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Multiple Level Pharyngeal Surgery for Obstructive Sleep Apnoea

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ABSTRACT

The aim of the study is to evaluate the results of multiple level pharyngeal surgery in patients with moderate to severe obstructive sleep apnoea in Changi General Hospital, Singapore. 13 patients who failed non-surgical treatment underwent surgery which includes uvulopharyngopalatoplasty, genioglossal advancement and modified hyoid myotomy and suspension. Epworth sleepiness scale, Cephalometric analysis and Sleep study were performed pre- and post-operatively to evaluate the results. 76.9% of the patients achieved more than 50% reduction in AHI with post-operative AHI of less than 20. Cephalometric analysis showed an average of 5.2 mm increase in posterior airway space. All patients achieved improvement in Epworth sleepiness scale with an average improvement of 11.8 points. The mean follow-up period of the 13 patients is 12.6 months. Our preliminary results suggest that multiple level pharyngeal surgery is an effective option in the treatment of moderate to severe obstructive sleep apnoea.

Keywords: Obstructive sleep apnoea , multiple level pharyngeal surgery.

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INTRODUCTION

Obstructive Sleep Apnoea is characterised by a cessation of normal oronasal airflow for 10 seconds or longer, and repetitive closure of the upper airway during sleep, resulting in sleep fragmentation and daytime hypersomnolence. Hypopnoea is defined as 50% reduction in normal tidal volume. Apnoea Hypopnoea Index (AHI) or Respiratory Disturbance Index (RDI) is defined as the number of apnoea plus hypopnoea per hour of total sleep. The severity of OSA can be classified into mild, moderate, and severe. (Table I).

Snoring and Obstructive Sleep Apnoea (OSA) in adults are more common with increasing age, in men, and in the obese and those with a high alcohol intake.

Table I. Classification of sleep apnea and hypoxemia severity.

	RDI	SaO_2 (%)
Mild	5 - 20	>85
Moderate	21 - 40	65 - 84
Severe	>40	<65

RDI, respiratory disturbance index (mean number of apneas and hypopneas per hour of sleep); SaO_2, arterial oxyhaemoglobin saturation recorded during sleep.

Snoring occurs in 10% of men under 30 of age and 60% of men over 60 of age[1,2]. Snoring can be immensely socially disruptive and may lead to marital difficulties. OSA was estimated to affect 4% of men and 2% of women[3] in middle age. Upper airway narrowing and sleep induced loss of muscle tone are important factors in the development of snoring and OSA. However, their relative importance and the precise interactions between these factors remain uncertain.

It is now well recognized that airflow obstruction in obstructive sleep apnoea is caused by collapse of the pharynx, although the precise anatomic and structural factors leading to pharyngeal collapse are not known. The airway is more dependent on the dilator muscle activity to maintain the patency as shown by the predisposition to closure. This vulnerability to closure relates to the greater subatmospheric inspiratory pressure generated in an attempt to achieve adequate airflow through the narrowed airway. Many studies have revealed the presence of underlying structural abnormalities of the upper airway in patients with OSA. With the use of sophisticated imaging techniques[4,5] such as Cephalometric radiographs, CT and MRI, more subtle structural abnormalities have been identified. In general, these studies have demonstrated that patients with OSA have a narrower upper airway than control subjects.

In addition, OSA fosters neurobehavioral alternations inhibiting school and work performance and decreasing psychomotor vigilance, resulting in as much as a seven times increased risk of motor vehicle accidents, daytime somnolence, morning headaches, personality change, intellectual deterioration, impotence. OSA has the added detriment of the

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cardiovascular sequelae[9-11] to include hypertension, cerebrovascular accidents, cardiac arrhythmias, and myocardial infarction and increased mortality rate.

Conservative medical measures used to manage snoring and OSA are numerous, but the recognised methods are nasal continuous airway pressure, bi-level positive airway pressure, demand positive airway pressure[6-8], oral appliance and weight loss. These modalities have limitation regarding success rate, patients' tolerance and patient compliance.

When conservative medical measures are exhausted or not tolerated, surgical interventions become necessary in relieving these symptoms caused by OSA[2]. It is now well established that there are multiple sites of obstruction in patients with OSA[4], especially in moderate and severe types. In the past, these regional sites have often been treated independently, an understanding of these problems would suggest that a concept of comprehensive upper airway reconstruction[15] should now include all anatomic regions and levels that may contribute to nocturnal airway obstruction, and this reconstruction approach should improve clinical outcomes from surgical intervention.

METHODS AND PATIENTS

From January 1996 to December 1998, we had 13 patients with moderate to severe OSA, Apnoea-Hypopnoea Index (AHI) more than 20, underwent multiple level pharyngeal surgery. There were 11 males and two females with an average age of 46 for male and 55 for female, all with abnormally high BMI (average BMI for male and female are 31 and 33.8 respectively). We evaluated all our patients very carefully, including all the biodata, occupation, duration and severity of symptoms and the extent of disturbance to the patients' daily routine.

