract. The simulation of pressure and volume stream in the upper airway pre and post treatment indicates clear a modification and reduction of basal risk parameters.

Discussion:
The digital procedure is well suited to analyze patient specific parameters accordingly evaluation of OSAS. The specific results should also optimize the therapy e.g. the position of a protrusion splint or to simulate a planned surgical intervention.
Can drug-induced sleep endoscopy in children predict OSA persistence after adenotonsillectomy

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Introduction:
OSA in children is related to hypertrophy of the tonsils, however, OSA persists in 10 to 35% after adenotonsillectomy (AT) Sleep endoscopy (DISE) may help to identify sites of obstruction and preview OSA persistence.

Objectives: to correlate sites of obstruction of UA with the polysomnography before and after adenotonsillectomy.

Material & Methods:
The study was approved by the local research ethic committee. In this prospective study, children with hypertrophy of the tonsils were invited to perform polysomnography before surgery, DISE at anesthesia induction during surgery and a second polysomnography 3 to 6 months after AT. DISE was scored by VOTE scale. We analyzed correlation of OSA severity and complex obstructions, and of OSA persistence and non-tonsillar obstruction.

Results:
20 children, 13 male, aged 3 to 9 years old, completed the protocol. Median AHI improved from 20.41 (4.5-46.5) to 4.98 (0.5-18.2), after surgery, OSA persisted in 45%. DISE showed obstruction of tongue or epiglottis in 12 (60%) children with no correlation to OSA severity at pre-operative evaluation. Out of the 9 children with persistent OSA, 6 showed obstruction at tongue or epiglottis and only one being obese. Out of 5 children with tongue level obstruction, 1 persisted with severe and 2 with moderate OSA, out of 4 children with epiglottis obstruction, 2 persisted with severe OSA.

Discussion:
DISE shows a high frequency of partial or complete obstruction at tongue or epiglottis level. In our case serie, obstruction of tongue or epiglottis showed a higher correlation to OSA persistence than obesity, DISE may be a tool for prediction.
DISE with online polygraphic cardiorespiratory monitoring in OSAS patients: 100 patients prospective analysis

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Introduction:
Drug induced sleep endoscopy is a diagnostic technique that allows dynamic upper airways evaluation. The implementation of simultaneous polygraphic monitoring of cardiorespiratory parameters during DISE (DISE-PG) has shown promising additional informations about localisation and patterns of collapse during artificial sleep.

Material & Methods:
100 patients underwent DISE-PG with the implementation of a cardio-respiratory monitoring online (PSG type 3) and trans-oral approach during sedation (TODISE) was carried out in all patients using TCI propofol sedation. After a routinely DISE the endoscope has been carried into oral cavity, at that level particular attention to tongue/palate position. PSG type 3 data, endoscopic features were noticed and recorded. All DISE procedures were carried out by the same ENT sleep apnoea expert. Baseline DISE parameters and DISE-PG parameters were compared. Nasal or mouth breathing, tongue position and secondary palatal obstruction were noticed.

Results:
Central apneas and hypopnea events are noticed in about 55% of the patients. About 2/3 of the patients were oral breather and 37% presents secondary palatal obstruction. Mouth breathers showed retroposition of the tongue body and secondary palatal obstruction, are likely to be affected by severe OSAS.

Discussion:
The efficacy of nonventilatory treatments in patients with OSAS is often associated with adequate identification of the site and pattern of upper airway obstruction, and application of the appropriate individualized treatment. The lack of a standardized procedure and the difficulties associated with direct visual detection of obstructive events result in poor intraobserver and interobserver reliability, especially when otolaryngology surgeons not experienced in the technique are involved. The DISE-PG technique could be helpful for accurate comprehension of upper airway obstructive dynamics (ie, degree of obstruction and multilevel pattern) and a nonobstructive breathing pattern (ie, central apneas).
Reliability of drug-induced sleep endoscopy: interobserver agreement according to level of training

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Introduction:
Several studies have demonstrated the feasibility, validity and reliability of drug-induced sleep endoscopy (DISE), which is now considered as a useful examination in assessing the topographic level of collapse in patients with obstructive sleep apnea hypopnea syndrome (OSAHS). The objective of this study was to determine the interobserver agreement and variability of DISE between a 2 cohorts of experienced ENTs and inexperienced ENTs.

Material & Methods:
Prospective cohort study. 76 ENTs (69 inexperienced in DISE: Residents, Attending Physicians, Hospital and Liberal Physicians and 7 experienced) observed 7 DISE videos. They were asked to determine the level(s) (soft palate, oropharynx, tongue base, larynx), the configuration (anteroposterior, lateral, and concentric), and the degree (partial or complete) of collapse, according to the VOTE classification. The specific agreement, the global agreement and the Fleiss’ Kappa coefficient were calculated for each subgroup “Experienced”, “Inexperienced”, “Juniors” (Residents and Attendings) and “Seniors” (Hospital and Liberal Physicians and Experienced), and then compared between “Experienced/Inexperienced” and “Juniors / Seniors”.

Results:
The interobserver agreement varied from bad to very good to determine the level of collapse, the best agreement being found for the oropharynx (Kappa≥0.7 in “Inexperienced” and “Juniors” groups), followed by the soft palate and the larynx; the worst agreement being found for the tongue base (Kappa≤0.41). The agreement for the configuration and the degree of collapse was globally moderate (Kappa between 0.40 and 0.54) except for the tongue base where the concordance for the degree of collapse was bad. The agreement for the number of sites / structures seen (1 to 4) was poor (Kappa between 0.22 and 0.32). In all cases, no statistically significant difference (p value = 0.05) was found between the “Experienced/Inexperienced” groups and “Juniors / Seniors” groups.

Discussion:
DISE is a technique with good interobserver agreement, particularly in the detection of levels of collapse. There was no statistically significant difference between an experienced and an inexperienced observer and, thus, no learning curve effect; the interpretation of this examination is therefore reproducible and the question of its generalization in current practice is relevant.
42

DISE during CPAP therapy in patients with CPAP failure

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Introduction:
Continuous positive airway pressure (cpap) often is the first choice of therapy in patients with severe obstructive sleep apnea (OSA). However, about 30% of cpap candidates do not respond adequately to this kind of therapy. Often patients discard the mask or dislike the unnatural way of sleeping with a cpap. In a subcategory of cpap failures the apnea-hypopnea index (AHI) fails to decrease to normal levels. The reason of this failure is mostly unknown.

Material & Methods:
Drug induced sleep endoscopy (DISE) was performed in 20 patients who had failed cpap therapy and maintained high AHI numbers. Endoscopy of the upper airway with increasing ventilation pressures was performed. An adapted cpap mask was used that allows an endoscope to enter the nose during ventilation.

Results:
In all patients, the reason of cpap failure was recognized. The most common cause of failure was a floppy epiglottis. Other causes of failure were a laryngeal collapse, a persistent complete concentric collapse of the palate and mask problems. The use of a combined therapy of for example a mandibular repositioning device (MRD) together with a cpap device often resolves the problem.

Discussion:
This new DISE technique, using an adapted cpap mask, often determines the cause of cpap failure in OSA patients. In most cases an adequate therapy can be followed subsequently with good results.
Symposium 10: Oral appliance & maxillomandibular advancement (MMA)

Follow-up reports on intraoral negative air pressure device treated patients underwent Obstructive Sleep Apnea uvulopalatopharyngoplasty

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Introduction:
The objective of this study was to investigate the uvulopalatopharyngoplasty outcomes of an intraoral negative air pressure device treated patients. This intraoral device is a novel medical device which retains tongue and soft palate by negative air pressure forming a confining space in the oral cavity during sleep for adults with obstructive sleep apnea.

Material & Methods:
A total of 43 OSA patients whose baseline apnea-hypopnea index (AHI) ranged from 6.70 to 107.90 had been treated by the intraoral negative air pressure device in the MacKay Memorial Hospital and were regularly and continuously followed. The age of these patients was 42.3 ± 11.5 years with body-mass index (BMI) at 25.9 ± 4.2 kg/m². By the treatment of the intraoral negative air pressure device, the AHI statistically significantly decreased from 38.59 ± 23.04 to 29.37 ± 26.99 (p<8.27E-08), resulted in 39.53% of patients whose treated AHI lower than 20 and reduced more than 50%.

The polysomnography (PSG) in this hospital was all performed and analyzed following the 2007 American Academy of Sleep Medicine (AASM) recommended rules, where hypopnea was required to have at least a 30% airflow reduction and a 4% SaO2 desaturation. The baseline condition and the treated outcomes were tested by paired t-test.

Results:
Among the 43 intraoral device treated OSA patients, three (male: female = 2:1) patients were deemed UPPP as proper surgery by the clinical physician. The age of these three patients was 44.27 ± 9.12 years with BMI at 23.80 ± 7.06 kg/m². The baseline obstructive apnea (OA) and AHI of first patient was 14.8 and 26.9, respectively. By the device intervention, the OA and AHI of this patient decreased to 9.9 and 20.2. After the surgery, his OA and AHI went down to 7.6 and 19. As to the second patient, his baseline OA and AHI was 18.4 and 22.2 which decreased to 5.4 and 8 separately by the device; after the surgery, it went down to 1.2 and 1.2, respectively. The third patient was a female, her OA and AHI was 18.1 and 18.9 before any treatment intervened. By the intraoral negative air pressure device, the OA and AHI went down to 11.7 and 12.3, which further turned down to 2.9 and 2.9 after the surgery.

Discussion:
The intraoral negative air pressure device treatment and the UPPP were both statistically significant in reducing OA and AHI for these three moderate OSA patients and there was no statistical significant difference in terms of reducing the OA and the AHI between these two interventions. To be noted that, the treatment effect of intraoral negative air pressure device was only first-night treatment outcomes and the surgery outcome was also only evaluated once. For moderate OSA patients, the use of the intraoral negative air pressure device may be as effective as properly selected patients underwent UPPP. More data and investigations are required for confirmative results.
Short talks: Drug-induced sleep endoscopy (DISE) II & nose

Optimization of drug-induced sleep endoscopy (DISE): persistent circumferential velopharyngeal collapse when head rotation in supine position with oral appliance correlate to more severe Obstructive Sleep Apnea

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Introduction:
This study aims to correlate the results of drug induced sleep endoscopy (DISE) done in supine or head rotation positions, with or without oral appliances, and compare them with the apnea-hypopnea index (AHI) of patients’ polysomnography (PSG), in an attempt to find out that: In addition to finding anatomic obstruction sites of upper airway, if DISE can help identify patients with more severe obstructive sleep apnea (OSA).

Material & Methods:
We retrospectively reviewed OSA patients who underwent PSG and DISE in our Hospital. The sleep endoscopy was done using target controlled infusion (TCI) with propofol in an out-patient setting. During DISE, 4 positions were utilized: supine position (Position 1), supine position with head rotation (Position 2), supine position and wearing oral appliance (Position 3), supine position with head rotation and wearing oral appliance (Position 4). Based on the endoscopic findings, VOTE classification was scored in each test result. We grouped the patients according to DISE results of each test, and compared their age, gender, body mass index (BMI), apnea-hypopnea index (AHI), and lowest O2 saturation during sleep (LaO2) according to the groups. (e.g. with or without anterior-posterior, lateral-lateral and circumferential velopharyngeal collapse, with or without oropharyngeal collapse, with or without tongue base collapse and with or without epiglottic collapse.)

Results:
Thirty-five patients (30 men and 5 women; mean[SD], 45.3[12.1] years) who completed PSG and DISE were included in the analysis. The mean(SD) AHI was 31.9(23.2), and mean(SD) LaO2 was 78.8(9.9) %. There were no significant AHI differences between patients with or without anterior-posterior or lateral-lateral velopharyngeal collapse, oropharyngeal collapse, tongue base collapse or epiglottic collapse, regardless of head rotation or not, wearing oral appliance or not. When 9 patients still presented circumferential velopharyngeal collapse in supine position with head rotation AND wearing oral appliance at the same time (Position 4), their mean(SD) AHI was 48.3(32.0), significantly higher than those other 26 patients who did not present circumferential velopharyngeal collapse after head rotation and wearing oral appliance. The other 26 patients’ mean(SD) AHI was 26.3(16.6). The AHI differences cannot be found in other 3 conditions between patients with or without circumferential collapse.

Discussion:
When complete circumferential velopharyngeal collapse is observed when head rotation in supine position with oral appliance in DISE, significant higher AHI scores from PSG are noted. Oral appliance can be used in sleep endoscopy to provide more objective observation of upper airway, better than jaw thrust. Head rotation in supine position with oral appliance are useful maneuvers in DISE and can be helpful for decision making to surgeons. Moreover, in our study, we found circumferential velopharyngeal collapse contribute more to OSA severity, especially when it was still noted when head rotation with oral appliance. More effective surgical procedure may be needed to treat this subgroup of patients.
Drug induced sedation endoscopy without the presence of an anesthesiologist

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Introduction:
The purpose of the study was to evaluate the safety and feasibility of DISE when patients were sedated with propofol in small, divided doses administered by the ENT staff nurse under the supervision of an ENT specialist, but without the presence of an anesthesiologist. Prior to this study both the nurses and doctors underwent specialist training in propofol administration organized and supervised by the Department of Anesthesiology.

Material & Methods:
In 2015, we introduced Drug Induced Sedation Endoscopy (DISE) in the Department of Oto-rhino-laryngology, Head & Neck Surgery and Audiology (ENT) at Copenhagen University Hospital. In this prospective study, we examined patients with obstructive sleep apnea or severe snoring. The patients were monitored by electrocardiography (ECG), oxygen saturation, blood pressure and respiration during sedation. A pharyngeal tube, oxygen supply and ventilation mask were at hand as well as the possibility for prompt anesthesiologist back-up if needed.

Results:
The patients were examined between May 2015 and November 2017. No significant changes in blood pressure, heart rate or oxygen saturation requiring treatment were encountered in the study. No adverse events were reported by the patients immediately after DISE or at the follow up appointment.

Discussion:
DISE by the ENT-team, without the presence of an anesthesiologist, seems safe and feasible when performed by ENT specialists and trained ENT staff in a hospital setting with the possibility for anesthesiologist back-up if needed. To our knowledge this is the first study on this subject.
Drug-induced sleep endoscopy findings in children with obesity and Down syndrome

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2University of Washington, Otolaryngology-Head and Neck Surgery, Seattle, United States

Introduction:
Drug-induced sleep endoscopy (DISE) has become an increasingly common part of the evaluation for pediatric obstructive sleep apnea (OSA). Few studies have investigated patterns of obstruction in surgically naïve children, and none have directly compared obstructive patterns in children with obesity or Down syndrome to a control group.

Material & Methods:
This was a cross-sectional analysis of children who underwent DISE at the time of AT as part of a prospective cohort study investigating the outcomes of AT. Indications for DISE included severe baseline OSA, obesity, age > 7 years, and Down syndrome. DISE findings were scored according to the Sleep Endoscopy Rating Scale (SERS) at 6 anatomic levels: 0 – no obstruction, 1 – partial obstruction, 2 – complete obstruction, summed for a Total Score ranging from 0-12. SERS scores were compared between obese and non-obese and between Down syndrome and non-syndromic patients using Student's t-test for mean SERS scores at 6 anatomic sites.

Results:
There were 168 patients who met inclusion criteria and had SERS scores available. Mean age was 9.8 ± 3.5 years. 97 (58%) were obese, 12 (7%) had Down syndrome. PSG data was available in 77 patients. Mean AHI was 18 ± 21, mean lowest O2 saturation was 85 ± 10. Mean SERS Total Score was 4.8 ± 1.7. There were no significant differences in SERS total scores when comparing obese to non-obese and Down syndrome to non-syndromic patients. However, when individual anatomic sites were examined, obese children had significantly greater tonsillar obstruction (1.67 ± 0.57 vs 1.28 ± 0.8, p = 0.0003) and less base of tongue obstruction (0.31 ± 0.51 vs 0.72 ± 0.70) compared to non-obese children. Patients with Down syndrome had less nasal airway obstruction (0.41 ± 0.67 vs 1.01 ± 0.63, p = 0.002), but greater base of tongue (0.92 ± 0.67 vs 0.45 ± 0.61, p = 0.013) and arytenoid obstruction (0.33 ± 0.49 vs 0.096 ± 0.32, p = 0.018) compared to non-syndromic patients.

Discussion:
Compared to non-obese children, obese children appeared to have greater tonsillar obstruction and less base of tongue obstruction. In contrast, Down syndrome children had greater base of tongue and arytenoid obstruction compared to non-syndromic children. These differences in DISE findings have not previously been described and may have implications for surgical treatment strategies in different subgroups of children with OSA.
Drug-induced sleep endoscopy: new insights of the effect and value of lateral head rotation as a screening tool in patients with positional dependent OSA.

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¹OLVG, Otorhinolaryngology / Head and Neck surgery, Amsterdam, Netherlands

Introduction:
In 56-75% of patients with OSA, apneas are influenced by body position. In POSA, supine position should be avoided. When positional therapy is considered, alone or as part of combination therapy, upper airway assessment in lateral position is also important. A previous study showed that head rotation during DISE is almost the same as lateral head and trunk position. We now compared these assessments in more detail, for both non-positional, supine isolated and supine predominant OSA patients.

Material & Methods:
We performed a prospective, single-center cohort study in a consecutive series of 100 OSA patients, confirmed by PSG, who underwent DISE at the Department of Otolaryngology/Head and Neck Surgery of OLVG West in Amsterdam, the Netherlands. In all patients DISE was performed in supine position, with head rotation alone and both head and trunk, and scored by using de VOTE classification.

Results:
Preliminary results: 100 OSA patients were included (81 male, age 47.4 ± 11.4 year, BMI of 27.1 ± 3.2) with a median AHI of 17.1 (8.9 - 26.0). 42% patients were diagnosed as non-positional OSA patients. Of the remaining 58%, 45% were diagnosed with supine isolated and 55% with supine predominant POSA.

Discussion:
The clinical consequences of the findings – how they might translate in therapeutic options - are being presently analyzed and will be discussed in detail.
 Including oxygen saturation both in conducting and in classification of drug-induced sleep endoscopy

R. Pavelka

Medicent, Baden, Austria

Introduction:
The aim of DISE is to reproduce sleep and to observe patterns of vibrations and collapses assumed to correspond those occurring in natural sleep.

To increase reliability, we adjust the depth of sleep by fractionated titration of Midazolam and Propofol until to the point where a similar number of apneas/hypopneas and similar oxygen desaturations occur constantly for a period of several minutes as the patient had in his nocturnal poly(somno)graphy in supine position.

Material & Methods:
In the last 5 years 90 DISE were conducted on patients with mostly low to moderate obstructive sleep apnea and primary snoring in an outpatients office setting using portions of 1-2,5 mg Midazolam up to 0,1 mg/kg body weight in total combined with several small boli of 10-20 mg Propofol each up to about 50-100mg in total. Pulse oximeter values were displayed simultaneously with the endoscopic picture on the PC screen and recorded.

The depth of sleep was adjusted to reach similar oxygen desaturations as the patients showed in their nightly polygraphy home recordings in OSA patients, whereas in primary snorers no significant desaturation should occur.

Polygraphy included acoustic frequency analysis of snoring, comparing to snoring in DISE.

A partial obstruction was only scored, when collapse was accompanied by desaturation >4% indicating a hypopnea. A total obstruction was only scored, when complete occlusion occurred longer than 10 sec. or desaturation >4% indicating an apnea.

Results:
It was possible in almost all patients to reproduce the nocturnal respiratory events or snoring for a period of at least several minutes according to the previous nocturnal polygraphy. The whole procedure lasted about 45 min.

