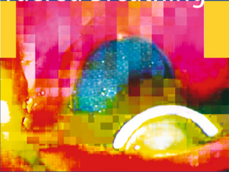
Karl Hörmann
Thomas Verse

Surgery for Sleep Disordered Breathing



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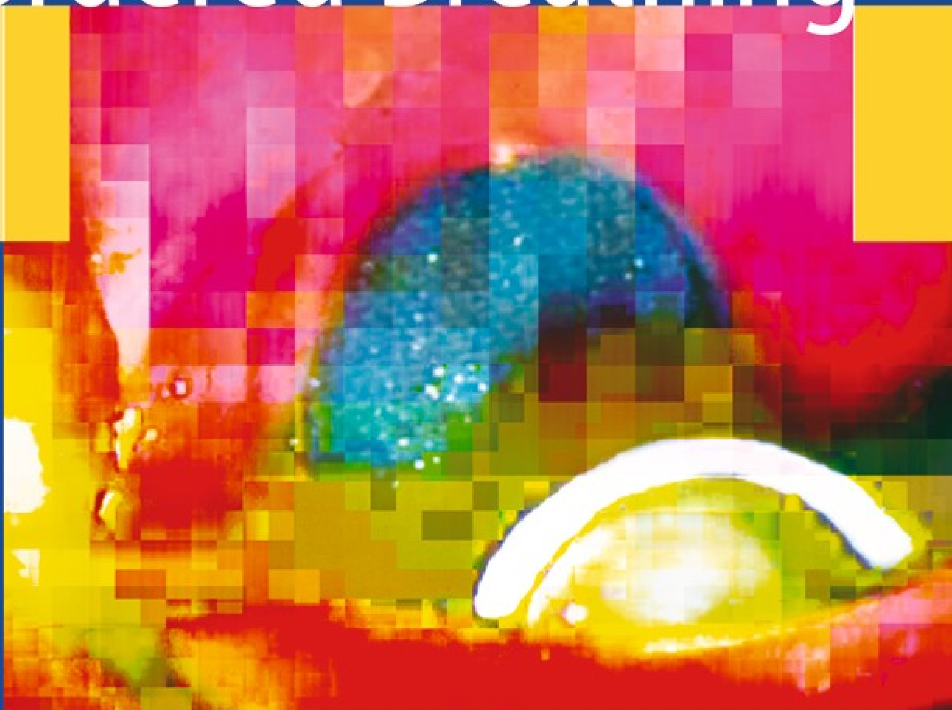

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With 92 Figures, Mostly in Colour, and 32 Tables

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Preface

Sleep disordered breathing (SDB) is of growing interest. To address the importance to the public health, it has been shown in 1993 that 9% of middle-aged women and 24% of middle-aged men suffer from SDB with consecutive cardiovascular disorders. It is suggested that the prevalence of undiagnosed SDB is much higher. Among these patients the obstructive sleep apnea syndrome (OSAS) plays the most important subgroup with cessations of breathing during sleep (apnea) and symptoms like snoring, daytime sleepiness and hypersomnolence with loss in concentration. Nasal continuous positive airway pressure (nCPAP) ventilation is the gold standard in the treatment of obstructive sleep apnea (OSA). Unfortunately nCPAP ventilation does not exceed long-term compliance rates of much more than 60 percent. To address these patients several alternatives exist. Beyond conservative therapies various surgical concepts become more important.

For more than 15 years now, we give special intent to the field of surgery in sleep medicine. Our sleep laboratory by now encompasses 20 cardiorespiratory polysomnographies each night. Per year we perform almost 1000 surgical procedures for sleep disordered breathing apart from numerous other conservative and apparative treatment modalities.

Referring to the present literature of sleep medicine especially concerning surgical procedures, we tried to summarize the recent knowledge in this field. We want to give general advice as well as specific hints for the surgical treatment of sleep disordered breathing. On the following pages we present standard surgical procedures as well as special concepts concerning sleep surgery. In consideration to our own clinical experience of more than 15 years this book gives advices in indications and contraindications of each surgical procedure and explains the postoperative care. We hope, that this book will become a helpful guidebook for all surgeons with special interest in modern sleep medicine.