In addition, we assessed patients' symptoms by Epworth sleepiness scales of 0-24 (Appendix 1). There

Appendix 1.

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Epworth
Sleepiness Scale

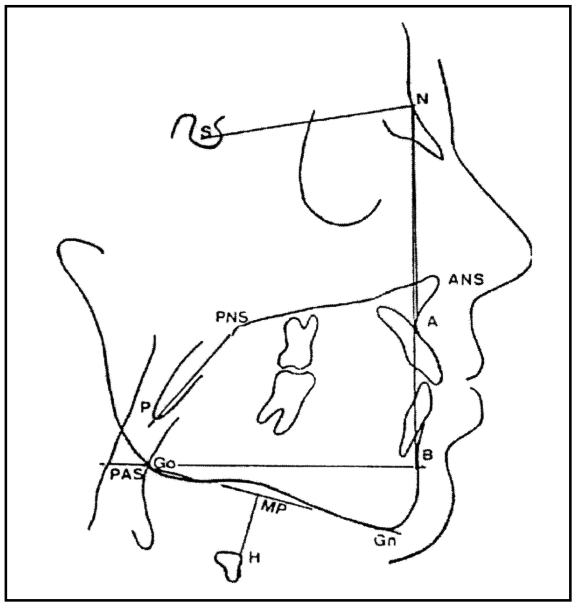
Date _____
Ht. _____ **m**
Wt. _____ **kg**

Please indicate the likelihood that you would fall asleep in the following situations (scale of 0-3). This refers to your usual way of life in recent times. Use the following scale to choose the most appropriate number for each situation:

0 = would ***never*** doze
1 = ***slight*** chance of dozing
2 = ***moderate*** change of dozing
3 = ***high*** chance of dozing

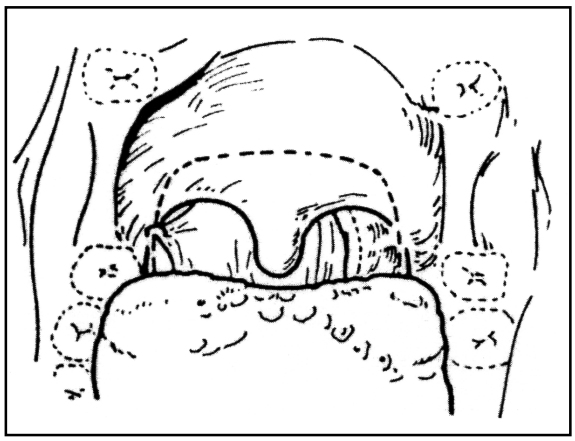
Situation	Chance of dozing
Sitting and reading	_____
Watching TV	_____
Sitting, inactive in a public place (e.g. a theatre or a meeting)	_____
As a passenger in a car for an hour without a break	_____
Lying down to rest in the afternoon when circumstances permit	_____
Sitting and talking to someone	_____
Sitting quietly after a lunch without alcohol	_____
In a car, while stopped for a few minutes in traffic	_____
TOTAL	

Appendix 2. Cephalometric analysis.



S - Sella
N - Nasion
A - Subspinale
B - Supramentale
ANS - Anterior nasal spine
PNS - Posterior nasal spine
Go - Gonion
Gn - Gnathion
H - Hyoid
PAS - Posterior air space
P - palate

Appendix 3. Uvulopalatopharyngoplasty Surgery.



were two main objectives in ENT & Head and Neck examinations. First, is to rule out any pathology causing airway obstruction, the second, objective is to identify the levels and areas of obstruction. Fiberoptic Nasopharyngoscopy is performed to assess the upper airway anatomy. Muller manoeuver, which is performed by inhaling against a closed oral and nasal passage to evaluate the collapse of the velopharyngeal tissues, base of tongue, and lateral pharyngeal wall. The increased intraluminal negative pressure with this manoeuver attempts to duplicate the sleep related pressure changes to more accurately assess the dynamic upper airway changes. This manoeuver is done by two independent surgeons and at two levels, the first level being the point just immediately above the soft palate, the second level is at the point of the greatest convexity of the tongue base.