The baseline oxygen level decreased much fewer by combining the both drugs than it was the case in previously used propofol DISE. Desaturations by hypopnea or apnea were short term and recovered completely to baseline inbetween the events like in polygraphy.

Acoustic frequency analysis of snoring in 15 concomitant recorded DISE and about 30 sequentially compared DISE showed a frequency pattern similar to that of the nocturnal recordings.

Discussion:
There are many concerns about the reliability of present methods of Propofol DISE, guided only by the depth of sleep in a short term procedure.

In our hands the mentioned way of conducting and evaluating DISE gives very reliable results based on comparison of acoustic sounds and frequency of snoring and of respiratory events like in nocturnal polygraphy.

Including desaturation in classification of collapses in analogy to hypopnea and apnea classification is much more objective as a subjective estimation of percentage of obstruction of the lumen.

My proposed classification of degree of obstruction is 1= slight obstruction without desaturation, 2=partial obstruction with desaturation >4%, 3=total obstruction with apnea with desaturation >4%. Snoring should be classified independently.
Short talks:
Drug-induced sleep endoscopy (DISE) II & nose

Figure 1

**NOHEL – Classification**
Robert Pavelka 2018

<table>
<thead>
<tr>
<th>Localisation</th>
<th>Vibration</th>
<th>Degree of Obstruction</th>
<th>Direction of Obstr./Vibr.</th>
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<td>- = no Obstruction</td>
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<td>- = no Obstruction</td>
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<td>- = no Obstruction</td>
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<tr>
<td>Larynx</td>
<td>- = no snoring</td>
<td>- = no Obstruction</td>
<td>antero-post., transversal, concentric</td>
</tr>
</tbody>
</table>

The border between Oro- and Hypopharynx is a plane from the insertion of the anterior palatal pillar in the tongue rectangular to the pharyngeal wall.

Figure 2

**NOHEL – Classification**  R. Pavelka 2018

Example: Nasal valve collapse, velar snoring, retrolingual part. obstruction, epiglottal obstruction with apnea, endolaryngeal part. obstruction

<table>
<thead>
<tr>
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<td>Larynx</td>
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<td>- = no Obstruction</td>
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</tr>
</tbody>
</table>

NOHEL-Classification:  N-1t Os1a H-2a Es3a L-2a
Elimination of complete concentric collapse at the level of the palate through maxillomandibular advancement surgery for Obstructive Sleep Apnea

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Introduction:
Absence of complete concentric collapse at the palate (CCCp) as observed during drug-induced sleep endoscopy (DISE) is a predictor for therapeutic success with upper airway stimulation (UAS) therapy for obstructive sleep apnea (OSA). Consequently CCCp became a formal exclusion criterion for UAS therapy. The objective of this study was to prospectively evaluate the effect of maxillomandibular advancement (MMA) surgery on upper airway collapse patterns during DISE.

Material & Methods:
Nineteen OSA patients were treated with a mandibular advancement device (MAD), followed by MMA surgery. In 14 patients (age 52 [46-57] y, expressed as median [quartile 1 - quartile 3]; BMI 26.3 [24.1-27.5] kg/m²; Apnea/hypopnea-index (AHI) baseline 31.4 [20.8-66.0] /h of sleep) baseline and postoperative DISE findings were obtained. Baseline AHI was compared with postoperative AHI using a Wilcoxon signed rank test. With Fisher’s exact test, the proportion of CCCp in the study group prior and after MMA surgery was assessed. Wilcoxon rank sum test was performed to compare AHI differences between the patients with and without CCCp, both at baseline and after MMA surgery.

Results:
CCCp occurred at baseline in 6 patients (43%). No significant difference in BMI and AHI was noted between patients with and without CCCp. MMA surgery reduced the median AHI (n=14) with 75% (p=0.0001). With baseline CCCp (n=6), AHI was reduced from 31.4 [24.2-42.2] to 7.9 [7.2-13.7] /h of sleep (p=0.0313); without CCCp (n=8), AHI was reduced from 37.9 [13.8-69.0] to 7.3 [4.4-11.9] /h of sleep (p=0.0078). There was no significant difference in AHI after MMA surgery. All patients had resolution of CCCp (p=0.0159) after MMA surgery (Figure 1).

Discussion:
CCCp is not a limiting factor for MMA surgery outcome in terms of AHI reduction and could therefore be a solution for OSA patients with CCCp, that are currently excluded from UAS. As such, MMA broadens the perspective for personalized medicine through DISE, as the results of this prospective study clearly suggest the potential of elimination of CCCp after MMA surgery.
Short talks:
Drug-induced sleep endoscopy (DISE) II & nose

Figure 1

![Figure 1: Graph showing AI-1 levels at baseline and MMA for subjects with and without CCCp.](image-url)
50

Remotely controlled mandibular positioning during drug-induced sleep endoscopy preceding mandibular advancement device therapy: protocol and feasibility

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O. M. Vanderveken¹,²
¹Antwerp University Hospital & University of Antwerp, Department of ENT-HNS & Faculty of Medicine and Health Sciences, Edegem, Belgium
²Antwerp University Hospital, Multidisciplinary Sleep Disorders Centre, Edegem, Belgium
³Antwerp University Hospital & University of Antwerp, Department of Special Care Dentistry & Faculty of Medicine and He, Edegem, Belgium

Introduction:
Stepwise protrusion of the mandible, referred to as titration, may yield to resolution of upper airway collapsibility in patients with obstructive sleep apnea (OSA). This can be done remotely under poly(somno)graphy using a remotely controlled mandibular positioner (RCMP). The optimal mandibular position is referred to as effective target protrusive position (ETPP). The aim of this study is to repeat these findings under drug-induced sleep endoscopy (DISE).

Material & Methods:
Ten patients diagnosed with OSA (50% male; age 54 ± 9.5 y; BMI 26.9 ± 2.1 kg/m²; Apnea-Hypopnea Index 28.4 ± 13.2 events/hour of sleep) were enrolled prospectively. Dental RCMP trays were fitted during wakefulness (Figure). Maximal protrusion and edge-to-edge positions were measured. Upper airway collapsibility was scored during DISE with RCMP within 45 minutes. ETPP was defined as the mandibular threshold protrusion yielding a stable upper airway in the absence of snoring, oxygen desaturations and apneas.

Results:
RCMP trays were retentive and no adverse reactions occurred. RCMP was fitted intraorally prior to sedation with maxillary and mandibular trays in edge-to-edge position. Upon sedation, reversed titration was performed followed by progressive protrusion until ETPP was noted. In 8 out of 10 patients ETPP could be determined successfully while in one patient snoring, apneas and oxygen desaturations did not resolve within the patients’ range of motion (ROM) from maximal retrusive position to maximal protrusive position of the mandible. In another patient RCMP needed to be removed due to adverse clenching.

Maximal retrusion, maximal protrusion, ETPP and ROM varied largely between patients. The Table depicts mean ETPP at 67% of total ROM. For individual patients an ETPP range from 37% to 88% of ROM was noted.

Discussion:
The results of this study illustrate that it is feasible to use RCMP during DISE and to determine ETPP within 45 minutes. Comparative research with poly(somno)graphy would be useful to further validate the therapy outcome upon use of RCMP during DISE.
Drug-induced sleep endoscopy (DISE) II & nose

Figure 1

Figure 2

<table>
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<tr>
<th>n</th>
<th>Age</th>
<th>Gender</th>
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<th>ESS</th>
<th>Retrusion</th>
<th>Protrusion</th>
<th>ETTP</th>
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<th>ROM</th>
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</table>

Mean 54 ± 9.5 50% 2.1 13.2 3.0 -3.6 ± 2.6 +4.0 ± 2.8 +2.0 ± 2.4 7.3 ± 2.0 9.9 ± 3.4 57 ± 16.9

57
51

Sound frequency spectra of snore in relation to the site of obstruction among snoring patients in Malaysia

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¹Universiti Kebangsaan Malaysia, Otorhinolaryngology - Head & NECK SURGERY, KUALA LUMPUR, Malaysia
²Universiti Kebangsaan Malaysia, Anesthesiology, Kuala Lumpur, Malaysia
³Universiti Kebangsaan Malaysia, Community Health, Kuala Lumpur, Malaysia

Introduction:
Frequency analysis of snores is a promising diagnostic tool for localizing the site of obstruction among snorers. The aim of this study was to map the origin of vibration in relation to frequency of snoring in the Malaysian population.

Material & Methods:
The snores (383 snores) of 40 participants (28 male, 12 female) with mean age of 38.95 and 35.45 respectively, were digitally recorded during natural and induced sleep, using a portable monitor (NOX-T3) with a built-in microphone. Upon recruitment, all participants underwent a natural sleep study whereby the apnea-hypopnea index (AHI) and the mean frequency of 10 random snores on supine position were documented. Following that, drug induced sleep endoscopy (DISE) using Propofol was carried out on all participants in which the real-time site of obstruction and frequency of snoring were recorded. The frequency spectra of snores at the respective level of obstruction was documented. The relationship between levels of snoring and AHI was assessed with chi-square test. The mean of snore frequency between the natural sleep and induced sleep was evaluated with t-test.

Results:
Most participants (62,5%) in this study were found to have multi-level obstruction and the commonest was palate and oropharynx (52.5%) in which bi-peak frequency was detected with mean of 463.68Hz and 1086.96Hz. The median peak frequency of palatal, oropharynx and epiglottis snoring was 522.5Hz (20 snores), 482.4Hz (91 snores) and 300.0Hz (26 snores), respectively. The severity of AHI was significantly associated with multi-level obstruction (p<0.0001). There was no significant difference between the mean frequency of snoring during natural sleep (n=383, M= 626.78, SD= 357.36) and induced sleep (n= 383, M= 612.2, SD= 332.75).

Discussion:
This study documented bi-peak snore frequency in multilevel obstruction and uni-peak frequency in uni-level obstruction. Multilevel airway obstruction during sleep was associated with more severe OSA. The snore frequency recorded during induced sleep was representative of natural sleep.
Urologic quality of life and urologic health in OSA patients

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¹Cedars Sinai Medical Center, OSA Treatment Center, Los Angeles, United States

Introduction:
OSA and other Sleep Disorders have been known to be probable risk factors for Urological health disorders. There have been several studies regarding Urological function of OSA patients, but the evaluation of Urologic Quality of Life using verified objective instruments, its relationship to OSA patient symptoms and understanding the effect of OSA treatment has not beeen evaluated.

Material & Methods:
Through verified, evidence based QOL instruments we studied new patients and clinical study patients to identify the relationship, correlation, and risk factors for urologic health in men and women with Sleep Disorders and OSA.

The American Urological Association Symptom Score, (AUASS) Urologic quality of like questionnaires in men and the Assessment of Overactive Bladder (OAB) — Urologic quality of life in women Symptom Score (OAB-q) in women, along with the SNORE-25 and ESSS were used to evaluate patients who had OSA and were seeking therapy. It was also used post therapy as a means to evaluate the efficacy of therapy. The severity of OSA (AHI, AI), OSA Symptoms, and BMI among other metrics were correlated with the QOL questionnaires.

Results:
Using the AUASS, and OAB-q along with the SNORE 25 and ESS, we found and will demonstrate the correlation of the risk factors for Urological Qualify of Life and Urologic Health in OSA patients and the direct and variable relationships to AHI, AI, BMI, CPAP usage Surgery, and OSA Symptoms.

Discussion:
This baseline data is reproducible can be used for evaluation of treatment efficacy will demonstrate the correlation of the risk factors for Urological Health in OSA patients and the direct and variable relationships to AHI, AI, BMI, CPAP usage Surgery, and OSA Symptoms.
**Short talks: Soft palate I**

53

**Five-year outcomes of palatopharyngeal surgery in patients with Obstructive Sleep Apnea Hypopnea Syndrome**

J. Ye¹, G. Yin¹, Y. Zhang¹
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**Introduction:**
To evaluate the long-term (5-years) effects of palatopharyngeal surgery in patients with obstructive sleep apnea hypopnea syndrome (OSAHS), and to analyze the predictive factors for long-term surgical success so as to improve the accuracy of preoperative predicting efficacy.

**Material & Methods:**
This is a retrospective study including 49 male patients who underwent palatopharyngeal surgery due to OSAHS. The preoperative and postoperative (6 months as short-term results and 60 months as long-term results) polysomnography (PSG) and Epworth Sleepiness Scale (ESS) data were analyzed to determine the surgery effects. The preoperative and postoperative 3-dimensional CT and physical examination data of upper airway were analyzed to find the predictive factors for surgical success.

**Results:**
For the 49 patients (age 40.1±8.1 years), their AHI, lowest SaO2 (LoSaO2) and ESS had been improved from 55.38±7.32 events/h, 75.6±4.12% and 14.21±2.11 preoperatively to 22.51±19.81 events/h, 83.8±8.48% and 7.11±1.97 six months after surgery, and to 22.89±21.3 events/h, 81.13±1.42% and 8.31±2.17 sixty months after surgery, respectively. The surgical success (postoperative AHI decreased >=50% than preoperative and AHI< 20 times/h) rate at 6 months and 60 months after surgery was 63.27% (31/49) and 57.14% (28/49), respectively, with no significant difference (P=0.754). The ESS seems showed a more obvious improvement than PSG parameters. Comparing all the 18 parameters between responders and non-responders, which were obtained from physical examination and CT scan of upper airway, only tonsil size (P=0.04), minimal palatopharyngeal transverse diameter (P=0.041), minimal palatopharyngeal cross-sectional area (P=0.034) and mandible-hyoid distance (P=0.038) showed significant difference.

**Discussion:**
The long-term effect of palatopharyngeal surgery on OSAHS is sustainable. Hyoid position and anatomical narrow due to hypertrophied tonsils may play key roles in the long-term efficacy of palatopharyngeal surgery. Subjective sleepiness symptom seems get more obvious improvement than objective PSG parameters.
The evaluation of results of expansion sphincter pharyngoplasty by acoustic pharyngometry

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Introduction:
We mainly aimed to find answers to the following question. Could we predict the success of expansion sphincter pharyngoplasty (ESP) with acoustic pharyngometric (AP) analysis in patients with sleep apnea?

Material & Methods:
Between October 2015 and July 2016, CPAP intolerant patients with obstructive sleep apnea, who referred to our clinic were included into our study. Candidates for ESP constituted our study group. Cases with hypertrophic tonsils (Mallampati 3/4) and with significant tongue base pathology (Cormack Lahane 3/4) were excluded. All patients were analyzed by AP preoperatively and postoperatively. Polysomnography was repeated postoperatively for all of the cases. Preoperative (pre) and postoperative (post) apnea hypopnea index (AHI), pre and post minimal cross-sectional area (MCA).

The difference between preAHI and postAHI, the difference between preMCA and postMCA were calculated. Median value of difference of MCA was used to divide the cases as less widened (lw) ones and more widened (mw) ones. The success was accepted in cases with reduction of AHI > %50 and postAHI < 20.

Results:
35 patients (26 male, 9 female with a mean age of 41.8±8.3) who had ESP were included into our study. PreAHI (29.6±16.3) was found to be reduced to 18.2±18.1 and this improvement in AHI was found statistically significant (p<0.001). MCA was found to be significantly (p<0.001) increased postoperatively (preMCA: 1.13±0.4, postMCA: 2.7±0.4). 22 patients respond to ESP well while 13 were accepted as unsuccessful. Mean enhancement in MCA was 1.17±0.5 among responders while this mean was 1.07±0.5 for non-responders. The difference between these values was not significant (p:0.69) (Figure 1). We divided the cases into two group according to the median of the difference of the MCA (1.12 cm²). Success rate was found to be 45.5% in <1.12 (lw) group with a mean AHI difference of 10.4±20.5; while success rate was 54.5% with a mean AHI difference of 12.2±14 in >1.12 (mw) group. The success rates (p:0.96) and change in AHI (p:0.98) were not found to be significantly different inbetween the groups.

Discussion:
AP is not suitable for predicting surgical success after ESP surgery and not effective for selection of patients.

Table 1

<table>
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<td>Postop MCA</td>
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Retrospective analysis of 10 years of pharyngoplasty techniques

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Introduction:
The aim of this study was to assess the surgical success rate of the different oropharyngeal surgery techniques applied in our department along the last 10 years.

Material & Methods:
This is a retrospective case series of surgically treated patients from 2006 to 2016. Inclusion criteria was patients with moderate or severe obstructive sleep apnea who did not tolerate conventional positive airway pressure with pre and postoperative sleep study at least 4 months after surgery. We performed different surgical techniques to treat oropharyngeal collapse in a chronological order: uvulopalatopharyngoplasty (UPPP), Z-palatoplasty (ZP), lateral pharyngoplasty (LP), expansion pharyngoplasty (EP) and barbed reposition pharingoplasty (BRP). Multilevel surgeries different from nose surgery was exclusion criteria. Success was defined as a 50% of reduction in AHI & postoperative AHI<10/h. Mean relative reduction (MRR) in the AHI (AHIpre – AHIpost / AHI X100) was calculated in order to know which technique showed higher AHI reduction.

Results:
76 patients were included (63 men), mean (SD) AHI was 41.2 (23.9)/h, 56.6% had severe OSA, mean age was 42.9 (10.0) y, mean body mass index (BMI) 27.6 (3.6) kg/m². There were no differences between groups in BMI, neither in BMI pre and postoperatively. Nevertheless, there were differences in mean preAHI. The surgical success rate was 50% in BRP, 69.2% in EP, 25% in ZP, 40% in LP and 41.4% in UPPP. MRR was 65.4% (28.4) with BRP, 55.3% (57.7) with EP, 40.9% (32.2) with ZP, 47.6.6% (49.6) in LP and 53.9% (53.1) with UPPP. There was a statistic significance difference in MRR between BRP and EP (p=0.006). The rest of the comparisons could not reach significance due to the small sample size.

Discussion:
In our hands, BRP has the best MRR in the AHI. Besides, this technique offers the possibility of performing a tailor-made pharyngoplasty according to the type of obstruction observed on DISE.
Polysomnogram outcomes in children undergoing adenotonsillectomy with and without concurrent pillarplasty: A case control study

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Introduction:
The primary objective of this study is to compare preoperative and postoperative polysomnography in children undergoing adenotonsillectomy with or without pillarplasty.

Material & Methods:
Retrospective case-controlled series of pediatric patients undergoing adenotonsillectomy with or without pillarplasty for obstructive sleep apnea at a tertiary care center between 2007-2015. Inclusion criteria were adenotonsillectomy with pillarplasty and the presence of both preoperative and postoperative polysomnogram within one year of surgery. Exclusion criteria were prior tonsillectomy. Adenotonsillectomy with pillarplasty cases were matched based on AHI and BMI percentile to patients undergoing adenotonsillectomy alone. Primary and secondary outcome measures included postoperative polysomnography and complications.

Results:
Forty-four patients were included. Twenty-two patients undergoing adenotonsillectomy with pillarplasty were matched based on AHI and BMI percentile to 22 patients undergoing adenotonsillectomy alone. There was no statistically significant difference between the preoperative characteristics of these two groups based on age, gender, ethnicity, BMI, Down syndrome, asthma, and polysomnography. Postoperative AHI showed no significant difference in adding pillarplasty to the surgery with mean AHI change 18.7 (SD = 23.2) and 22.1 (SD = 30.7) for case and control populations, respectively. The distribution of severity grouping in the two groups did not differ postoperatively with cure rates of 45% in adenotonsillectomy and pillarplasty and 55% in adenotonsillectomy alone (defined as an AHI < 1). There was no difference in outcomes among subgroups mentioned above. There was no difference in complication rates.

Discussion:
Adenotonsillectomy with pillarplasty does not appear to result in significant reductions in obstructive sleep apnea severity compared to adenotonsillectomy alone based on polysomnography data. The addition of pillarplasty did not result in significantly different rates of complications nor adverse outcomes. Further studies should attempt to identify subgroups who may benefit from the pillarplasty or alternative procedures to improve outcomes.

Figure 1
Uvulopalatoplasty surgery using radiofrequency induced thermotherapy (RFITT) – based on own experience

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Introduction:
Hypertrophy of soft palate and uvula is very common change in anatomical development in patients complaining of snoring and sleep apnea syndrome. Minimally invasive techniques are increasingly used in the treatment of sleep disorders caused by obstructive upper respiratory tract infections. These techniques mainly include interstitial thermoablation.

The aim of the study is to demonstrate the efficacy of RFITT bipolar thermotherapy in the treatment of snoring and apnea.

Material & Methods:
The procedure was performed in 1487 patients - 1334 men and 153 women. A detailed medical history, Epworth sleep apnea questionnaire, medical examination card, endoscopic and fiberoendoscopic diagnostics during pharmacological sleep and photographic documentation were taken before surgery and after 6 weeks.

Results:
Disorders subsided in 281 patients, decreased in 1147 patients, no improvement was observed in 59 patients.

Discussion:
The method is minimally invasive, uses the phenomenon of vaporization of tissues without the effect of carbonization, which significantly affects the shortening of the healing process. Interstitial coagulation reduces bleeding. The procedure is performed in an outpatient setting of 30 - 40 minutes, which is very comfortable for the patient.

The procedure can be repeated - reducing the risk of severe complication. The effectiveness of the method is superior to classical methods (classic surgery, electrocoagulation, laser surgery, cryosurgery).
Introduction:
Several conservative and surgical treatment strategies for the management of OSA have been studied intensively in the last two decades. Innovative surgical techniques remodel the narrow pharynx advancing the soft palate and splint the lateral pharyngeal walls enlarging the lumen and lessen pharyngeal collapse. Based on this new surgical strategy for OSAS treatment approaching to palatal collapse has been performed combining two different techniques: lateral and expansion pharyngoplasty.

Material & Methods:
The Ethics and research committee of São Camilo University Center approve this study with nº10.011. It was a retrospective cohort study with 38 patients that were submitted to these techniques in one stage to treat lateral and anteroposterior pharyngeal collapses. Reviewing medical records of patients with symptoms of OSAS from January 2012 to December 2016. We evaluated body mass index, age, sex, Epworth Scale (EPW) and polysomnography. Inclusion criteria were patients who visited the ambulatory of OSA between 18 and 60 years old, patients clinically staged with Friedman I and II, flexible endoscope examination presenting retropalatal and lateral-lateral closure in the oropharynx and/or hypopharynx (Fujita I and II). Exclusion criteria were craniofacial deformity, tongue base obstruction. The surgical technique is described in the figure 1.

Results:
We studied 38 patients that 31 were male (81.6%) and 7 female (18.4%), the age ranged from 30 to 58 years, with an average of 40.8 years. Epworth preoperative with mean of 12 and Epworth post-operative with a mean of 3.4; Preoperative snore with mean of 8.5 and Snore post-operative with a mean of 3.4. Mean preoperative BMI was 27.4 and a mean postoperative BMI of 26.6. There was a significant decrease on snoring and excessive daytime sleepiness according to Epworth Sleepiness Scale (p<0.001), success rate was of 84% according to AHI decrease, lower oxygen saturation and arousal index significantly decreased (p< 0.001). No complications or side effects were reported.

Discussion:
In the last years innovative surgical techniques try to remodel the narrow pharynx advancing the soft palate and splint the lateral pharyngeal walls enlarging the lumen and lessen pharyngeal collapse. In the search airway remodeling, the lateral pharyngoplasty remodel the deep pharyngeal muscular layer, transforming the superior constrictor in to a pharyngeal dilator muscle. Pang and Woodson developed a technique variation of UPPP named Expansion sphincter pharyngoplasty, isolating the phalatopharyngeal muscle and rotate it superior-anterior-laterally, to create a lateral wall tension and removing the bulk of the lateral pharyngeal wall. Our strategy is to perform these two techniques in one stage to treat the different ways of collapse in the UAW: lateral-lateral and antero-posterior.
Suspension suture palatopharyngoplasty SSPP: A new surgical technique in Snoring & OSA management

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Introduction:
Lateral pharyngeal muscle wall collapse has been demonstrated to plays a significant role in the pathogenesis of OSA in imaging studies. Most authors found difficulty to create, surgically, adequate lateral pharyngeal wall tension to prevent its collapse. Many techniques are described to stabilize the lateral pharyngeal wall including: lateral pharyngoplasty expansion sphincter pharyngoplasty, relocation pharyngoplasty & barbed reposition pharyngoplasty.

Material & Methods:
Suspension suture palatopharyngoplasty (SSPP) is a new technique to stabilize the lateral pharyngeal wall and relieve retro-palatal collapse by using two suspension sutures. First suture from the pterygoid hamulus to upper part of palatopharyngeus muscle. Second suture from the pterygomandibular raphae to the lower part of the palatopharyngeus muscle.

This study was performed in 35 cases with snoring with mild or moderate OSA. Each patient was subjected to full history taking, ENT examination, awake and sleep endoscopy, sleep study before and six months after the procedure.

Results:
The average operative time was 13 min and the average blood loss was 23.5ml. Postoperatively the patients suffer from pain that was relieved by fenatnil patch in the first 3 postoperative days. Postoperative bleeding encountered in a case (after 10 days from surgery) that stopped spontaneously by conservative measures. Also extrusion of the sutures occurred in 2 cases. These sutures stayed for a longer duration than pillars sutures (20 – 35 days). The average AHI decreased from 26/hour (preoperatively) to 7/hour (postoperatively). Subjective improvement of snoring and day time sleepiness was encountered in 31 cases.

Discussion:
This technique proved to be adequate for snoring, mild and moderate apnea. The advantages of this technique over other techniques are: simple & rapid procedure (no flap raising), less bleeding (no muscle dissection or palatal tunneling), comparable results to ESP and cost effective. This technique can be applied alone or in combination with other nasal and tongue procedures Multilevel surgery. Selection criteria should be followed and are similar to that the expansion sphincter pharyngoplasty.
Endoscopic expansion pharyngoplasty

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Introduction:
SAHS surgery has evolved in the last 10 years, to a more physiological surgery based on the understanding of functional anatomy. This has made it possible to reduce morbidity and achieve higher success rates based on the adequate selection of cases that the incorporation of DISE entails. We present the technique of expansion pharyngoplasty with Silhoutte Soft traction wires. It is a variation with respect to the classic BRP performed endoscopically.

Material & Methods:
We present a series of 25 patients, 18 man and 7 women with a mean age of 43 years. Diagnosed of SAHS, with mild grade 2, moderate 18 and severe 5. In all cases, preoperative DISE was performed, in which there was a circular collapse with the participation of the lateral pharyngeal walls. In all cases they had not presented an adequate adaptation to CPAP. The surgical technique was performed in 20 patients with general anesthesia and in 5 patients with local anesthesia and sedation.

Results:
No postsurgical complications have been reported. The maximum postoperative pain occurred between 5 and 8 days. In VAS index, the reduction of snoring step from 8.5 to 3.8. The result, validated by Cpap suppliers, is the withdrawal of the CPAP in 20 cases, modification of the CPAP titration in 4 cases and, in one case, an increase in the IAH index.

Discussion:
The threads with cones allow a greater and the accomplishment of less sutures, reason why the technique is faster. The previously described rates of success with barbed sutures are maintained, both in the reduction of snoring and the AH index. The combination of realization with a harmonic scalpel and local anesthesia and sedation allows us to see the technique as an attractive and feasible alternative for many patients.
Long-term outcome of modified cautery-assisted palatal stiffening operation as a treatment of obstructive sleep apnea syndrome.

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¹Universiti Kebangsaan Malaysia Medical Centre, Otorhinolaryngology, Head and Neck Surgery, Kuala Lumpur, Malaysia
²Universiti Kebangsaan Malaysia Medical Centre, Clinical Epidemiology Unit, Department of Emergency Medicine, Kuala Lumpur, Malaysia

Introduction:
Obstructive sleep apnea syndrome (OSAS) is a global problem in line with the increasing rates of obesity. Continuous positive airway pressure (CPAP) has been the gold standard for its treatment but compliance remains an obstacle. Multiple surgical interventions have been proposed to treat OSAS. This study discusses about the long term outcome of modified cautery-assisted palatal stiffening operation (CAPSO) in Universiti Kebangsaan Malaysia Medical Centre (UKMMC).

Material & Methods:
This is a cross sectional study, which took place in UKMMC between May 2016 and October 2017. From a total of 89 patients identified, 39 patients fulfilled the inclusion criteria were recruited for this study. The mean follow-up duration is 3.59 years with standard deviation of 1.33 years. Data such as Apnea-Hypopnea Index (AHI), lowest oxygen saturation (LSAT), Epworth Sleepiness Scale (ESS) and snoring Visual Analogue Scale (VAS), Body Mass Index (BMI), tonsil size, neck circumference and complications before and after modified CAPSO were extracted from the medical record into the data collection form. The patients underwent a repeat sleep study. The patient's ESS and snoring VAS were recorded. Statistical analysis was done using SPSS version 20.

Results:
Cure is defined as AHI less than 5 events per hour. It is 28.2% versus the failure at a high 71.8%. Success, which is defined as 50% reduction of AHI postoperatively and AHI less than 20 events per hour was found to be at 46.2%. In this study, 76.9% or 30 patients achieved a reduction in AHI. The AHI is significantly reduced post-operatively by 28.3 with a median of 14.2 (IQR 35.8) from a median of 42.5 (IQR 45.8) pre-operatively (p<0.00). The LSAT is improved post operatively by 11% from a median of 71% (IQR 19%) to 82% (IQR 11%) with p<0.00. The ESS is significantly less when comparing the pre-operative and post-operative results. It reduced by 6 from a median of 15 (IQR 7) pre-operatively to 9 (IQR 6) post-operatively (p<0.00). The snoring VAS is also significantly reduced from an initial median of 9 (IQR 2) pre-operatively down to 5 (IQR 4) post-operatively (p<0.00). There was no reported complication.

Discussion:
The long-term cure and success rates of modified CAPSO are low. However we found significant reduction of objective and subjective outcome measures such as AHI, ESS and snoring VAS and improvement in LSAT. Lifetime follow-up with periodical repeat polysomnograms are recommended as the disease severity is dynamic and changes with time.
Advantages of the multi-level bipolar radiofrequency (RF) for the treatment of moderate Obstructive Sleep Apnea (OSA) and snoring.

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HNO Service Winnenden, Winnenden, Germany

Introduction:
The main advantage of the method relies on it minimal invasively. It based on physiologically and anatomically data, employs the inherent benefits of bipolar technology and the same types of instruments on all levels.

Material & Methods:
We present a retrospective study of clinical cases with a sample of 90 snorers (BMI 27,3) and 26 out-patients (4 CPAP assisted) with mild (tAHI 5-15) to moderate (tAHI 16-30) OSA (BMI 31,3) conducted between the years 2005 and 2012. The patients were selected by polysomnography (PSG) trial and depending on anatomical findings operated primarily in one, two or in three stages upon local anaesthesia. To assess the critical obstructions and implicit the collapsed areas, the contacts or pressions points we routinely used both rigid and flexible (awake) endoscopy, occasionally rhinomanometry and in selected cases palatal MRI and cephalometry. A 6-12-24 month follow-up survey was carried out. The intensity as well as the snoring density was determined on a numeric analogue scale (NAS). PSG control-studies were performed by OSA patients. Histological examinations of resected uvula tissues or small biopsy of the treated palatal folds helped us to evaluate the RF effects.

Results:
After 6 and 12 months postoperative 78% of snorers and after 24 months 69% of them, reported (NAS score 0 to 2, preoperative 3,3) a noticeable decrease of snoring intensity or density. Moderate improvement in AHI (baseline 22, postoperative 6 ±1) values were objectified by OSA patients. Two of them have renounced to CPAP. 50% of OSA patients felt a durable relief in the throat, reporting better oral respiration. All reported improvements in that nasal. Preoperative videendoscopic observations were compared with those postoperative. As long the drug induced sleep endoscopy(DISE) produces a central sleep apnoea syndrome we have not proposed this exploration to our patients with obstructive sleep apnea in this trial. The patient’s tolerance of the procedures and local anaesthesia respectively the acceptance of the graduate technique applications was very good. The intra-and postoperative outcome was short and fast without complications.

Discussion:
In the aim to relax the sphincter palatopharyngeal muscle and reduce without cut the webbing, we developed special dual electrodes. Then to circumvent the intratissue tongue complications reported after monopolar treatments and avoid the counterproductive injury of the anticollapse tongue intrinsic muscles, we performed and recommended the limited reduction of the lingual tonsils. The integrity of the genioglossus muscle can be a perquisite condition for the successful nerve stimulation. Meanwhile, lingual tonsil’s coblations or robotic resections are often reported and a foreign study consider the results after our RF-method to be better as those obtained after the functional expansion pharyngoplasty. The method proves to be a safe and effective.
Hypopharyngeal collapse in OSA – hidden areas in OSA surgery – how to address it?

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Introduction:
Hypopharynx is the area between the base of tongue (upper border of Epiglottis) and lower border of cricoid cartilage. Large number of sleep surgery failures occur as a result of less addressing of this area. Clearing the obstruction in this area is the key to achieve good results in OSA surgeries.

Material & Methods:
The aim of this study was to find the role of Hypopharynx in obstructive sleep apnea and improve the results in sleep surgeries. Cases like failure after classic UPPP surgeries, no marked improvement in apnea/hyponea index after surgeries and no satisfaction after CPAP trial and CPAP failures were selected for the study. All these cases were then posted for sleep nasal endoscopy with Propofol drug induced sedation and assessed the level of obstruction. Interestingly there was significant collapse in Hypopharyngeal area like floppy epiglottis, huge tongue base pushing the epiglottis posteriorly, lingual tonsil and bilateral abductor paralysis causing vocal cords adduction. Address these areas is very important to improve the results after surgery. Coblation wand evac 70 and ultra sp wand were used as main surgical tools. All these cases were treated with procedures like tongue base reduction Epiglottopexy posterior cordectomy and lingual tonsillectomy respectively.

Results:
All these cases were assessed post operatively with sleep study, pain after surgery, voice change and any history of aspiration. There was improvement in apnea/hyponea index and in quality of life after surgery in 90 % cases. In two cases there were altered sensation of taste. Almost in all the cases pain was severe and this was managed with pain killers. In two cases there was history of aspiration for liquids and not for solids especially in Epiglottopexy and suturing of epiglottis with tongue base. These case were followed for 3 months and there was good improvement in aspiration control. There was mild voice change in posterior cordektomy case.

Discussion:
Hypopharyngeal airway collapse is the main cause of failure in almost all cases of OSA surgeries. Pre operative proper Sleep Endoscopy is the most important tool to assess the exact site of obstruction. Multilevel Surgeries tailored to each patient is important to give good results. Areas like tongue base, Epiglottis and Vocal cords should be actively looked for and treated effectively to increase the outcome.
Single session multilevel soft tissue radiofrequency treatment as an option in snoring/obstructive sleep apnoea – a pilot study on safety, patient satisfaction and symptomatic improvement

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Introduction:
Snoring and daytime sleepiness are the main complaints of patients seeking treatment for obstructive sleep apnoea (OSA). Hypertrophied, lax or redundant upper airway soft tissue are contributing causes. Some patients desire symptom improvement, but refuse lifelong ventilation therapy or major surgery. We aim to examine the improvement in snoring and daytime somnolence, safety and patient satisfaction after radiofrequency (RF) treatment in these patients.

Material & Methods:
Consecutive patients with snoring and OSA diagnosed on level 1 polysomnography, who declined ventilation therapy or surgical intervention under GA, were recruited for single session multilevel soft tissue RF treatment between February to September 2017 from a tertiary hospital. Patients on anticoagulants, cardiorespiratory comorbidities, body mass index (BMI) >35, Mallampati score ≥3, tonsil size ≥3, abnormal nasoendoscopic findings, floppy epiglottis or lingual tonsil hypertrophy were excluded. RF was applied to bilateral inferior turbinates and soft palate under local anaesthesia (LA). Partial uvulectomy was concurrently performed when a long redundant uvula was present. Age, BMI, apnoea-hypopnoea index (AHI), pre- and post-procedure Epworth Sleepiness Scale (ESS), snoring visual analogue score (VAS 0-3), procedure time, patient satisfaction score (1-10) and complications were collected and analysed.

Results:
Fourteen patients were recruited. Mean age was 42.2±2.9 years, mean BMI was 25.1±1.1 and mean AHI was 24.0±5.3. The mean pre-procedure ESS was 9.9±1.1, while the mean pre-procedure snoring VAS was 2.1. Partial uvulectomy was performed in the majority of patients (71.4%). The mean decrease in ESS and snoring VAS scores at a mean follow-up time of 7.2 months was 3.14 (95% CI, 1.21 to 5.08; p=0.02) and 0.82 (95% CI, 0.31 to 1.32; p=0.68) respectively. Mean patient satisfaction score post procedure was 7.8. Two patients experienced minor soft palate ulcers which spontaneously healed. No epistaxis or per oral bleeding occurred. Mean procedural time was 26.2±3.2 minutes.

Discussion:
Our pilot study shows that single session multilevel soft tissue RF treatment under LA is safe and patient satisfaction is high. The procedure achieves sustainable and significant reduction in daytime somnolence and may reduce snoring. It is a valuable option for select OSA patients who decline ventilation therapy or GA sleep apnoea surgery. Larger studies will be required to validate our findings.
Mechanical splinting of the nasal and velopharyngeal airway for patency of the upper airway in OSA

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Introduction:
Obstruction of the pharyngeal airway is the key symptom in obstructive sleep apnea (OSA). The root causes may reside in the pharynx, but also in the nasal passage. As an alternative to positive pressure ventilation by CPAP to open up the airway, natural nasal breathing can be restored by mechanical splinting of the nasal or velopharyngeal airway.

Material & Methods:
Fluid dynamic studies have elucidated the essential regions of risk leading to pharyngeal obstructions. Essential conclusions from a broad scientific literature analysis will be presented and compared to the clinical results from mechanical splinting of the nasal and velopharyngeal airway by nitinol stents.

The dynamic view on the fluid mechanical situation in the different compartments of the upper airway is an indispensable approach to achieve a reliable view on the root causes of OSA. This enables an optimized therapeutic approach for OSA patients, to achieve high therapeutic efficacy and concurrent patient compliance.

Results:
Numerous mechanical and computer fluid dynamics studies revealed the high importance of a good laminar nasal flow to prevent pharyngeal obstructions in patients anatomically predisposed for OSA. Decreased nasal breathing leads to high flow velocities in the nasal passage, resulting in an increased negative pressure in the naso/velopharynx where the highest amount of soft tissue (pharyngeal walls, soft palate) is located. Consequently, this region is the most prone-to-collapse one in the upper airway, which is reflected by the very high incidence of concentric or antero-posterior collapses.

Nasal airway splinting by stents leads to good nasal flow and may improve the OSA condition. Velopharyngeal mechanical splinting prevents obstructions in this region and, thereby, keeps the airway patent. Mandibular advancement devices may complement the mechanical splinting approach in case of mandible instability leading to a narrow oropharynx.