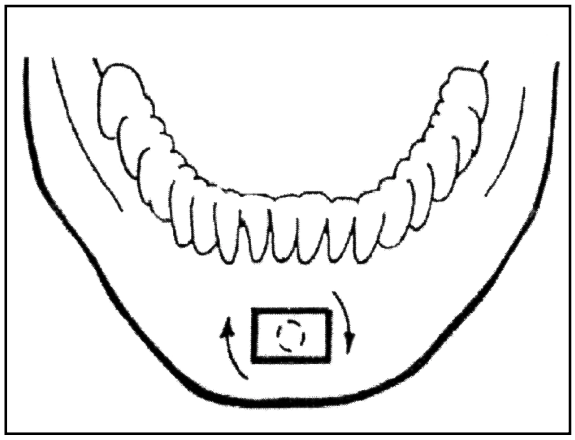
Cephalometric radiology is the standardised lateral radiographs of the skull, from which various linear and angular measurements are made between defined landmarks[4,5] (Appendix 2).

The aims of the cephalometric analysis are to establish baseline measurement prior to surgery and also assess the post-operative changes with particular emphasis on posterior airway space (PAS) of retrolingual level. Orthopantomogram is done to determine the depth and positions of teeth, thus we could determine the position of bony window needed on the mandible should the patients require surgical interventions later on.

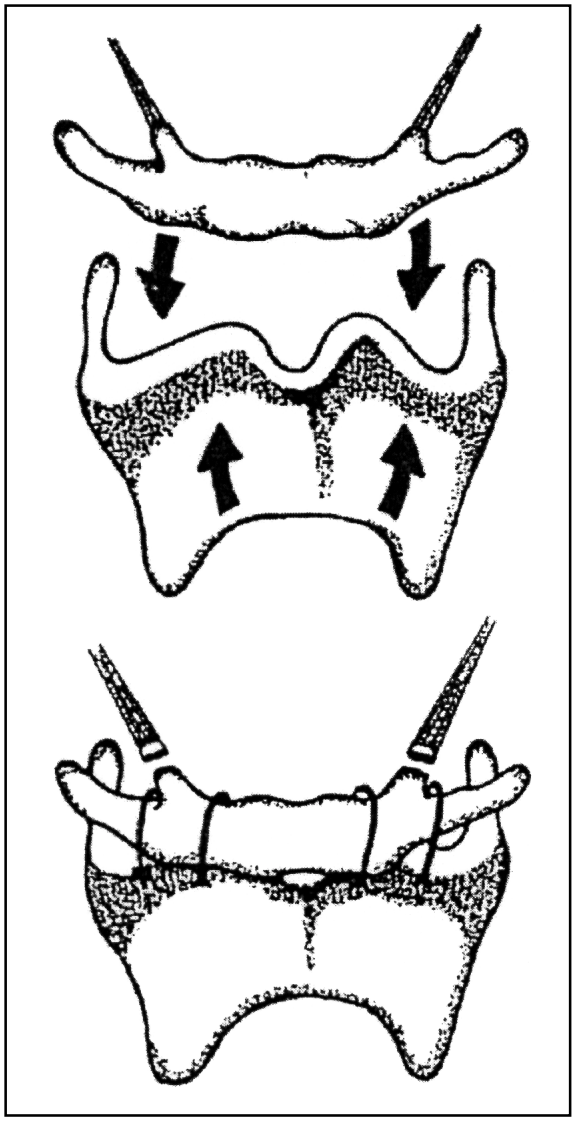
Sleep Study is routinely done by chest physicians for all the patients who have signs and symptoms of OSA. Inputs from Neurologists are also obtained. Detailed discussion with patients with regards to diagnosis and treatment options is crucial and necessary in the decision making and overall management of OSA. All patients are given advice regarding weight reduction, dietary advice in ENT clinics, and CPAP (continuous positive airway pressure) is offered as first line of treatment to all patients by chest physicians after the sleep study. When patients failed or were unable to tolerate conservative treatment, surgical treatment would then be considered and discussed with the patients.

The levels of upper airway obstruction are identified with detailed ENT, Head & Neck examinations together with fiberoptic nasopharyngoscopy, Muller manoeuver and cephalometric radiology as we described earlier. Patients with isolated obstruction at the level of the soft palate receive a palatal surgical procedure and patients with obstruction at the level of base of tongue obstruction receive procedures at both sites[14-18], simultaneously. All 13 patients in this study received both palatal and base of tongue surgical procedures. When nasal obstruction is identified, it is usually addressed with a staged nasal procedure after the palate and hypopharyngeal areas are treated[22]. Although the timing of nasal surgery in patients undergoing other procedures for OSA remains controversial, but we feel that performing staged procedures[22] is a safer option in the surgical management of patients with moderate to severe OSA, as nasal packing with blood clot after nasal surgery will further compromise the narrow, obstructed upper airway of patients with moderate to severe OSA if nasal surgery is performed first or concurrently.

Appendix 4. Inferior Mandibular osteotomy with genioglossus advancement surgery.



Appendix 5. Modified hyoid myotomy and suspension procedure.