Discussion:
Mechanical splinting of the upper airway improves the fluid mechanical situation. It enables normal natural nasal breathing by preventing collapses and consequently OSA, as long as no oropharyngeal obstructions are involved. Furthermore, optimal nasal breathing is relevant to ensure flow of the nasal nitric oxide (NO), produced mainly in the sinuses, to the lung. NO is a key regulatory molecule for many physiological functions. Its blood concentration is known to be reduced in OSA, in parallel to O2. NO deficiency is the trigger for cardiovascular complications, etc.
Longterm compliance of supine avoidance using smartphone apps in patients with positional obstructive sleep apnea

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Introduction:
Two smartphone Applications (apps) are available for treatment of positional obstructive sleep apnea (POSA). Fixated to the chest of the patient, the smartphone is able to detect supine position and – using a vibration pattern – train the patient to change the body position. Therapy efficacy and usage was evaluated in a clinical study started in 2014 in the Mannheim university ENT department. Yet, longterm compliance was never reported up to date.

Material & Methods:
Patients with polysomnographic diagnosed POSA (apnea-hypopnea-index (AHI) in supine position > 10 + AHI in non supine position < 10 with 2 times AHI in supine position) were offered to participate.

One month later, PSG was repeated, to evaluate therapy efficacy. Conducting a telephone interview, the compliance and clinical symptoms were recorded after 6 and 24 month. A patient was considered as compliant if using the device for > 4h/night + 5 of 7 days

Results:
33 patients showed up for 2nd PSG (25 responders (AHI < 50% and <20/h)). Compliance of responders was 79.2% after 6 month and 40% after 24 month. Another 20% kept on using the device on a irregular basis only. The clinical symptoms of OSA disappeared in 60% of the patients after 24 month.

Discussion:
Longterm compliance of supine avoidance using a smartphone app remained on high levels after 24 month and was comparable with other supine avoidance devices. The study furthermore showed the importance of therapy monitoring and counseling of patients even after 24 month.
67

Treatment of sleep-disordered breathing with positional therapy: long-term results

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Introduction:
Positional obstructive sleep apnea (POSA) is defined as supine apnea/hypopnea index (AHI) ≥ 2x non-supine AHI and 10-90% supine sleep. The objective of this study was to assess the overall clinical effectiveness of a sleep position trainer (SPT) in patients with positional obstructive sleep apnea (POSA) and to evaluate the objective and subjective adherence during 1-year follow-up.

Material & Methods:
POSA patients who purchased an SPT device (NightBalanceTM, the Netherlands, Delft), after a trial period, were evaluated and questioned during a 1-year follow-up visit. Polysomnography was performed at baseline and after 1 year use of the SPT. Patients received questionnaires to assess the subjective adherence and patient satisfaction of the treatment. Finally, data were collected from the SPT.

Results:
A full data set was obtained from 32 patients (Table 1). A significant reduction in overall AHI from 16/h to 6/h and supine AHI from 41/h to 0/h was observed with SPT (p < 0.001). The median percentage of supine sleep decreased significantly from 38% at baseline to 1% with SPT (p < 0.001). There was no difference in the number of vibrations generated during the first week of SPT use as compared to the last week the SPT was used, nor in the response to the vibrations (Table 2). The objective adherence data were collected from the SPT with a mean SPT use of 7.3 ± 0.9 h/night and 68 ± 25% of the nights. Patients reported a subjective mean usage of the SPT of 6.7 ± 1.6 h/night and this for 83 ± 25% of the nights. Furthermore, 75% of the patients report a better sleep quality since the start of treatment, and 50% of the patients were satisfied in terms of decreased snoring. Twenty-nine patients decided to continue treatment after one year, leading to a 91% continuation rate.

Discussion:
Long-term treatment with the SPT was effective in significantly reducing AHI and supine position. Supine sleep is almost completely absent in this study population, leading to a decrease in supine AHI of 0/h. In addition, patient satisfaction was high when using the SPT, leading to improved sleep quality and decrease in snoring, which are the main symptoms in patients suffering from sleep apnea. In conclusion, the results of this study illustrate that SPT treatment can be a successful long-term treatment option with a high one-year continuation rate of 91%.
Table 1 Anthropomorphic and polysomnographic parameters at baseline and with SPT. Results in mean ± standard deviation, median (quartile 1; quartile 3). SPT: sleep position trainer, BMI: body mass index, AHI: apnea/hypopnea index, TST: total sleep time, ODI: oxygen desaturation index, SpO₂: oxygen saturation, ESS: Epworth sleepiness scale, VAS: visual analogue scale, *statistically significant differences.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Baseline</th>
<th>With SPT</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/female, number</td>
<td>26/6</td>
<td>26/6</td>
<td></td>
</tr>
<tr>
<td>Age, years</td>
<td>55.0 ± 8.0</td>
<td>54.0 ± 8.0</td>
<td></td>
</tr>
<tr>
<td>BMI, kg/m²</td>
<td>27.3 ± 2.9</td>
<td>27.3 ± 2.2</td>
<td></td>
</tr>
<tr>
<td>AHI, events/h</td>
<td>16.4 (12.2;23.2)</td>
<td>5.5 (3.1;12.5)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>AHI supine, events/h</td>
<td>40.5 (21.8;58.2)</td>
<td>0 (0;18.4)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>AHI non-supine, events/h</td>
<td>5.2 (2.5;9.0)</td>
<td>5.0 (3.0;9.6)</td>
<td>0.198</td>
</tr>
<tr>
<td>Time spent in supine position, % TST</td>
<td>37.8 (20.9;61.3)</td>
<td>0.5 (0;9.8)</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>ODI, events/h</td>
<td>5.7 (2.5;10.0)</td>
<td>2.4 (1.3;4.0)</td>
<td>0.002*</td>
</tr>
<tr>
<td>Mean SpO₂, %</td>
<td>95.1 (94.2;95.9)</td>
<td>95.3 (94.7;96.1)</td>
<td>0.308</td>
</tr>
<tr>
<td>Minimum SpO₂, %</td>
<td>87.0 (84.0;89.0)</td>
<td>89.5 (84.8;91.3)</td>
<td>0.047*</td>
</tr>
<tr>
<td>ESS</td>
<td>9.0 (3.3;12.3)</td>
<td>7.5 (4.0;12.3)</td>
<td>0.765</td>
</tr>
<tr>
<td>VAS for snoring intensity (0-10)</td>
<td>3 (0.6)</td>
<td>2 (0.5;5)</td>
<td>0.312</td>
</tr>
<tr>
<td>Time of snoring during PSG, %</td>
<td>24.8 (7.6;35.3)</td>
<td>17.3 (0;62.5)</td>
<td>0.421</td>
</tr>
</tbody>
</table>

Figure 2

Table 2 Data derived from the SPT. Results in mean ± standard deviation. N=28

<table>
<thead>
<tr>
<th></th>
<th>First week (diagnosis)</th>
<th>last week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of vibrations /night</td>
<td>27.3 ± 23.2</td>
<td>25.8 ± 27.5</td>
</tr>
<tr>
<td>Response to vibrations</td>
<td>5.0 ± 3.5</td>
<td>5.3 ± 4.7</td>
</tr>
</tbody>
</table>
Adult Obstructive Sleep Apnea syndrome and tonsil hypertrophy: should soft palate surgery be associated with tonsillectomy?

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Introduction:
Velopharyngoplasty and palatine tonsillectomy are at the very heart of surgical obstructive sleep apnea syndrome (OSAS) care. In case of clinically major tonsil hypertrophy, we evaluated the relevance of associating soft palate surgery to tonsillectomy.

Material & Methods:
We conducted a retrospective single-center study in OSAS patients with a grade III or IV tonsils treated by tonsillectomy. Preoperative assessment included an awake upper airway examination and a polysomnography. Surgical efficacy was assessed on postoperative polysomnography. Success was considered when postoperative apnea-hypopnea index (AHI) was less than 20 events/hour with a 50\% reduction. We compared palatine tonsillectomy efficacy alone (group A) and associated with soft palate surgery (group B).

Results:
We analyzed 31 patients who had undergone surgery between December 2006 and March 2016. Their preoperative mean BMI and mean AHI respectively were 27.7±7.6 kg/m\textsuperscript{2} and 36.6±20.8 events/hour. The two groups (A, n=15 and B, n=16) were clinically comparable. Success rate was 73.3\% in group A. Success rate was 62.5\% in group B. There was no statistically significant difference between the two groups. A postoperative bleeding required reintervention in group A and no complication was reported in group B.

Discussion:
In case of major tonsillar hypertrophy, simultaneous soft palate surgery had no significant impact on success rate. Although our series is limited in size, associating soft palate surgery to palatine tonsillectomy does not seem required to increase success rate. Tonsillectomy could be performed alone as soft palate surgery has its own risks including nasopharyngeal stenosis or velopharyngeal insufficiency.
Vertebropharyngeal prosthesis (VPP) for treatment of Obstructive Sleep Apnea

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Introduction:
Obstructive sleep apnea (OSA) is an underdiagnosed condition characterized by recurrent episodes of partial or total obstruction of the upper airway leading to sleep fragmentation and intermittent hypoxemia during sleep. (1) Diagnosis of OSA is based on sleep questionnaires, physical examination, polysomnography (PSG), home-based portable monitors and drug-induced sleep endoscopy (DISE). (2) There are various nonsurgical and surgical methods for treatment of OSA. Nonsurgical methods contain paptherapy, oral appliances and positional therapy.

Material & Methods:
Surgical methods contain tracheotomy, nasal surgeries, uvulopalatopharyngoplasty and variations, Palatal advancement pharyngoplasty, palatal implants, tongue reduction, partial glossectomy, tongue ablation, lingual tonsillectomy, tongue advancement/stabilization, genioglossus advancement, hyoid suspension, mandibular advancement, tongue suspension, epiglottoplasty, hyoid suspension, maxillomandibular advancement, hypoglossal nerve stimulation, minimal invasive surgical procedures and bariatric surgery. (3)

Most important reason against success of OSA surgery is collapse of lateral pharyngeal wall. (4) Vertebropharyngeal prosthesis (VPP) designed for solving this problem.

Vertebropharyngeal prosthesis (VPP) is designed to avoid the collapse of lateral pharyngeal wall during apnea episodes. This prosthesis has two main parts: 1- Body 2- Arms. (Fig. 1)

Body of VPP contains 1- motor 2- Power source 3- Wifi module 4- Cylindrical rolling part. (Fig. 1)

VPP has four arms that include several fragments with convex heads and concave tails. (Fig. 2) The convex-shaped head of each fragment is designed to insert in the concave shaped tail of former part. There is a semiflexible wire attached to the center of the inner part of the last fragment, which passes through a hole located in the center of all other fragments. At the other end, the wire is attached to the cylindrical rolling part of the prosthesis body. All of the arms are inside a soft tunnel that is covered with a very thin biocompatible material. (Fig. 3, Fig. 4) This biocompatible material also covers the body of the prosthesis, too. The cylindrical rolling part is in contact with the motor and rolls in two directions. Motor is powered by the power source. The wifi module connects the motor and the remote control device. When the motor turns the cylindrical rolling part clockwise, the wire is pulled toward the body of the prosthesis and it makes all the fragments of arms unificate and each arm becomes rigid. When the motor turns the cylindrical rolling part counter-clockwise, the wire pushes the last fragment and the fragments of arms separate from each other. This motion makes the arms flexible.

The prosthesis is fixed to the transvers process of third cervical vertebra. (Fig. 5) For inserting this prosthesis surgically, the surgeon should perform a horizontal-lateral incision at the level of third cervical vertebra transorally. After elevation of soft tissues over the vertebra in one side, surgeon should create a pouch at the lateral part of incision in the lateral pharyngeal wall for inserting the arms of the prosthesis. For fixing the prosthesis body, surgeon could use titanium micro-screws.

Results:
One month after surgery, when wound healing is completed, the prosthesis could be operated. At the day time, when patient is awake, the prosthesis arms fragments should be separated, so the arms of VPP are flexible and soft. (Fig. 3, 6) Before going to sleep, the motor is started by the remote control. VPP motor rolls the cylindrical rolling part counter-clockwise and by pulling the semiflexible wire the fragments of arms unificate. It makes the arms rigid and this rigidity creates a resistance against collapse of lateral pharyngeal wall during apnea attacks. (Fig. 4, 6) When the patient is awake, the cylindrical rolling part rolls clockwise and the wire pushes the end fragments of arms by using remote control. The separation of fragments makes the arms of VPP flexible and soft again. (Fig. 3, 6)

Patent application no: 2017/18703
References:


Figure 1

Figure 2
The impact of postoperative CPAP Therapy on the efficacy of palatopharyngeal surgery in patients with OSAHS

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Introduction:
To evaluate if postoperative CPAP therapy affect the results of palatopharyngeal surgery in patients with Obstructive Sleep Apnea Hypopnea Syndrome (OSAHS).

Material & Methods:
46 male patients underwent palatopharyngeal surgery due to OSAHS were included in this study. All the patients received a full-night pulse oximetry monitoring on the 7th postoperative night, and patients with ODI (the number of ≥3% SaO2 desaturation events per hour) > 10 and lowest SaO2 < 90% would be suggested CPAP therapy. 28 patients completed long-term (>= 3 months) postoperative CPAP therapy as the observation group, and 18 patients who refused or failed to adhere to long-term postoperative CPAP therapy as the control group. All the 46 patients underwent polysomnography (PSG) 6 months after surgery. The baseline data and postoperative PSG results between the two groups were compared and analyzed.

Results:
Age, pre- and post-postoperative BMI changes, tonsil sizes, preoperative AHI and lowest SaO2 between the two groups showed no significant difference (P=0.719, 0.402, 0.191, 0.635, 0.452, respectively), whereas the AHI changes before and after surgery (P=0.021), postoperative AHI (P=0.002) and lowest SaO2 (P=0.001) showed significant differences. The surgical success (postoperative AHI decreased >=50% and postoperative AHI < 20 events/h) rate of the observation group was 76.54%, whereas just 50.03% in the control group, with statistical significance.

Discussion:
Postoperative CPAP therapy could improve the efficacy of palatopharyngeal surgery for OSAHS, researches on the mechanism are expected.
Symposium 12: Pediatric sleep disordered breathings (SDB) – role of conservative and surgical therapies

71

Evaluation of adenoidal regrowth after adentonsillectomy in pediatric obstructive sleep apnea

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2Dokkyo Medical University, Otorhinolaryngology, Head and Neck Surgery, Tochigi-ken, Shimotsuga-gun, Japan

Introduction:
The obstructive sleep apnea (OSA) is estimated to affect 1-3 percent of all children. Given the fact that most common cause of OSA in children is enlargement of the adenoids and the tonsils, adenotonsillectomy has been widely accepted as the first line of the treatment.

However, several previous studies have documented a prevalence of recurrent OSA after surgical treatment.

Material & Methods:
We retrospectively analyzed postoperative adenoid tissue proliferation after adentoidectomy to determine the incidence of recurrent OSA.

We enrolled children (1 to 16 years of age) who had OSA diagnosed by overnight PSG and who underwent at least 1 adentoidectomy.

Results:
A total of 71 children had undergone an adetononsillectomy, 36 of 71 cases underwent adenoidectomy using a traditional curette and adenotome, and the other 35 of 71 cases underwent power-assisted adenoidectomy using a microdebrider for OSAS in the study. Transnasal fibroscopy examinations postoperatively, identified regrowth of adenoidal tissue in 11 cases (15.5%). Adenoidal regrowth was correlative with the age of the patients. The rate of repeated adenoidectomy was 7.0%(5 cases). The mean age at first adentonsillectomy was 2.2±1.0 year.

Discussion:
Age younger than 3 years was identified as important risk factors for repeated adentoidectomy in OSA children.

Parents and caregivers should be made aware of the increased risk of adenoid regrowth if surgery is performed at a young age.
Symposium 12: Soft palate II & pathophysiology

72

Effectiveness of Barbed Repositioning Pharyngoplasty (BRP) in different surgical settings for OSA treatment

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Introduction:
The surgical treatment of obstructive sleep apnoea (OSA) in patients who are non-compliant with continuous positive airway pressure therapy still represents a valid alternative. Since the introduction of lateral pharyngoplasty for the treatment of OSA, several techniques addressed to lateral pharyngeal wall have been proposed.

The aim of our work is to present the most recent scientific literature on Barbed Repositioning Pharyngoplasty (BRP) produced by our group.

Material & Methods:
Three different studies are presented:

1. A multicenter study including 111 patients treated with BRP as stand-alone procedure or part of multilevel setting

2. A retrospective comparative study including 75 patients treated with BRP or Expansion Sphincter Pharyngoplasty (ESP) or Uvulopalatopharyngoplasty (UPPP)

3. A retrospective comparative study including 30 patients treated with BRP or ESP or UPPP as part of a multilevel robotic setting

For all cases, the following data were retrieved and revaluated: preoperative and postoperative apnoea-hypopnoea index (AHI), preoperative and postoperative Epworth Sleepiness Scale (ESS), pain visual analogue scale (VAS; 0-10) for the first 5 days postoperatively, palatal operative time for each surgical technique, discharge date and complication types and rate

Results:
1st Study. The average hospitalisation period was 2.5 ± 0.5 days. The mean preoperative and postoperative AHI was 33.4 ± 19.5 and 13.5 ± 10.3, respectively (P < .001). The mean preoperative and postoperative ESS score was 10.2 ± 4.5 and 6.1 ± 3.6, respectively (P < .001).

2nd Study. The mean of pre- and post-operative differences of AHI values were higher in BRP group than ESP: 15.76±14.5 Vs 10.13±5.3; P <0.05 and UPPP groups: 15.76± 14.5 Vs 6.08±5.5; P <0.0005. The mean of differences of ESS values was higher in BRP group than ESP group: 5.52 ±4.1 Vs 4.84±3.3; P <0.005 and UPPP groups: 5.52 ±4.1Vs 1.36±1.9; P <0.005.

3rd Study. Both BRP and ESP resulted in better postoperative AHI values and higher surgical success rates in comparison with UPPP. On the other hand, BRP was not more effective than ESP. ESP surgery time was significantly higher than UPPP, while BRP was the quickest procedure.

Discussion:
Both ESP and BRP seem to be more effective than UPPP in different surgical settings. However, being quicker, easy to learn and with a low rate of complications, we consider BRP a safe, effective and promising option for treatment of OSA patients.
Short talks:
Soft palate II & pathophysiology

73

Prospective multi-centre study on expansion sphincter pharyngoplasty standing alone as surgical treatment of obstructive sleep apnea-hypopnea syndrome.

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²Clinica Universtaria de Navarra, Otolaryngology, Pamplona, Spain
³Hospital Quiron Marbella, Otolaryngology, Marbella, Spain
⁴ASIA Sleep Centre, Otolaryngology, Singapore, Germany

Introduction:
Lateral pharyngeal muscle wall collapse has been demonstrated to be important in the pathogenesis of obstructive sleep apnea-hypopnea syndrome (OSAHS). The aim of this study was to demonstrate the safety and effectiveness of Expansion Sphincter Pharyngoplasty (ESP) in management of OSAHS patients through a prospective multi-centre study.

Material & Methods:
Design: prospective study
Setting: multicenter study.
Participants: patients suffering from OSHAS selected after DISE to ESP as standing alone procedure.
DISE inclusion criteria: lateral collapse on oropharynx.
PSG inclusion criteria: preoperative AHI between 10 and 50.
Surgical technique: ESP as first introduced by Pang and Woodson in 2007 including bilateral tonsillectomy, palatopharyngeus muscle rotation flap that is antero-supero-laterally rotated.
Follow-up: more than 12 months.

Results:
75 ESP procedures were performed between January 2014 and December 2016, were analyzed in 3 different centers. The average hospitalization period was 1.7 ± 0.5 days. The mean patient age was 46.7 ± 10.5 years. The average BMI at the time of the procedure was 28.1 ± 2.7 and the majority of the patients were men (71%).

The mean pre-operative and post-operative AHI was 22.1 ± 12.2 and 8.6 ± 6.7, respectively (p < 0.001). The mean pre-operative and post-operative ESS score was 11.5 ± 4.7 and 4.6 ± 6.6, respectively (p < 0.001). AHI < 5 was obtained in 17 patients, and CPAP was not further needed after surgery in a total of 33 patients.

Discussion:
Previous meta-analysis have shown that patients with OSHAS had greater benefit from the ESP compared to the traditional uvulopalatopharyngoplasty or the traditional adeno-tonsillectomy. In this prospective multi-centre study, patients undergoing ESP standing alone for the treatment of OSAHS have a reasonable expectation for success with minimal morbidity.
Figure 1

Figure 2
Sphincter expansion pharyngoplasty (ESP) in the treatment of patients with Obstructive Sleep Apnea / Hypopnea Syndrome (SAHS): Our experience.

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Introduction:
This article started with the aim of assessing surgical’s success rate of patients undergoing oropharyngeal surgery, selected through drug-induced sleep endoscopy. In this study, we assessed the efficacy of expansion sphincter pharyngoplasty (ESP) to treat obstructive sleep apnea/hypopnea syndrome (OSAHS).

Material & Methods:
Design: we conducted a prospective trial.
Twenty adults with small tonsils, body mass index less than 32 kg/m2, of Friedman stage I or II and with lateral or anteroposterior pharyngeal wall collapse were selected for the study. Patients suffering from OSHAS selected after DISE to ESP as standing alone procedure.
DISE inclusion criteria: lateral or anteroposterior collapse on oropharynx.
PSG inclusion criteria: preoperative AHI between 10 and 50.

Results:
20 ESP procedures were performed between November 2015 and April 2016, were analyzed. The average hospitalization period was 1.2 ± 0.5 days. The mean patient age was 42 ± 10.5 years. The average BMI at the time of the procedure was 27.97 ± 2.7 and the majority of the patients were men (70%). The mean pre-operative and post-operative AHI was 24.4 ± 12.2 and 10.2 ± 6.7, respectively (p < 0.001). The mean pre-operative and post-operative ESS score was 10.05 ± 4.7 and 6.1 ± 4.1, respectively (p < 0.001). AHI < 5 was obtained in 5 patients, and CPAP was not further needed after surgery in a total of 15 patients.

Discussion:
The ESP may offer benefits in a selected group of OSA patients.
Machine learning for the classification of snoring noise: The Munich Passau Snore Sound Corpus

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Introduction:
Snoring can be located at different anatomical levels of the upper airway. The excitation locations are correlated with certain acoustic characteristics of the snoring noise. To enable an automated distinction of different snoring types, a database of snore sounds has been developed, which was labelled with the location of sound excitation, and machine learning techniques have been applied to this database.

Material & Methods:
Based on video and audio recordings from three different Ear Nose and Throat centers (Munich, Halle, and Essen) taken during drug induced sleep endoscopy (DISE) examinations, snore events have been identified and classified into four classes based on a simplified version of the VOTE classification. The resulting dataset, the Munich Passau Snore Sound Corpus (MPSSC), contains 828 snore events from 219 subjects. The Corpus was first introduced as a sub-challenge in the INTERSPEECH 2017 Computational Paralinguistics Challenge. To date, the results of seven classification experiments with the MPSSC using various feature sets and classifier combinations have been published.

Results:
Baseline classification results using the official INTERSPEECH COMPARE feature set, containing 6373 features describing the acoustic properties of the snore signal, have shown an unweighted average recall (UAR) of 58.5% using a Support Vector Machine (SVM) Classifier. Aiming for better performance using alternative combinations of features and classifiers, UAR rates of up to 67% have been published.

Discussion:
With the MPSSC, it could be demonstrated for the first time that automatic classification models based on acoustic properties are able to distinguish between snoring excited at the different levels of the upper airway. Increasing the number of subjects of the database, and developing novel descriptors for snoring sound characteristics may further improve classification performance of snoring, with the perspective of complementing DISE as a diagnostic measure in the targeted treatment of sleep disordered breathing.
76

Histological comparison between fibers of the palatopharyngeal and superior pharyngeal constrictor muscles in individuals with and without Obstructive Sleep Apnea

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Introduction:
The two main muscles that form the lateral pharyngeal muscular wall are the palatopharyngeal muscle (PPM) and the superior pharyngeal constrictor muscle (SPCM). The objectives of the study were verify the histological structure of PPM and SPCM fibers in control subjects without obstructive sleep apnea syndrome (OSAS), and evaluate whether OSAS individuals demonstrate histological changes in these muscles compared to controls.

Material & Methods:
Twenty-eight adults (age range between 18 to 55 years old) were evaluated, 17 with severe OSAS and 11 controls. On the control group, 7 had primary snoring and 4 had no snoring or OSA. PPM and SPCM fragments were collected in lateral pharyngoplasty surgery for the primary snoring and severe OSAS patients and a palatine tonsillectomy was executed in individuals with chronic caseous tonsillitis. The collected muscles specimens were frozen in liquid nitrogen. Histological and immunohistochemical staining were used to evaluate the histology of muscle fibers concerning their morphology, the distribution of fiber types, the size of the intercellular space and the prevalence of hybrid fibers in the two muscles in both groups.

Results:
The control group showed predominance of type II fibers (fast contraction and high fatigability) in PPM and SPCM, without statistical difference between the two muscles. We found a high prevalence of hybrid fibers in the control group (45.45% in PPM and 27.27% in SPCM), without statistical difference between the two muscles. Regarding the comparison between the control and OSAS groups, we verified a reduction in the percentage of SPCM type II fibers in individuals with OSAS (p = 0.04) when compared to controls.

Discussion:
PPM and SPCM have histological composition with predominance of type II fibers and high prevalence of hybrid fibers in individuals without OSAS. Patients with OSAS have a reduction in the percentage of type II fibers in SPCM compared to controls, and this may have implications in the efficiency of this muscular function, which may contribute to the etiopathogenesis of OSAS.
A murine model of Obstructive Sleep Apnea to study circadian dysregulation

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Introduction:
Pediatric obstructive sleep apnea (OSA) is a pervasive disease with significant medical burden. Multiple clinical sequelae are seen in children with OSA, including elevated blood pressure. The underlying pathophysiology is not well understood. The circadian and hypoxia response pathways play important roles in lung function but haven’t been studied in OSA. We developed a murine model of OSA to examine the relationship between hypoxic injury and circadian dysregulation.

Material & Methods:
Per2LUC mice have a Luciferase-fusion transgene to track endogenous PER2 expression in cells. We entrained these mice to a 12h light:12h dark cycle for 10 days. Mice were then exposed to intermittent hypoxia and recovery by cycling mice from 21% to 10% oxygen throughout sleep. A 12h acute exposure to intermittent hypoxia and recovery was compared to chronic exposure for 12 days. Control mice were kept in 21% oxygen during sleep. Following exposure, mice were sacrificed and lungs harvested. Kinetic luciferase activity was measured continuously for 7 days from the lung explants.

Results:
Acute intermittent hypoxia and recovery exposure or exposure to ambient air did not result in changes to PER2 expression. Surprisingly, however, chronic exposure to intermittent hypoxia and recovery increased the baseline and amplitude of PER2 expression, demonstrating general changes to clock function.

Discussion:
Intermittent hypoxia and recovery in Per2LUC mice is a viable model to study crosstalk between the circadian and hypoxia pathways. Chronic exposure to intermittent hypoxia and recovery changes circadian clock function in lung. Future work will characterize hypoxia induced circadian dysregulation to identify signaling pathways contributing to end-organ damage in pediatric OSA.

Figure 1

![Graph showing luciferase activity over time](image-url)
Dinamometric measures of upper airway collapse

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Introduction:
The collapse of the upper airway conditions the appearance of the sahs. As well as the mass and volume of the soft tissues, it remains stable during sleep and wakefulness, the behavior of these depends on the absence of muscle tone. The absence of muscular tone causes the behavior of these tissues as inert structures that are affected by gravity.

Material & Methods:
We analyzed the tensile forces necessary to overcome the collapse in 20 patients diagnosed with SAHS. According to the IAH data 5 of them were mild, 8 moderate cases and 7 severe cases. In 3 of them there was a collapse of the soft palate, in 9 a collapse of the soft palate and lateral walls of the pharynx and 8 patients, in addition to a collapse of the base of the tongue and the other structures. We made the dinamometer measures in all of them in soft palate and the tongue in order to overcome the collapse and stop the apneas point.

Results:
We found in the dynamometric measurements that the greater weight in both, the soft palate and the tongue base was in the patients with higher body mass index, as well as a higher neck parameter. the highest body mass was found with patients with severe SAHS, needing up to a maximum of 2.69 newtons to overcome the collapse.

Discussion:
The amount of weight and volume of the tongue base is the greatest condition in cases of severe SAHS. This measure us the forces to overcome with the methods that we use for the treatment of these patients as conservative methods as surgical approaches.
ePoster: Combined treatments, CPAP, Nose

P01
Retrospective analysis of a 2-years multidisciplinary sleep centre experience

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Introduction:
Obstructive sleep apnoea-hypopnea syndrome (OSAHS) is considered a disabling, high-social cost and chronic pathology. Intolerance to continuous positive airway pressure (CPAP) therapy is a severe problem. The introduction of multidisciplinary sleep centre can reduce the amount of patients without effective treatment, improving OSAHS care.

Material & Methods:
We performed a multidisciplinary assessment by a team composed by pneumologists, ENT and maxillo-facial surgeons, dentists, and internal doctors, who contemporaneously evaluate OSAHS patients not compliant to CPAP. The last 2 years 77 patients (mean age 48±2) were evaluated and addressed to alternative therapies (surgery, oral appliance, positional therapy, diet). We retrospectively analysed our results in terms of therapy effectiveness, time of diagnosis and costs. Therefore effectiveness of our protocols was evaluated by using apnoea-hypopnea index (AHI), Compliance and Mean Disease Alleviation (MDA).

Results:
After multidisciplinary evaluation, the number of patients without an effective treatment was significant reduced compared to baseline (p<0.001). Considering the therapeutic options, all the patients were comparable for the polysomnographic outcomes. The patients were homogeneously addressed to ENT surgery (19%), maxillo-mandibular advancement (19%), oral appliance (23%) and CPAP (20%). The main reasons for the continuation of CPAP were patients refusal to undergone surgery or to cover the costs related to positional therapy or oral appliance. Among the therapeutic options, surgery was the preferred choice by the patients as it was considered able to permanently solve or considerably improve OSAHS symptoms. Comparing the effectiveness of the alternatives therapies we found that compliance and MDA were statistically improved after multidisciplinary evaluation (p<0.001; p=0.029).

Discussion:
The multidisciplinary approach increases the percentage of patients compliant to therapy, improves compliance to treatment, reduces social costs and the delay of diagnosis. In literature we found very few descriptions of multidisciplinary OSAHS care, and all of them gained good with cost reduction. Further studies should be performed, with longer follow-up.
P02

Oral appliance treatment in patients with persistent Obstructive Sleep Apnea after uvulopalatopharyngoplasty

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Introduction:
Oral appliance therapy has gained a foothold as main alternative to continuous positive airway pressure (CPAP) in the treatment of obstructive sleep apnoea (OSA). One of the surgical alternatives addressing the palatal and oropharyngeal level of the upper airway is uvulopalatopharyngoplasty (UPPP). In case of failure of one therapeutic option for OSA as a stand-alone therapy, a combined treatment can be considered.

Material & Methods:
The aim of this study was to assess the combination therapy of mandibular advancement device (MAD) therapy and UPPP in patients with OSA in whom monotherapy by means of UPPP was not successful. Seventeen patients with OSA who failed UPPP were treated with a custom-made, titratable MAD.

Results:
Ten patients (9 males; baseline AHI 25.4 ± 7.6/hour sleep; baseline BMI 28.7 ± 3.0 kg/m²) completed the follow-up schedule. Apnoea hypopnoea index (AHI) and body mass index (BMI) were evaluated at baseline, after UPPP and with MAD in situ. Treatment response was defined as an AHI reduction of >50%. The post-UPPP AHI was 27.4 ± 11.3/hour sleep (p>0.05). Additional treatment with MAD led to a significant reduction in AHI to 14.7 ± 8.8/hour sleep (p<0.05). An AHI reduction of >50% was noted in 6 patients.

Discussion:
The results indicate that MAD treatment could be an effective additional therapy in a subset of patients in whom OSA persisted after UPPP.
From upper airway reconstruction to upper airway stimulation

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Introduction:
The development of upper airway reconstructive surgeries (palatopharyngoplasty, tongue base surgery, and maxillomandibular advancement) can improve the patients' tolerance of CPAP, life quality, or even totally cure OSA. However, with the limit of anatomical structures and systemic co-morbidities, the option of surgical treatment can be restricted in some cases.

Material & Methods:
We report the case of a 65 year old obese male with severe OSA (RDI 89.1, AHI 82.7, minimum saturation 75%), hypertension, and diabetes. Because of intolerance to CPAP, he was referred to the senior author for surgical treatment. Complete concentric collapse (CCC) was found during presurgery screening of hypoglossal nerve stimulation (HGNS), which is a contraindication for surgery. The CCC upper airway configuration was changed by palatopharyngoplasty to meet selection criteria for HGNS.

Results:
Postoperative reduction of OSA scores (RDI 2, AHI 2, minimum saturation 83%) demonstrated surgical success, with resolution of daytime somnolence.

Discussion:
In conclusion, HGNS is an effective surgical tool to broaden the surgeon's ability to treat OSA. In select cases, CCC configuration can be modified by adjunct surgical intervention to convert the contraindicated patient to HGNS indication.
Poster session: Combined treatments, CPAP, Nose

P04

Overlooked Causes of PAP non-compliance for the Otolaryngologist

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Introduction:
Otolaryngologists are commonly requested to evaluate patients with PAP non-compliance for optimization of contributory nasal factors and/or to surgically address obstructive sleep apnea as an adjunct or alternative to PAP therapy itself. As such, it is important for the otolaryngologist to be aware of causes of PAP difficulties in both the non-surgical and peri-/post-operative settings.

Material & Methods:
Three cases demonstrating commonplace, yet frequently overlooked causes of PAP non-compliance in the setting of a hospital-based Otolaryngology clinic will be presented (Patient 1: Persistent nasal congestion resulting in nocturnal mask removal without nasal anatomic abnormalities and despite the use of nasal steroids and humidification; Patient 2: Worsening APAP intolerance after nasal septoplasty in a previously PAP-compliant patient; Patient 3: New onset early PAP termination 3 months status-post-UPPP). The mechanisms leading to difficulties with PAP therapy will be reviewed in each case and management of these issues discussed.
P05
Effect of doctor and device manager on adherence with positive airway pressure therapy in obstructive sleep apnea

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Introduction:
The purpose of this study was to investigate the relationship between PAP therapy adherence and doctors or device managers.

Material & Methods:
Between February 2013 and June 2015, 163 patients newly diagnosed moderate to severe obstructive sleep apnea (OSA) in five hospitals were enrolled in this study. All patients received PAP treatment during 6 months, which was handled by doctors and device managers. Purchase rate of PAP device was compared among doctors and device managers. Furthermore, data from the PAP device were obtained following 6 months, with adherence defined as >4 h/night on 70% of nights.

Results:
The purchase rate of PAP device was significantly different among device managers and doctors. After 6 months, total adherence rate to PAP therapy was 36.8% (n=60). The adherence rate of device manager ¹ was 28.8% (34/118) and device manager ² was 57.8% (26/45), and there was statistically significant difference between two device manager. Furthermore, there were statistically significant differences in the adherence to PAP therapy ranging from 84.6% to 0.0% according to the doctors.

Discussion:
Our study demonstrates that device manager and doctor may be also important factors for good adherence to PAP therapy in patients with OSA.
Efficacy of intravenous ibuprofen vs. dexketoprofen for treatment of pain for acute postoperative pain relief after septorhinoplasty

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Introduction:
Effective postoperative pain management can reduce postoperative pain-related complications and decrease the cost and duration of hospitalization by enabling early mobilization.

Intravenous NSAIDs are playing an increasingly large role in analgesia, anti-inflammation and antipyresis in the hospitalized setting. Intravenous ibuprofen was approved by the US FDA for the treatment of pain and fever in adults in 2009.

Material & Methods:
We investigated the postoperative analgesic efficacy and effect of intravenous ibuprofen vs. dexketoprofen.

The study involved 30 patients who underwent elective septorhinoplasty after receiving general anaesthesia between 2016-2017. Thirty patients were enrolled in the study, 14 women and 16 men, aged 18 to 52 years.

Patients were divided into two groups to receive dexketoprofen and ibuprofen. Group D (n=20) received dexketoprofen (50 mg) intravenously 30 minutes before surgery and at the postoperative 12 th hour, whereas group I (n=10) received ibuprofen (800 mg) intravenously 30 minutes before surgery and at the postoperative 6 th hours for 24 hours.

Pain was evaluated using a 0–10 mm visual analogue scale at 0, 0.5, 1, 2, 6, 12 and 24 h postoperatively.

Additional painkillers requirements were recorded during the first 24 h postoperatively.

Results:
There was no statistically significant difference between the groups for sex, age, weight, height, ASA class, anesthesia and surgery duration.

Comparison of the groups at 0, 0.5, 1, 2, 6, 12, and 24 hours showed that VAS values in group I were statistically significantly lower at all times (P<0.001).

Discussion:
According to our study, ibuprofen provides good postoperative analgesia than dexketoprofen when administered by patient-controlled analgesia for postoperative pain after septorhinoplasty.
Success of nasal surgery in patients with Obstructive Sleep Apnea: is the presence of allergic rhinitis relevant?

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Introduction:
The aim of this study was to evaluate the relationship between surgical success rate and subjective symptom improvement after nasal surgery in patients with obstructive sleep apnea (OSA) and to evaluate the factors associated with success of nasal surgery.

Material & Methods:
Thirty five subjects were diagnosed with OSA and underwent nasal surgery, such as endoscopic sinus surgery, septoplasty and inferior turbinate reduction to correct nasal pathologies. Preoperative Drug Induced Sleep Endoscopy (DISE) was performed to evaluate the obstruction site. Patient history, Body mass index, MAST, serum-specific IgE, and total IgE levels were reviewed before surgery. The polysomnography derived apnea and hypopnea index (AHI), respiratory disturbance index (RDI), lowest oxygen saturation, mean oxygen saturation, position dependency, percentage of the time spent with oxygen saturation below 90% (CT90) and Epworth sleepiness scale, Visual analogue scale for subjective assessment were evaluated before and after nasal surgery.

Results:
Surgical success rate was only 14.3%, but the subjective symptoms were found to be significantly improved after nasal surgery. In objective assessment, AHI, RDI, mean oxygen saturation, supine AHI, CT90 were statistically significant improved before and 6 months after surgery. Surgical success rate was significantly higher in OSA patients with allergic rhinitis and nasal obstruction.

Discussion:
Nasal surgery itself can improve subjective symptoms in patients with OSA regardless of their surgical outcome. OSA subjects with allergic rhinitis are expected to have a better surgical outcome.
ePoster: Diagnostics in sleep

P08
The use of overnight pulse oximetry and phoniatrics parameters in the screening protocol of Obstructive Sleep Apnea

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Introduction:
A sleep-related breathing disorder (SRBD) is a spectrum in which snoring is the initial presenting symptom. Obstructive sleep apnea syndrome (OSAS) is the end of this spectrum which is defined by five or more respiratory events (apneas, hypopneas) in association with excessive daytime sleepiness, witnessed apneas and loud snoring. Each episode must last a minimum of 10 seconds, and is usually terminated by brief, unconscious arousals from sleep.