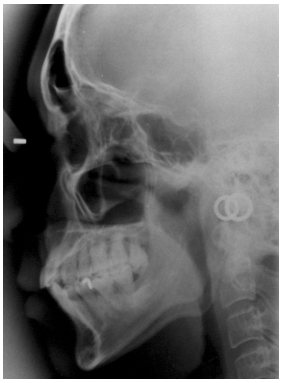


Fig. 1 Cephalometric Radiology (Pre-operative).

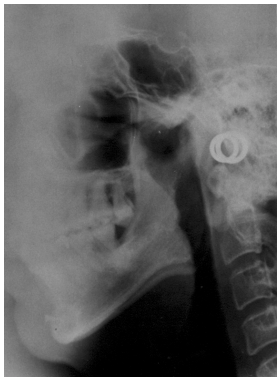


Fig. 2 Cephalometric Radiology (Post-operative).

SURGERY

Uvulopalatopharyngoplasty[15,18] surgery is to reduce the excessive tissue found in the palate, uvula, and posterior, and lateral pharyngeal walls. Tonsils are also included in the surgery if they are present, in order to optimise the oropharyngeal airway (Appendix 3).

Inferior mandibular osteotomy with genioglossus advancement surgery[14-17] is to increase the retrolingual airway space. The osteotomy was made at genial tubercle of mandible. A 22 mm rectangular bony segment is cut using a sagittal saw, which was then advanced, rotated and secured with 9 mm screws. The outer cortex of the segment is drilled down to maintain normal contour of lower mandible (Appendix 4). Modified hyoid myotomy and suspension[15-17] is to increase the retrolingual area and alleviate obstruction by redundant lateral pharyngeal tissue or retrodisplaced epiglottis. The body of hyoid is isolated in the midline and the inferior aspect is dissected clean. The stylohyoid ligament may need to be sectioned from the lesser cornu to allow adequate mobility. Two strong sutures are passed around the hyoid and through the superior aspect of thyroid cartilage and approximated (Appendix 5).

RESULTS

76.9% of patients (10 out of 13 patients) achieved more than 50% reduction in AHI with post-operative AHI of less than 20 (average pre- and post-operatively AHI are 52.8 and 15.6 respectively). Cephalometric analysis showed an average of 5.2 mm increase (average pre- and post-operatively are 4.6 mm and 9.8 mm respectively) in posterior airway space at hypopharyngeal level post-operatively (Fig. 1, 2).

All patients have shown improvement in Epworth sleepiness scale with an average improvement of 11.8 points (average pre- and post-operatively are 18.2 points and 6.4 points respectively) (Table II & Table III). Complications include 1 minor wound infection, 2 lower teeth hypo-aesthesia and 1 gingivolabial sulcus incision dehiscence which healed spontaneously two weeks later. All our patients are monitored in Intensive Care Units post-operatively for 24 - 48 hours before they are sent to the High

Table II. Biodata of 13 patients in this study.

Male	11	Female	2
Age mean	46	Age mean	55
BMI mean	31.0	BMI mean	33.8

Table III. Results of multiple level pharyngeal surgery. (Pre and Post surgery)

AHI mean	Pre - 52.8	Post - 15.6	index
SNA mean	Pre - 81.5	Post - 81.5	degrees
SNB mean	Pre - 79.8	Post - 80.0	degrees
PAS mean	Pre - 4.6	Post - 9.8	mm
PNS-P mean	Pre - 39.4	Post - 29.0	mm
MP-H mean	Pre - 25.4	Post - 22.8	mm
Epworth mean	Pre - 18.2	Post - 6.4	points

Dependency Unit for further 24-hour monitoring. The average length of hospital stay for our patients is 8.5 days.

DISCUSSION

Many leading sleep disorders centres[14,17,19,20,21] defined surgical success as an improvement of AHI greater than 50% and post-operative AHI of less than 20. We have adopted this widely accepted standard as our surgical objective of multiple level pharyngeal surgery. All 13 patients have post-operative studies in six months' time. The average length of follow up is 12.6 months with minimum of six months and maximum of 24 months.

The success rates from other leading centres are ranging from 42% to 78% with mean follow-up periods of nine to 14 months. OSA could result in a variety of constitutional and psychological impairment, and also have been epidemiologically to have an increased association with myocardial infarction, strokes etc and a wide range of morbidity and mortality. When conservative medical treatment fails, a comprehensive pre-operative evaluation and surgical therapy directed at specific sites of obstruction, adherence to a treatment management protocol and diligent follow-up is absolutely necessary to increase patients' satisfaction, lower morbidity and increase surgical success rates. Our preliminary results suggest that multiple level pharyngeal surgery is an effective option in the treatment of patients who have moderate to severe OSA with multiple levels of pharyngeal obstruction. We understand that long-term follow-up is essential and this is also emphasized to our patients. Annual follow-up for the first three years has been scheduled and we are in the process of collecting and analysing the subsequent data.

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