Material & Methods:
The study material included 20 patients with presumptive clinical diagnosis of OSA Signed informed consent was taken from patients.

Methods: Each patient was subjected to: full history taking, Systemic examination, standard ENT examination, fibroptic pharyngoscopy with Müller maneuver. Polysomnography was compared to overnight pulse oximetry and phoniatrics parameters: (Auditory perceptual assessment (APA)), Acoustic analysis of voice using Computerized speech lab (CSL) model 4300 from Kay Elemetrics, and Acoustic analysis of snoring sounds.

Results:
The sensitivity and specificity of screening oximetry were dependent on the severity of OSA. Overnight pulse oximetry alone allowed confident recognition of moderate and severe cases of OSA but it was inadequate for exclusion of milder cases.

Acoustic analysis of voice: The formant frequencies of OSA patients were significantly lower compared to non-OSA individuals. The formant bandwidths characterizing the voices of OSA subjects were significantly wider compared to non-OSA individuals.

Acoustic analysis of snoring sounds: Average pitch, Central Frequency: Palatal snoring :108Hz with SD = 23.7Hz and the mean duration of the waveform was 0.45Hz, Tongue base snoring :332Hz, with SD = 79.5Hz and the mean was 1.46Hz.

Discussion:
Overnight pulse oximetry offers an inexpensive method of screening for the diagnosis OSA. Equivocal results are likely and repeat oximetry or more detailed polysomnography will then be required if clinical suspicion is high. Acoustic analysis of snoring sounds and voice:

1. Is useful as a screening or supportive method with other investigations to diagnose the site of upper airway obstruction during sleep.
2. A screening method to differentiate between simple snoring and OSA patients.
3. A useful tool to differentiate palatal snoring from tongue base snoring.
P09
Computational fluid dynamic study in Obstructive Sleep Apnea patient: preliminary study

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Introduction:
Obstructive sleep apnea (OSA) is a common disorder which may need surgery to widen the airway.
However the success rate of surgery is variable. Thus it is necessary to predict the outcome of the surgery preoperatively.
The purpose of this study is to evaluate the mechanical parameter of the upper air way in OSA patient using computational fluid dynamics (CFD) method.

Material & Methods:
We extracted the upper airway from CT of patient who is diagnosed as OSA using polysomnography.
Three Dimensional structure was constructed from CT information in upper airway.
The mechanical parameters of upper airway were calculated with CFD study (Fluent).

Results:
Plane velocity of airflow was highest value at retroplatal plane when the value was compared at three plane (nasopharynx, retropalatal, retrolingual plane)
The pressure value was highest at the nasopharynx plane.
The wall shear stress value was high at the nasopharynx and retroplatal plane.

Discussion:
This is the preliminary study in OSA patients.
The further study is needed to evaluate upper airway character and to predict the surgery result in OSA patients.
P10
Incidental findings on upper airway computed tomography images in patients with sleep-disordered breathing

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Introduction:
To evaluate incidental findings and upper airway anatomical factors associated with Sleep-related breathing disorder (SRBD) on upper airway computed tomography (UACT).

Material & Methods:
A total of 378 participants (304 males, 74 females) were evaluated using medical records, UACT, and polysomnography. UACT was performed from the skull base to the tracheal carina to examine the upper airway.

Results:
Of the 378 patients evaluated, 74 had lesions that were unrelated to SRBD. Among these patients (male: 59, female: 15) there were 32 cases of sinusitis, 16 cases of thyroid disease, 6 cases of lymphadenopathy, 6 cases of brain lesions, 3 cases of pulmonary tuberculosis, 2 cases of vallecular cyst, 1 case of pulmonary nodule, and 9 other cases. A total of 25 patients underwent medical treatment, and 11 had surgical treatment.

Discussion:
Clinically important diseases can be detected incidentally from UACT, and it is necessary to carefully evaluate and manage the suspected diseases.
Association between STOP-BANG and Mallampati score in commercial drivers referred for health license

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Introduction:
Obstructive sleep apnea (OSA) is one of common sleep disorders that increases risk of traffic accidents among drivers. Using objective parameters along with self-reported ones may be more sensitive for OSA screening in commercial drivers. This study aimed to assess the association between Mallampati Score (MS) and STOP-BANG (Snoring, Tiredness, Observed stop of breathing, Blood Pressure, Body Mass Index, Age, Neck circumference, Gender) score in commercial drivers.

Material & Methods:
A total of 1743 male drivers were recruited in this cross-sectional study during 2014-15 in Baharloo Hospital, Tehran, Iran. Validated STOP-BANG questionnaire was used. STO symptoms were self-reported by drivers. Age, height (m), weight (Kg), blood pressure (mmHg), neck circumference (cm), and MS (I-IV) were recorded by physician. STO and P-BANG scores were computed for all participants. Data were analyzed using ANOVA test for comparing means among different classes of mallampati.

Results:
Among 1743 participated drivers, mean (SD) age was 41 (10.6) years. STOP-BANG score was <3 in 90% of them. Mallampati Score II was the most frequent (36%) following by I, III, and IV, respectively. STO score was more likely to be higher in classes III and IV with no significant association. P-BANG score had significant linear correlation with Mallampati Score (df:3,F:34, P<0.001). STOP-BANG score was associated with higher Mallampati Score (df:3,F:31, P<0.001).

Discussion:
STOP-BANG and P-BANG scores were significantly associated with MS. MS may be used as a screening parameter for OSA in commercial drivers along with available tools such as STOP-BANG and Epworth Sleepiness Scale that is mainly based on self-reports of drivers. Our limiting in this study was not having polysomnography for all 2 groups to compare STO, PBANG, STOPBANG and mallampati with AHI, which give us the most valuable diagnose for obstructive sleep apnea. We recommend another study which compare each of subjective and objective criteria and also mallampati with scorin of AHI with polysomnography.
Figure 1. Association between mean STO score and Mallampati class.

Figure 2. Association between mean P-BANG score and Mallampati class.
P12
A game changer in diagnosing Obstructive Sleep Apnea (OSA): The ApneaGraph®Spiro.

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To increase the clinician"s access to correct, simple and cost-effective diagnosis by bypassing PSG and EEG, a new diagnostic tool, the ApneaGraph®Spiro (AGS), has been developed. Well suited for home recordings, this 10-channel device comprises a small data logging unit connected to a 1 mm. thin catheter, microphone, actimeter and pulsoxymeter.

According to upgraded international recommendations, American Association of Sleep Medicine (AASM 2014), OSA is to be expressed by the Respiratory Distress Index (RDI) as the sum of Apnea-Hypopnea Index (AHI) and Respiratory Effort Related Arousals (RERA), OSA = AHI + RERA = RDI. The parameters needed are: Airflow, Respiratory Effort Related Arousals (RERA), Total Sleep Time (TST), Oximetry, Pulse Recording, Snoring sound and Body Position. Additional pressure sensors were used for finding the pharyngeal site of obstruction and snoring, as this is believed mandatory if surgery is an option.

Close concurrence in PSG/AGS recordings are earlier demonstrated for determination of AHI.

TST and RERA obtained from AGS were evaluated towards PSG. RERA is defined as "Increased RE for more than 10 seconds, ending with an Arousal, without meeting the AH criteria". A new parameter, "The Respiratory Efficiency based Arousals (REA)", were calculated from the gold reference RE standard, esophageal pressure curves.

While PSG only finds the cortical events, the AGS calculated RERAs includes both cortical and subcortical, as per AASM 2014 criteria. Discrepancies will be discussed.

We conclude that OSA can be completely and reliably diagnosed, by a small, reliable and fully automated 10 channel device for home monitoring. It is suggested that this new and cost-effective tool can substitute PSG, thus enhancing the ENT doctor"s access to correct OSA diagnosis tremendously. The AGS also gives valuable information in treatment selection.

Disclosure:
The lecturer is working with the ApneaGraph development.
P13
The influence of media technology on sleep habits

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Introduction:
Sleep is fundamental for physiologic and neurocognitive regeneration. Excessive use of communication technologies and social media (mobile phone, facebook, twitter etc) has become very popular, with negative influence on sleep hygiene. In Brazil, there are more than 200 million registered cell phones. Thus, the aim of the study was to analyze the time spent with communication technologies and social media and its influence on subjective sleep perception.

Material & Methods:
the study was approved by the local ethic committee. A validated questionnaire, 11 questions, was applied to 90 subjects of the general population, divided into 5 age-groups. The result of the questionnaire varied between 0 (best) and 42 (worse). Results were analyzed per age-group and compared (ANOVA, Spearman).

Results:
22 subject were aged up to 20 years, 25 up to 30 years, 17 up to 40 years, 12 up to 50 years old and 14 older than 50 years old.

The questionnaire showed a higher sum in the younger groups (p<0.001) When analyzed isolated questions, those related to daily performance, time spend with the technologic device, time spend at night in bed, number of messages sent at night when in bed, where the most frequent answered by the young population.

Discussion:
Excessive use of technologies is more frequent in the younger population without any perception on the influence on sleep hygiene. Action promoting health perception and more conscious use of mobile phones are necessary.
P14
Routine snoring frequency analysis in home polygraphy gives valuable hints about vibration localisations in real life influencing treatment decisions

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Introduction:
Snoring sounds have different frequency patterns according to their origin, as known from sleep endoscopy. High frequency bands > 850 Hz are associated with the severity of sleep apnea. Low bands below 300 Hz are typical for palatal snoring.

The aim is to find out which conclusions could be drawn from the frequency analysis of snoring in nocturnal polygraphic home studies in snorers and OSA-patients in differentiation of vibration or obstruction sites.

Material & Methods:
Our experience with frequency analysis comprises more than 200 patients within the last 2 years.

In 15 patients Midazolam/Propofol sleep endoscopy (DISE) was performed simultaneously with FFT-polygraphy, in 23 patients sequentially.

17 patients were compared before and after surgery. Routinely 2 nights were measured and compared.

We were using the commercially available polygraphy device T3 from NOX-Medical with built in microphone measuring 50-4.000 Hz with fast Fourier transformation (FFT) and splitting in 3 frequency bands according to Lee L.A. et al. 2012: band1 below 300 Hz, band2 300 – 850 Hz and band3 850 - 2000 Hz over the whole recording. Grafic and semi quantitative evaluation is possible. Correlations are made to sleep position, apnea or hypopnea events, desaturations.

Results:
Measurements during drug induced sleep endoscopy (DISE) are correlated to the visual findings, Frequency changes before and after surgery are compared.

High frequency bands over 850 Hz are associated with tongue base or palatal tonsil snoring or obstruction, whereas low frequencies below 300 Hz are typical for palatine snoring. Frequency pattern are changing with position in PD-OSA. Night to night variations are frequent. After palatopharyngeal surgery the amount of low frequencies is diminished but sometimes high frequencies persist, indicating not treated retrolingual snoring or obstructions. After apneas the first snore can indicate retrolingual high frequencies, followed by low frequency palatine snoring.

Discussion:
Consistent results confirm the value of frequency analysis to get an insight into the real life dynamics of snoring and obstruction sites during natural home sleep within one night or from night to night and the changes due to surgery or other treatments like mandibular advancement devices (MAD).

It is a valuable tool in indicating what type of surgery is necessary or to omit surgery and prefer conservative treatment when high frequencies indicate possible base of tongue involvement.

Of course there remain patients with doubtful acoustic meaning, they have to be investigated with DISE. But DISE cannot state about later sleep phases like REM and it can be biased by side effects of the drugs used. Therefore, we find optimal the combination of acoustic analysis and DISE if necessary.
Figure 1

Positional dependent OSAS – frequency changes with position change

Events
Position
Frequency
Sound Intensity
50-4,000 Hz
Band 1 < 300 Hz
Band 2 300-850 Hz
Band 3 > 850 Hz

right
Supine
right
Supine
left
Supine

Figure 2

High frequency band >850 Hz in DISE in PD-OSA patient due to hypertrophic tonsils and collaps of lateral pharyngeal wall

FFT during DISE

0-2 kHz
Vol in dB
< 300 Hz
> 850 Hz
ePoster: General OSA & drug-induced sleep endoscopy (DISE)

P15
Comparison of jaw thrust maneuver effect between positional and non-positional obstructive sleep apnea patient during DISE

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Introduction:
Obstructive sleep apnea syndrome (OSAS) is a common disorder due to upper airway collapse during sleep. Common symptoms include unexplained daytime sleepiness, restless sleep, and loud snoring. It occurs when your throat muscles intermittently relax and block your airway during sleep. It is also a risk factor for a variety of medical conditions including neurocognitive deficits, cardiovascular and metabolic disease. The severity of OSAS varies and is determined by multiple factors.

Material & Methods:
We compared clinical characteristics between positional and non-positional OSAS patients and studied upper airway structural changes induced by jaw thrust maneuver in OSAS patients during DISE.

Results:
We could see the results according to position between positional and non-positional obstructive sleep apnea patient

Discussion:
It is well known that sleep position affects the occurrence and severity of sleep apnea. OSAS patients are classified into positional patients with supine apnea-hypopnea index (AHI) that is at least twice as high as the non-supine AHI, and non-positional patients with a supine AHI that does not reach double values of the non-supine AHI. Drug-induced sleep endoscopy (DISE) uses sedative-hypnotics to induce obstruction in OSAS patients, thereby facilitating anatomic assessment of obstructive physiology. DISE is a powerful tool for studying the dynamic airway in a sleeping patient with OSAS. Using the knowledge gained from sleep endoscopy, the surgeon can tailor the operative procedure to the patient's specific condition.
**P16**

**Characteristics of upper airway collapse assessed during drug-induced sleep endoscopy predict response and deterioration under mandibular advancement device therapy**

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**Introduction:**

Therapy outcome for mandibular advancement devices (MAD) varies among patients. Loop gain and upper airway collapsibility can predict MAD therapy response. Moreover, response to upper airway stimulation is negatively influenced by the presence of complete concentric collapse at the palate (CCCp) observed during drug-induced sleep endoscopy (DISE). The current study aims to quantify the effect of site, pattern and degree of upper airway collapse assessed during DISE on MAD response rates.

**Material & Methods:**

Clinicaltrial.gov registration: NCT01532050

One-hundred patients were prospectively recruited, 72 patients completed 3-month follow-up. Each patient underwent baseline polysomnography (PSG) to confirm obstructive sleep apnea diagnosis, 3-month follow-up PSG with MAD, as well as DISE. MAD was fitted intraorally at fixed 75% protrusive position in all patients. Upper airway collapse levels, patterns and degree were assessed by 4 ENT surgeons with broad experience in DISE using a standard scoring system. Response and deterioration were defined as apnea/hypopnea-index (AHI) reduction ≥ 50% and increase during treatment respectively.

Continuous variables were compared using paired/unpaired t-tests or the Wilcoxon signed-rank/rank-sum test. Categorical parameters were tested using simple and multiple, corrected for baseline AHI and BMI, logistic modelling.

**Results:**

AHI was significantly (p<0.0001) reduced by MAD treatment from 18.6±11.7 to 12.2±12.6/h. Patients with tongue base collapse showed 2.74 (1.04–7.23) higher odds for response (p=0.0378) using simple, or 3.69 (1.27–10.73), p=0.0128 using multiple logistic regression. Deterioration was significantly (p=0.0455) related to complete laterolateral oropharyngeal collapse (CLLCop) using simple logistic regression, odds ratio 6.62 (1.14–38.34). Complete palatal collapse, CCCp and CLLCop significantly related to deterioration using multiple logistic regression, with odds ratios of 3.65 (1.02–13.00; p=0.0359); 5.32 (1.21–23.28; p=0.0234); and 6.62 (1.14–38.34; p=0.0330), respectively. (Figure)

Figure: Baseline (white) and 3 month follow-up (gray) AHI for all subjects, with complete concentric collapse at the level of the palate (CCCp), complete oropharyngeal (CLLCop) and tongue base collapse.

**Discussion:**

DISE might be a promising tool for upfront MAD therapy patient selection. The study results indicate complete palatal collapse, CCCp and CLLCop might predict deterioration and tongue base collapse might predict response.
Figure 1
P17

How to find out the best treatment of Obstructive Sleep Apnea? Evaluation of 100 Drug induced sleep endoscopies (DISE)

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Introduction:
CPAP therapy is known as best option to treat patients with obstructive sleep apnea. Besides this procedure there are alternative therapies like lower jaw brace or surgical interventions with similar effect. Next to polysomnography we use drug induced sleep endoscopy (DISE) to give the patient expert advice for best treatment. Otherwise we perform DISE to find out alternative ways of treatment if the patients can’t accept CPAP therapy.

Material & Methods:
In 100 patients (men and women) we used DISE to evaluate the best treatment option for OSA or to find out alternative therapies. DISE is an upper airway technique which we carry out in the operating theatre. With the help of the anesthetist the patients get 2µg/ml Propofol i.v.. This dose shall be increased by 0.1µg/ml every 90 seconds. During the procedure we use video documentation to record the status and the variation of velum, oropharynx, tongue and epiglottis before and during the administration of Propofol. To control the depth of anesthesia we use the bispectral index (BIS). The average depth of sediation should be obtained by a BIS of 60-80.

Results:
All of the 100 DISE were evaluated with the V (velum) O (oropharynx) T (tongue) E (epiglottis) classification. This classification incorporates the 4 major structures that contribute the airway obstruction in most patients. Additionally we distinguished between the gender and different age categories.

Discussion:
DISE is a good method to find out the best treatment options for OSA either it is a noninvasive (CPAP therapy, lower jaw brace) or an invasive (hypoglossal nerve stimulation, uvulopalatopharyngoplasty, reduction of the tongue base tonsil) procedure. With the help of DISE we have many patients who are satisfied with their form of OSA therapy.
Does drug-induced sleep endoscopy predict surgical success of limited palatal muscle resection in patients with Obstructive Sleep Apnea?

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¹Pusan National University Hospital, Department of Otorhinolaryngology, Busan, South Korea

Introduction:
Limited palatal muscle resection (LPMR) was attempted to shorten and tighten the soft palate with preservation of the uvula in order to increase the retropalatal upper airway patency. The aims of this study were to determine the associated factors affecting the success rate of LPMR, and to investigate whether drug-induced sleep endoscopy (DISE) could predict the therapeutic response to LPMR in patients with obstructive sleep apnea (OSA).

Material & Methods:
Twenty-one consecutive OSA patients underwent LPMR were enrolled. All patients received routine ENT examination, preoperative DISE, and polysomnography (PSG). Clinical, polysomnographic, cephalometric variables, and DISE findings were evaluated. The measurements were related to the success or failure of LPMR based on the results of preoperative and postoperative PSG. Pre- and postoperative AHI scores were compared to determine surgical success for LPMR. All patients were followed for 6 months, and according to the success criteria that were defined as AHI fewer than 20 times per hour and a decrease of 50% or more, the 21 patients were divided into success and failure group.

Results:
The overall success rate of LPMR was 66.6%. Postoperative AHI and minimal oxygen saturation were significantly decreased after LPMR \((p<0.001)\). Comparison between success and failure groups revealed no significant differences in BMI, Friedman stage, preoperative AHI, minimal oxygen saturation, and all cephalometric parameters. However, the success of LPMR was significantly correlated with site, degree, and configuration of obstruction in DISE. In the velopharynx, complete obstruction \((p=0.006)\) with anterolateral or concentric pattern \((p=0.044)\) had significantly better success rate than partial obstruction with lateral pattern.

Discussion:
DISE was only predictive method for identifying the success in OSA patients undergoing LPMR. Patients with anteroposterior or concentric total obstruction in the velopharynx might be suitable candidate for LPMR.

Figure 1

The author has objected to the publication of the figure.
P19
Relevance of surgery for second-line treatment of Obstructive Sleep Apnea in Germany

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Introduction:
Gold standard for Obstructive Sleep Apnea (OSA) treatment is nightly application of positive airway pressure (CPAP). Though highly effective, its efficacy is reduced due to side effects and low degree of convenience, which impact therapy adherence. As second line treatments, mandibular advancement devices as well as surgical interventions are available and performed on a routine basis. Aim of this study is to evaluate recent application of OSA surgery in Germany.

Material & Methods:
Procedural data on OSA treatments were obtained from the official German Hospital Statistics, which is routinely collected for all treatments performed in in-patient setting and is publicly available from InEK institute (www.g-drg.de). All cases that were coded with primary diagnosis OSA (ICD-10 German modification: G47.31) in 2016 were included in the analysis. Analysis included all cases for OSA surgery as well as non-surgical treatment for OSA in relation to other interventions. Differentiation of surgical treatments was performed using the official procedure and intervention coding system OPS 2016.

Results:
In total, 63,580 treatments for OSA were performed in the in-patient sector in Germany in 2016. Thereof, 3,034 surgical cases, with 7,656 interventions per OPS code, could be identified from the InEK database. Most common procedures include tonsillectomy (31.19%), surgery of external nose (24.41%), palate surgery (17.02%) and plastic correction of nasal septum. Less common were tongue procedures (1.99%), hypoglossal nerve stimulation (1.31%) and maxillo-facial advancement (0.89%).

Discussion:
Surgical interventions have a low share in OSA care in Germany, with 4.75% of all treatments for OSA in the in-patient sector. Given failure rates with CPAP of 30-50%, a higher relevance of surgery as second-line treatment for this disease was expected. Reasons for this low usage was out of the scope of this analysis, but could include low acceptance with patients and referrals as well as unfavorable funding for OSA surgery. A limitation of this study is that only complete data on in-patient treatments is available in Germany. The amount of smaller interventions that are performed to treat OSA in outpatient clinics cannot be determined from available data.
Carotid arterial calcium scoring using upper airway computed tomography on the Obstructive Sleep Apnea patient: Clinical usefulness as the predictor of cerebrocardiovascular disease

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²Dong-A University, Otorhinolaryngology, Head and Neck Surgery, Busan, South Korea

Introduction:
The purpose of my study is to evaluate the clinical value of upper airway computed tomography (CT) in patients with obstructive sleep apnea (OSA) as predictor of cerebrocardiovascular disease (CCVD) by quantitative analysis of carotid arterial calcification.

Material & Methods:
This study included a total of 287 consecutive patients aged 40–80 years old who underwent both polysomnography and upper airway CT between March 2011 and October 2015. The carotid arterial calcium score (CarACS) on each upper airway CT were quantified using the modified Agatstone scoring method. The severity of OSA was divided into four groups (normal, mild, moderate and severe) using the respiratory disturbance index (RDI) as the results of polysomnography. Various clinical characteristics including age, gender, body mass index (BMI), comorbid disease (e.g., hypertension, diabetes mellitus, and smoking), blood pressure, and total cholesterol were analyzed in each patient. I investigated the prevalence of CCVD events, including ischemic heart disease, cerebral infarction, cardiac or cerebrovascular death.

Results:
Among the 287 patients, CCVD events were seemed on 27 patients (9.3%) at the end of follow-up. The patients with CCVD events showed significantly higher prevalence of old age and hypertension, whereas genders, BMI, other comorbid disease were not significantly different. The carotid arterial calcification (CarAC) was found in 68 patients, and the incidence of CarAC was 51.9% (14/27) in patients with CCVD events, which was significantly higher than those without CCVD events (20.7%, 54/260, \(P <0.001\)). The severity of OSA or RDI was not different between with CCVD events group and without CCVD event groups. Univariate analysis using Cox hazards model showed the age, hypertension, incidence of CarAC, and log transformed CarACS were risk factors for CCVD events. In multivariate analysis, incidence of CarAC was the only significant risk factor for CCVD events.

Discussion:
The carotid arterial calcification is independent risk factor for CCVD events in OSA patients, whereas the RDI did not contribute to risk factor. Therefore, additional analysis of CarACS based on airway CT scans may useful for predicting the CCVD.
P21

Sonographic evaluation of anatomical variations in patients with Obstructive Sleep Apnea

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Introduction:
Obstructive sleep apnea (OSA) is among the most common respiratory dysfunctions during sleep. It is mostly associated with high body weight and insufficient dilating muscle tissue of the upper airways. OSA increases the risk of heart failure, coronary heart disease, Diabetes Mellitus and other respiratory and cardiological disorders.

The aim of this project was to investigate the correlation between anatomical landmarks, evaluated with ultrasonography, and the severity of OSA.

Material & Methods:
Patients were acquired in the sleep laboratory of the Department of Otorhinolaryngology / Head and Neck Surgery. The diagnosis was made and the severity evaluated with home sleep studies and polysomnographies. In addition to demographic variables clinical parameter, such as Mallampati score, neck circumference and BMI were collected. The OSA cohort was divided into three severity degrees: mild OSA (AHI 5-15/h), moderate OSA (AHI >15 to 30/h) and severe OSA (AHI <30/h). Two control groups were designed: patients with snoring and healthy subjects. Various sonographic landmarks were evaluated with high-resolution ultrasonography (THI, 7-14 MHz).

Results:
The OSA group contained 54 patients with a mean age of 55,5 years (16 females, 38 males), separated in 3 subcategories: 12 patients with mild OSA, 23 patients with moderate OSA and 19 patients with severe OSA. The average BMI was 30,46 kg/m².

The control group included 6 patients (3 females, 3 males) with a mean age of 54,6 years and a mean BMI of 25,24 kg/m².

Comparing the 5 groups, significant differences regarding the BMI (p=0.021) and the neck circumference (p=0.038) could be observed. A trend towards a difference regarding the sonographic distance between both lingual arteries (p=0.065), the horizontal (p=0.108) and vertical tongue thickness (p=0.120) could be observed. Significant correlations compared to the group membership were observed for the BMI (r=0.338), the neck circumference (r=0.374), the distance between the lingual arteries (r=0.297) and the horizontal tongue thickness (r=0.293).

Discussion:
Ultrasonography enables the detection of various anatomical variations which correlate with the severity of obstructive sleep apnea. These results will be part of ongoing investigations in larger patient cohorts and might provide further insight in the pathogenesis of the disease and facilitate future treatment approaches.
P22

Regarding precision medicine it needs a new index for identifying those patients with obstructive sleep apnoe syndrom (OSAS) who are really in need for effective treatment with respect to OSAS-associated comorbidities

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Introduction:
The association of OSAS with cardiovascular diseases as coronary heart disease (CVD), hypertension, stroke, arrhythmias, heart failure and metabolic disease as diabete II is well documented. Results of correlations with different parameters of OSAS are controversy. The results of ESADA 2014 concluded a link between AHI and CVD but confirmed a link between CVD and ODI.

Material & Methods:
From January to April 2017 we examined 450 consecutive patients who were admitted to the sleep lab to clarify the diagnosis and degree of severity of OSAS to set the individual therapy.

We looked for comorbidities including medication and compared their occurrence depending on AHI and new index.

Results:
We could demonstrate that there is no association between AHI and the listed comorbidities in contrast to a clear reference to the new index.

Discussion:
In OSAS it seems necessary to put more weight to the oxygen saturation with view to precision medicine to identify those patients who are really in need to the effective treatment at an early stage.
ePoster: Soft palate & tongue base

P23
A preliminary study on the treatment of OSA by pterygoid hamulus suspend palatopharyngoplasty

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Introduction:
To investigate the feasibility of the treatment of OSA by pterygoid hamulus suspend palatopharyngoplasty

Material & Methods:
This procedure was designed on the base of the reposition pharyngoplasty. The "U" incision was done on the surface of the palatine arch mucosa and the submucosal fat was removed to expose the palatopharyngeal muscle. Touch the pterygoid hamulus position and make mark. The prolene line was used for the continuous suture of the palatopharyngeal muscle, Then the needle was inserted from the palatal pharynx incision to one side of pterygoid hamulus. From the origin pinhole, the arcuate needle was up close to the root of pterygoid hamulus, and puncture out from the mucosa of medial side of the pterygoid hamulus. Then puncture again return to the palatal pharynx incision. Tie a knot to pull the palatopharyngeal muscle reposition lateral and forward. The same procedure was performed with the other side of the palatopharyngeal. The incision was sutured with the absorbable line.

Results:
Palatopharyngeal muscle through continuous suture can heighten its force, pterygoid hamulus suspend palatopharyngoplasty can obviously increase the cross-sectional area of the palatopharyngeal plane, and can improve the tension, alleviate the tongue relaxation and falling on the collapse of the airway obstruction. The postoperative reaction was mild and the wound healing was about 2 weeks. The symptoms were significantly improved. More than 30 cases have been performed. Preliminary clinical observation shows good efficacy, no serious adverse reactions and complications.

Discussion:
The anatomy and mechanics study suggests pterygoid hamulus can bear large pulling force and not easy to slip. Pterygoid hamulus suspend palatopharyngoplasty significantly expand the left and right diameter, also the anteroposterior diameter, and improve the soft palate tension, alleviate the tongue pharynx overlap on the collapse of the airway obstruction. This procedure has minimally invasive and fast recovery, has good clinical application prospects.
P24

Predictive factors of pharyngeal surgery for Obstructive Sleep Apnea (OSA)

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²Ota Memorial Sleep Center, Kawasaki, Japan

Introduction:
Pharyngeal surgery for OSA is not always effective, therefore surgical indication is important. In this study, we retrospectively evaluated the predictive factors related to pharyngeal surgery.

Material & Methods:
Retrospective study using Ota memorial center data base. 149 patients who performed the pharyngeal operation for OSA, and who could be evaluated by PSG before and after surgery during 2009 to 2017 (June) were evaluated.

We divided 149 patients to two groups, surgical treatment responder group (postoperative AHI less than half before treatment or less than 10) and non-responder group. Age, sex, degree of obesity, degree of palatine tonsil hypertrophy, cephalometric parameter, PSG parameters were analyzed.

Results:
1. AHI reduction rate: 59.2%. 2. Obstructive apnea reduction rate: 83%. 3. Hypopnea reduction rate: 36.4%. 4. Surgical treatment reaction group: 49.0%.

Independent predictive factors of the surgical treatment responder group were 3 or more (Odds 3.08) in 4 steps of palatine tonsil hypertrophy, facial axis 86.6 degrees or more (Odds 2.22), PNS-P 39 mm or more (Odds 2.34).

Discussion:
1. The results of pharyngeal surgery were similar to the previous studies. 2. Surgical indications for pharyngeal surgery should consider degree of palatine tonsil hypertrophy, maxillofacial morphology, pharyngeal soft tissue morphology.
P25

**Palate surgery from the patients' perspective: Comparision of barbed reposition pharyngoplasty and relocation pharyngoplasty techniques using a post-operative palate surgery specific questionnaire**

**H. T. Lau¹, R. Leong¹, T. Tan¹, P. Mok¹**

¹Khoo Teck Puat Hospital, Otorhinolaryngology, Singapore, Singapore

**Introduction:**
We seek to evaluate patients' perceptions and common complications of two palate surgery techniques by administering a recently introduced post-operative questionnaire – Palate Post-Operative Problems Score (PPOPS).

The surgical management of sleep disordered breathing commonly involves a multi-level approach where the soft palate/oropharynx is the most common level addressed. Patient satisfaction from surgery remains an important and realistic measure of surgical success.

**Material & Methods:**
The PPOPS questionnaire is the first targeted post-operative palate surgery questionnaire formulated to evaluate, in a practical manner, patient-reported satisfaction and complications. It consists of twelve items where the answers to each item are scored from 0 to 3 with a total score from 0 up to 36.

A retrospective study was performed in Khoo Teck Puat Hospital, Singapore. Forty patients who were diagnosed with OSA and underwent either barbed reposition pharyngoplasty or relocation pharyngoplasty, both without tongue base procedures, were selected and divided into two groups based on palate surgery technique. The PPOPS questionnaire was administered to both study groups and the answers between the groups were recorded and compared by individual item (0 to 3) and as a total score (0-36).

**Results:**
The overall average scores between both groups were similar. Although not statistically significant, responses from patients tended to favor barbed reposition pharyngoplasty over relocation pharyngoplasty for some items. Each item score was separately analysed in detail and described later in the results.

**Discussion:**
The PPOPS questionnaire is a useful tool in aiding detailed analysis of patient satisfaction and perception after palate surgery. It allows sleep surgeons to critique the advantages and disadvantages of the different palate surgery techniques using detailed and organized feedback solicited from patients.

Larger prospective cohort studies using PPOPS are required to compare our more recently adopted barbed reposition pharyngoplasty technique with our previous relocation pharyngoplasty technique in terms of patient satisfaction, as well as by using other parameters of palate surgery success for comprehensive evaluation.
P26
Transoral endoscopic coblation tongue base resection not reduction, the robot simulator

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²University of Ferrara, ENT, Forli, Italy
³Alexandria university, ORL HNS, Alexandria, Egypt

Introduction:
Tongue base hypertrophy is an obstructive condition in many, if not most of, cases of obstructive sleep apnea–hypopnea syndrome (OSAHS). Base of tongue (BOT) is difficult to manage surgically, and its surgery remains a great challenge for both surgeon and patient. Transoral robotic surgery (TORS), as described by Prof. Claudio Vicini, has proved to provide excellent and safe access to BOT.

Material & Methods:
This is a feasibility study, Coblation was used to resect tongue base, not ablate (unlike CELL technique), with the same technique as described in TORS in our country where TORS is still not available.

Results:
Coblation BOT resection was found to be feasible and effective and well tolerated (as regards postoperative pain) by patients undergoing multilevel surgery for severe OSAHS.

It also allowed measuring the volume of resected tissues and it took shorter operative time with less exposure to anaesthesia in those critical cases. as compared with CELL technique.

Discussion:
An endoscope holder was used to put 30 degrees up looking rigid endoscope, or assistant surgeon holds the scope and keep god view of tongue base.

Right angled forceps was used to hold tongue base tissues and Evac coblation wand was used in resection.

Lingual tonsillectomy was carried out (right and left halves) as described in TORS, then tongue base muscle was excised according to visual and volume feedbacks as in TORS. remaining obstructing tissues were ablated at the end of procedure.

Volume of resected tissues should be at least 9cc to achieve good results.

postoperative pain was (VAS 3) and postoperative swallowing difficulties were minimal also.

This technique can be used if TORS is not available (The Robot simulator), however, exposure was limited as compared to TORS.

Figure 1
Modified tongue radiofrequency ablation in the treatment of OSAHS

X. Zhang

Introduction:
To evaluate a modified tongue radiofrequency ablation treatment of obstructive sleep apnea hypopnea syndrome (OSAHS).

Material & Methods:
Choose by PSG confirmed Friedman stage II and stage III OSAHS patients for surgery treatment. Under local anesthesia or general anesthesia. First of all, put the left index finger into the patient’s mouth along the tongue back and the tongue base midline. The right hand holding the low temperature plasma needle radiofrequency electrode (ablation is set to 5), along the edge of mandible midline puncture the needle, insert until feel towards the left index finger pointed tip close, start ablation and slowly back about 15 mm subcutaneous stop, ablation time to 25 seconds. Again respectively along the midline different direction, ablation 7 ~ 9 lines, pay attention to avoid puncturing the mucosa.

Results:
From 2015 to present using the surgical treatments for 22 cases of sleep snore, 32 cases of OSAHS. Postoperative mild pain and mild swallowing limited, some pronunciation little unclear was observed. After A few days, no obvious pain and foreign body sensation, discomfort, eat and words as usual, the wound healed well, no severe bleeding and infection. Reexamination after 3 months, if not satisfied curative effect, again the operation can be performed. There are 18 cases in postoperative 3 months after the second surgery, 4 cases of 3 times surgery, 1 case underwent surgery on 4 times. Follow-up 3 months to 1.5 years, 46/54 cases of subjective symptoms improved significantly. Operation success was 61% evaluated by PSG.

Discussion:
Modified tongue radiofrequency ablation based on the study of anatomy and biomechanics of the tongue, choose from the percutaneous midline mandible as a new surgical approach, along the direction of approximate genioglossus fiber contraction mechanics, The radiofrequency ablation solidification of organization, makes your tongue and the tongue of every organization to obtain larger degree of melting and solidification, hardening of the scar and contraction, and their direction of contraction and chin muscle tension direction near the tongue, and can obtain good curative effect. Tongue midline neurovascular, less approach is safe, and only one into the needle point located in the outlets of skin, can reduce bleeding and edema, reduce postoperative infection and pain.
Hyoid expansion with titanium plate and screw with hyomandibular suspension: A study of human cadavers with Computed Tomographic comparative analysis

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Introduction:
Surgical reconstructive surgery of the upper airway is an option for OSA patients that fail continuous positive airway pressure therapy. Collapse of the airway is usually multilevel and collapse of the hypopharyngeal level is particularly challenging to address. The hyoid provides attachment of the constrictors that form the luminal walls of the hypopharynx. This study aims to evaluate the effect of combining hyoid expansion with suspension on the dimensions of the upper airway.

Material & Methods:
Anatomical feasibility study performed in a dissection laboratory using 10 human cadaver heads. The hyoid bone is exposed and tri-fractured with a bone cutter. The 3 segments are Thdistracted and held in place with titanium plates and screws. The expanded hyoid bone is then suspended to the mandible. CT scans are then performed on the cadavers to measure the airway dimensions before and after the procedure.

Results:
This procedure resulted in statistically significant increase in airway dimensions at the level of the hypopharynx in all 10 human cadaver heads.

The mean area of the airway at the level of the hyoid increased from 999.3±193.0mm² to 1241.4±326.2mm². Statistically significant increase in upper airway volume based on 3D reconstruction was also noted. Upper airway volume increased from 6.94±6.26ml to 13.58±8.29ml.

Discussion:
The airway dimensions increased with hyoid expansion and hyomandibular suspension in our cadaveric study measured using CT scans. Further studies are needed to see if this technique can be translated to clinical use in live patients.
Evaluation of radiofrequency ablation therapy for patients with sleep-disordered breathing

C. Kastoer, V. Fabiani, J. Beyers, J. Verbraecken, P. Van de Heyning, M. Fabiani, O. M. Vanderveken

Introduction:
In patients with sleep-disordered breathing radiofrequency ablation (RFA) treatment aims for volume reduction and stiffening of upper airway (UA) structures, including soft palate and tongue base. The aim of this study is to evaluate the therapeutic effect of RFA of the palate and the tongue base on sleep-disordered breathing.

Material & Methods:
A single-center retrospective cohort study over 11 years (2005 until 2015) was performed. Six hundred sixty one selected patients, with palatal and tongue base obstruction evaluated during drug-induced sleep endoscopy, underwent RFA of palate and tongue base under general anesthesia. Patients were excluded from the dataset when they suffered from chronic respiratory problems, mental- or genetic disabilities or had undergone previous treatment for OSA. Only patients that underwent pre- and postoperative polysomnography (PSG) at the sleep laboratory in Antwerp University Hospital were analyzed to ensure comparability, as different scoring criteria were used over the years had to be taken into account. Consequently, data analysis could be performed on 162 patients (134 male, 28 female; age 48 ± 10 y; BMI 27.3 ± 3.3 kg/m2).

Results:
No serious adverse events occurred after RFA treatment. Postoperative pain, dysphagia, swelling of the tongue and initial increased snoring only occurred temporarily. After RFA patients remained in the same category of OSA severity (mild, moderate or severe) (Table 1). Overall no significant changes occurred in postoperative AHI (21.3 ± 18.4) and ODI (9.7 ± 14.0) as compared to baseline (Table 2). Postoperative ESS decreased to 7.3 ± 3.8 (no daytime sleepiness, p<0.05). Postoperative VAS for snoring decreased from baseline severe snoring to light to moderate snoring (3.7 ± 2.3, p<0.05).

Discussion:
The results of this study suggest that RFA as a monotherapy cannot be recommended for the treatment of OSA. Nevertheless RFA may be a useful tool in selected patients to reduce snoring and/or daytime sleepiness. Alternatively, RFA can be used as part of multi-level surgical approach in patients with multilevel obstruction of the UA. In addition RFA should most likely be considered as adjunctive treatment modality when socially disturbing snoring persists after either surgical treatment or after initiation of treatment with an appliance (e.g. sleep position training, CPAP, oral appliances that protrude the mandible).
Figure 1

**Table 1**

<table>
<thead>
<tr>
<th>AHI OSA cat.</th>
<th>n (%)</th>
<th>preAHI mean ± SD</th>
<th>Min</th>
<th>Max</th>
<th>postAHI mean ± SD</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>No OSA&lt;5</td>
<td>5 (3.1)</td>
<td>2.6 ± 1.6</td>
<td>0.3</td>
<td>4.2</td>
<td>5.8 ± 5.6</td>
<td>1.4</td>
<td>12.1</td>
</tr>
<tr>
<td>Mild (5-15)</td>
<td>50 (30.8)</td>
<td>11.1 ± 2.7</td>
<td>5.1</td>
<td>14.8</td>
<td>14.7 ± 10.8</td>
<td>1.2</td>
<td>43.6</td>
</tr>
<tr>
<td>Moderate (15-30)</td>
<td>74 (45.7)</td>
<td>21.4 ± 3.8</td>
<td>15.3</td>
<td>29.4</td>
<td>21.3 ± 16.3</td>
<td>1.0</td>
<td>70.0</td>
</tr>
<tr>
<td>Severe (&gt;30)</td>
<td>33 (20.4)</td>
<td>43.2 ± 14.0</td>
<td>41.8</td>
<td>71.1</td>
<td>31.9 ± 25.8</td>
<td>1.5</td>
<td>118.6</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>162 (100)</strong></td>
<td><strong>21.9 ± 14.0</strong></td>
<td><strong>0.3</strong></td>
<td><strong>71.1</strong></td>
<td><strong>21.3 ± 18.3</strong></td>
<td><strong>1.0</strong></td>
<td><strong>118.6</strong></td>
</tr>
</tbody>
</table>

Figure 2

**Table 2**

<table>
<thead>
<tr>
<th></th>
<th>pre-op mean ± SD</th>
<th></th>
<th>post-op mean ± SD</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AHI pre-op</td>
<td>21.9 ± 13.5</td>
<td>AHI post-op</td>
<td>21.3 ± 18.4</td>
<td></td>
</tr>
<tr>
<td>ODI pre-op</td>
<td>5.7 ± 5.4</td>
<td>ODI post-op</td>
<td>9.7 ± 14.0</td>
<td></td>
</tr>
<tr>
<td>Min O2 sat pre-op</td>
<td>84.5 ± 7.8</td>
<td>Min O2 sat post-op</td>
<td>84.9 ± 7.8</td>
<td></td>
</tr>
<tr>
<td>Mean O2 sat pre-op</td>
<td>95.1 ± 1.5</td>
<td>Mean O2 sat post-op</td>
<td>84.9 ± 1.5</td>
<td></td>
</tr>
<tr>
<td>VAS snoring pre-op</td>
<td>7.4 ± 3.3</td>
<td>VAS snoring post-op</td>
<td>3.7 ± 2.3</td>
<td></td>
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ePoster: Upper airway stimulation & pediatrics

P30
Polysomnography outcomes following adenotonsillectomy in children with trisomy 21: effects of weight and Obstructive Sleep Apnea severity

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Introduction:
The most common site of airway obstruction in children with obstructive sleep apnea (OSA) is adenotonsillar hypertrophy and adenotonsillectomy (AT) is the initial step in treatment of OSA in children. There is a higher incidence of persistent OSA after AT among obese children and children with Trisomy 21. This study seeks to assess the effects of weight and OSA severity on polysomnography (PSG) outcomes and changes in sleep architecture following AT in children with Trisomy 21.

Material & Methods:
A retrospective chart review was conducted of children aged 1-13 years with Trisomy 21 who underwent AT between 2005 and 2015 at a tertiary care academic hospital and had both pre- and postoperative PSG. Thirty-six children were included in the study. We compared preoperative and postoperative changes in apnea hypopnea index (AHI) and changes in other sleep parameters recorded on PSG, including arousal index and percentage of various sleep stages between children who are normal weight, overweight and obese.

Results:
The mean preoperative AHI for normal weight, overweight and obese children were 15.6, 12.2 and 15.0, respectively while their mean postoperative AHI were 10.6, 9.4 and 10.2, respectively (p>0.05). Improvement in AHI was only significant among children with severe OSA (AHI > 10), but not among children with mild OSA (AHI 1.5 to 5) or those with moderate OSA (AHI 5 to 10), both with and without controlling for weight status (p=0.01, p=0.009). There was no significant change in sleep parameters among obese vs. non-obese and non-normal weight (overweight + obese) vs. normal weight children (p>0.05).

Discussion:
Weight status does not appear to affect the results of AT in children with Trisomy 21. This subset of children have persistent OSA following AT regardless of weight. Only those children with severe OSA have a significant improvement in AHI after AT. We suggest that AT may not be a curative treatment option among children with Trisomy 21 and OSA regardless of their weight but it can significantly improve the severity of OSA among children with severe OSA.
P31

Obstructive Sleep Apnea in a patient with Prader-Willi Syndrome – case report

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Introduction:
Prader-Willi syndrome (PWS) is a genetic disorder, which features vary with age, being characterized by neonatal hypotonia, failure to thrive in early childhood and hyperfagia leading to obesity after second year of life. Sleep disorders, including obstructive sleep apnea (OSA) are more frequent in children with PWS, leading to daytime hyperactivity, restless sleep and higher risk for lung diseases. Here we report a case of a child with Prader-Willi syndrome and severe OSA.

Material & Methods:
The patient was first referred to Otorhinolaryngology with 6 years-old, presenting with chronic nasal obstruction, snoring and witnessed sleep apneas. He weighed 45 kg, being 117 cm length and presented tonsillar hypertrophy grade III/III. Cavum X-ray demonstrated adenoid hypertrophy and polysomnography (PSG) a severe OSA, with apnea/hipopnea index (AHI) of 30. He was submitted to adenotonsillectomy, improving the AHI to 1.9.

Results:
Patient first improved with adenotonsillectomy, however, he presented again 4 years later with worsening of symptoms and with an AHI of 39 in PSG, with a body mass index of 35. He was suggested to use a CPAP, which he didn't accept, so now he is under surveillance.

Discussion:
Obstructive sleep apnea in PWS has higher incidence than in normal population, mainly because of increased viscosity of secretions, craniofacial anomalies with smaller airways, hypotonia leading to airway collapse and obesity. Untreated OSA is associated in these children with lower cognitive function and cardiovascular complications such as high blood pressure, heart disease and strokes. Thus, early detection of OSA is mandatory in this condition and baseline PSG has been recommended in early childhood. Adenotonsillectomy is the first treatment of choice, however sometimes it is necessary CPAP in poor responsive children.
Selective upper airway stimulation – a surgeon related outcome analysis

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Introduction:
Upper airway stimulation (UAS) has gone a long way from being purely experimental to commercial application as it has shown its effectiveness in treating patients with obstructive sleep apnea (OSA) in numerous studies. The University Medial Centre Mannheim as one of the top implanting centers has done more than 100 implantations of UAS devices so far. Two surgeons are performing implantation surgery for the hypoglossal nerve stimulator on an equally distributed basis in this hospital.

Material & Methods:
Because of this unique situation, a surgeon related outcome analysis was performed of patients implanted with a selective upper airway stimulator. Data was retrospectively analyzed und the Wilcoxon rank sum test for group wise comparisons and the Pearson correlation as test for variable dependencies.

63 patients were analyzed so far, 59 of male sex.

Results:
The average BMI at baseline was 28.7 ± 3.6, the average apnea hypopnea index at baseline was 35.6 ± 14.5/h. AHI postoperatively was 9.6 ± 8.3/h. Regarding baseline parameters the two surgeons groups did not differ significantly. Also regarding the postoperative AHI no significant difference showed up between the two surgeons. Yet, when further analyzing the outcome data and looking for correlation in terms of age and BMI, surgeon one’s patients significantly performed better with higher BMI, whereas surgeon two’s patients performed better with higher age than the other way around.

Discussion:
The results clearly show that different surgeons are performing differently in upper airway stimulation surgery. The findings also suggest that outcome in terms of AHI is dependent on surgeons experience and training. More exposure to different anatomy, age and BMI may be helpful in achieving a favorable outcome. The results further suggest that upper airway stimulation surgery should solely be performed at specialized centers to provide best exposure of surgeons to a variety of cases.
Introduction:
Upper airway stimulation (UAS) has emerged as a viable alternative therapy option for select patients with obstructive sleep apnea (OSA) who are unable to tolerate traditional positive pressure therapy. Prior data has shown benefit in both polysomnographic and quality of life variables. With this study, we review outcomes of patients undergoing UAS at a single, high volume, academic center.

Material & Methods:
We performed a retrospective chart review of all patients undergoing UAS therapy at our institution. All patients had moderate to severe OSA, were unable to tolerate PAP therapy, and had amenable anatomic findings on drug induced sleep endoscopy.

We recorded demographic data including age and gender. We used the Epworth sleepiness scale (ESS) to assess daytime sleepiness. We also evaluated preoperative polysomnogram (PSG) data including AHI and O2 desaturation nadir. Our primary outcome measure was postoperative AHI, O2 desaturation nadir, and ESS. The AHI was attained from the optimal treatment AHI during the postoperative titration PSG.

We used a paired samples T test to compare pre and postoperative variables.

Results:
To date, we have performed 108 UAS implants at our institution. This cohort has consisted of 71 men and 37 women. The mean age and preoperative BMI were 61.65±11.96 years and 29.40±4.01 kg/m² respectively. The mean preoperative AHI, O2 desaturation nadir, and ESS were 36.65±18.18, 79.75±8.04, and 11.19±4.37 respectively. 87 of these patients have undergone postoperative titration PSG and were included in the analysis.

The mean postoperative BMI was lower than the preoperative value; 28.29±3.92 (p=0.043). The mean postoperative AHI, O2 desaturation nadir, and ESS were 8.26±12.85, 89.01±3.42, and 5.67±3.35 respectively. These were all significantly different than the preoperative values (p<0.001). Patients used therapy for a mean of 49.57±14.15 hours per week.

Defining success as a decline in postoperative AHI by 50% and to less than 20, 83.72% of patients reached surgical success. 85.06% reached an AHI less than 15 and 59.09% reached an AHI less than 5.

Discussion:
OSA impacts a significant proportion of our population and can influence quality of life and multiple comorbid cardiovascular disease states. The primary treatment modality for OSA is CPAP, but many patients are unable to tolerate therapy necessitating alternative options. UAS continues to show its ability to be well tolerated and successfully treat OSA in select patients mitigating both polysomnographic and quality of life measures.
P34
Subpectoral implantation of the hypoglossal nerve stimulator: an effective technical modification in sleep apnea treatment

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Introduction:
Upper airway stimulation (UAS) is an important treatment option for selected patients with obstructive sleep apnea (OSA). Inspire Medical Systems Inc. (Maple Grove, MN) has emerged as the leader in UAS treatment. The implanted pulse generator (IPG) component is placed in a subcutaneous pocket in the upper chest. We report a case in which the IPG was re-implanted into a deeper position below the pectoralis major muscle.

Material & Methods:
The clinical course and procedural details of a single patient were reviewed. A literature search was conducted (PubMed, 1950 to November 2017) for subpectoral device placement and hypoglossal nerve stimulation for OSA.

Results:
A 67-year-old female with severe OSA (AHI 45) elected to undergo hypoglossal nerve UAS implantation after meeting FDA approved selection criteria. She had a history of bilateral mastectomy and chemoradiation resulting in anatomy that favored left-sided IPG implantation. The procedure was performed without complication in April 2016. Skin necrosis over the implant (model 3024) was noted on postoperative day 7, with implant exposure and wound infection 3 weeks later. Despite attempts at debridement and antibiotic therapy, surgical site infection ultimately necessitated device removal. Reimplantation on the right side was performed in August 2017. The IPG (model 3028) was placed in a subpectoral pocket with the respiratory sensing lead placed through the same incision. There were no postoperative complications. Postoperative titration polysomnogram demonstrated OSA resolution (AHI of 0.1) at 1.9 volts with substantial sleep quality improvement and excellent tolerance.

Discussion:
The safety of subpectoral implants is well-documented in the literature for deep brain stimulators and cardiac pacemakers. Subpectoral placement of the IPG for hypoglossal nerve stimulation is a feasible alternative to the conventional technique via technically simple surgical modifications. Subpectoral implantation is a consideration for patients in which wound healing is at risk (e.g. prior mastectomy, chest wall irradiation, implant infection/extrusion or infection).
Emergence of cheyne-stokes breathing after hypoglossal nerve stimulator placement in two patients

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Introduction:
The hypoglossal nerve stimulator (HGNS) is an implant approved for treatment of obstructive sleep apnea (OSA) and recommended for patients with an apnea-hypopnea index (AHI) that includes fewer than 25% central events. We present 2 patients that underwent HGNS as a salvage procedure despite being outside these guidelines due to inadequate control of OSA on positive airway pressure therapy. Both developed significant central sleep apnea (CSA) with Cheyne-Stokes Breathing (CSB) after HGNS.

Material & Methods:
Patient 1 had a known history of complex sleep apnea, AHI=93.7 with central apnea index (CAI) 67 (71.5%) and obstructive index (OI) 26.7, lowest O2 saturation (LSAT) 86%. Continuous positive airway pressure (CPAP) resulted in minimal improvement in the OI (26.7 to 20.7), but significant improvement in the CAI (67 to 6.3). He underwent salvage HGNS for inadequate treatment of OSA with CPAP.

Patient 2 had moderate OSA (AHI=22.6, OI 22.3 CAI 0.3), LSAT 84%. CPAP, bilevel PAP, and adaptive servo ventilation (ASV) were ineffective for treatment as each resulted in treatment emergent central sleep apnea[IS1] at all pressures. He underwent supraglottoplasty and hyoid suspension for a complete epiglottic collapse identified with drug-induced sleep endoscopy (DISE). Post-operative AHI was 44.4 (OI 31.9 CAI 12.5 (28%)), LSAT 78%. During repeat CPAP titration, he developed previously unseen CSB and titration was inadequate. He was offered HGNS given favorable DISE findings.

Results:
Patient 1 (body mass index (BMI)=26) was sleepy (Epworth sleepiness scale (ESS)=11) and tolerating 1.5Volts (V) when he presented for his titration polysomnogram. Optimal titration was achieved at 1.7V with an AHI=30.8, (OI 25.4 CAI= 5.4), and LSAT=89%. [IS1] At levels exceeding 1.7V, his CAI continued to climb with CSB making up the majority of central events. Patient 2 (BMI=27) was not sleepy (ESS=7) and was also tolerating 1.5V when he underwent titration. Optimal titration was achieved at 1.9V with an AHI= 83.8, (OI 4.9 CAI=78.9), and LSAT= 87%.

Discussion:
Patient 1 reports nightly HGNS use with subjective improvement in sleep quality despite no significant improvement in his obstructive AHI or ESS with HGNS. Patient 2 reports nightly HGNS use with subjective and objective improvement in sleepiness (Post-ESS=7). He has had complete resolution of obstructive events (obstructive AHI=4.9) but has significant treatment emergent CSA with CSB with HGNS. This is the first known report of CSB presenting after HGNS placement. Prior to surgery, both patients had complex sleep apnea with central events representing >25% of the total AHI. Patient 1 did develop CSB with high CPAP pressures before surgery. Both patients are undergoing workup to rule-out congestive heart failure as the etiology for OSA with CSB.
### Figure 1

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Oops, its the wrong nerve! Encountering the wrong nerve in hypoglossal nerve stimulation

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**Introduction:**
Surgical challenges during hypoglossal nerve stimulation surgery aren’t common and they are usually related to identification of the medial division branches. We report an unusual case of an undescribed setback in which the mylohyoid nerve was confused for the hypoglossal nerve. The nerve anatomy, its large caliber in this particular case, having signals consistent with protrusion activity in the tongue and the early use of the microscope where among the causes that led us to the confusion.

**Material & Methods:**
We describe the case of a 62-year old man with a five-year history of OSA, with CPAP intolerance. A body mass index (BMI) of 24, an Epworth Sleepiness Scale 9/24, and Apnea Hypopnea index (AHI) of 47/hour, and history of tonsillectomy during childhood. Physical examination, awake endoscopy and drug-induced sleep endoscopy (DISE) revealed an antero-posterior soft palate and tongue base collapse. Having met surgical implantation criteria, upper airway stimulation surgery and an Inspire system implant were indicated.

**Results:**
During surgery, a nerve located in the juncture between the anterior belly of the digastric muscle overlying the mylohyoid and the anterior edge of the submandibular gland with protrusion activity registered by nerve integrity monitoring system (NIM) and no retraction activity was assumed to be hypoglossal nerve. Latter on device verification revealed poor protrusion activity and lack of tongue movement, a device failure and a detached lead was ruled out. A thorough revision was performed and after a complete control and lateralization of the submandibular gland, another nerve was visualized, this time being clearly deep to the posterior mylohyoid (i.e. XII is sandwiched between the overlying mylohyoid and the underlying hyoglossus muscle) as well in the anterior edge of the gland but this time more inferiorly. After meticulous dissection of the nerve, protrusor, stiffener and retractor branches were dissected with the use of the microscope and NIM verification was obtained.

**Discussion:**
In this particular case the mylohyoid nerve was more inferior to the lower border of the mandible than expected, and seeing it so low in the anterior edge of the submaxillary gland an its large caliber misled us. The early use of the microscope may have misled us via a magnified view of the wrong nerve in a very small surgical area. Also having signals consistent with protrusion activity in the tongue registered by EMG when performing bipolar electrical stimulation from the NIM system led to the confusion. This may be explained by the stimulation of the anterior belly of the digastic muscle and the mylohyoid muscle innervated by the mylohyoid nerve, which stimulation elevates the hyoid and therefore some protrusion was registered in the tongue, nevertheless no tongue movement was observed.
Figure 1

Figure 2
P37
Combining MMA and Upper airway stimulation: When and Why?

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Briefly, our studies have shown a strong response of upper airway tension via DISE after MMA (resolution of CCC at velum and complete LPW collapse. The response at the tongue level is highly variable). We have a series of patients who are 15 years post MMA who still have stability of the velum and LPW, and have responded very well to hypoglossal nerve stimulation. At the same time, we have younger patients now who are able to do a much smaller skeletal procedure (distraction osteogenesis maxillary expansion: DOME) to resolve CCC predictably, and combine treatment with hypoglossal nerve stimulation. The synergistic effect of skeletal procedures and upper airway stimulation is pertinent in a number of patient phenotypes. We hope to show our preliminary findings/results, and future directions for continued research.