Mannheim, February 2005

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Abbreviations

ACP	Antral choanal polyp
AHI	Apnea hypopnea index. Number of apneas and hypopneas that occur per hour of sleep
AI	Apnea index. The number of apneas that occur per hour of sleep
ATE	Adenotonsillectomy
BMI	Body mass index. A measure of weight compared to height, calculated as weight in kilograms divided by height in meters squared (healthy: 18.5–24.9 kg/m^2; overweight 25–29.9 kg/m^2; obesity >30 kg/m^2; morbid obesity >40 kg/m^2)
BSSO	Bilateral sagittal split osteotomy
CAPSO	Cautery-assisted palatal stiffening operation
CPAP	Continuous positive airway pressure. Gold standard treatment of obstructive sleep apnea and the upper airway resistance syndrome
CT	Computer tomography
DOG	Distraction osteogenesis
EBM	Evidence-based medicine
ECG	Electrocardiogram
ESS	Epworth Sleepiness Scale. A subjective measurement of sleepiness.
FFT	Fast Fourrier transformation
HS	Hyoid suspension. A surgical procedure for OSA
LAUP	Laser-assisted uvulopalatoplasty. A surgical procedure for simple snoring
LUPP	Laser uvulopalatoplasty. A surgical procedure for simple snoring
MAD	Mandibular advancement device. An oral appliance that moves the lower jaw forward against the upper jaw
MLP	Midline partial glossectomy
MLS	Multi-level surgery
MMA	Maxillomandibular advancement
MO	Mandibular osteotomy with genioglossus advancement
MRI	Magnet resonance imaging
MST	Mucosal strip technique; a surgical procedure for simple snoring
nCPAP	Nasally applied continuous positive airway pressure
NSAID	Non-steroidal anti-inflammatory drugs
ODI	Oxygen desaturation index. Number of oxygen desaturations >4 % that occur per hour of sleep
OSA	Obstructive sleep apnea
PAS	Posterior airway space
PSG	Polysomnography. A graphic measurement of sleep and cardiorespiratory parameters
RDI	Respiratory disturbance index. The number of respiratory events that occur per hour of sleep (equivalent to AHI)
RFQ	Radiofrequency. An interstitial thermal ablative technique to reduce hypertrophy of soft tissues and produce scarification
SDB	Sleep-disordered breathing. An inclusive term that denotes all respiratory abnormalities during sleep
SI	Snoring index
STS	Sodium tetradecyl sulfate
TAP	Transpalatal advancement pharyngoplasty; a surgical procedure for OSA
TE	Tonsillectomy
TT	Tonsillotomy
UARS	Upper airway resistance syndrome

UPPP Uvulopalatopharyngoplasty. A surgical procedure for SDB
VAS Visual analog scales
VPI Velopharyngeal incompetence. A dysfunction of the sphincteric closure action of the soft palate

Sleep-Disordered Breathing

1

In our modern competitive society, non-restorative sleep is acquiring an enhanced significance. The international classification of sleep disorders includes 80 different diagnoses of possible causes for non-restful sleep [13]. A subgroup with a comparatively high incidence rate is formed by the so-called sleep-disordered breathing (SDB) disorders. These are further divided into disorders with and without obstruction in the upper airway. SDB disorders without obstruction include primary alveolar hypoventilation (Ondine's curse syndrome), secondary alveolar hypoventilation, and central sleep apnea. These clinical syndromes have neurological causes, and in general resist surgical treatment.

Sleep-disordered breathing disorders with obstruction include primary snoring, upper airway resistance syndrome (UARS) and obstructive sleep apnea (OSA). Currently, these syndromes are regarded as different grades of severity of the same pathophysiological disorder [341]. Snoring is caused by vibrations of soft tissue in constricted segments of the upper airway. By definition, primary snoring is not accompanied by breathing impairment, and entails neither disruption of sleep nor increased daytime sleepiness. Primary snoring may lead to a social problem as a result of the nocturnal breathing sounds, but it is not essentially a disorder of the patient's physical health.

Yet in the case of OSA, an imbalance exists between forces dilating and occluding the pharynx during sleep. The muscle tone supporting the pharyngeal lumen is too low, and the inspiratory suction force, as well as the pressure of the surrounding tissue, which both narrow the pharynx, are too high [412, 386]. This disorder occurs only during sleep as a result of a physiological loss of muscle tone of the pharyngeal muscles in this state. The effects are complete cessation of breathing (apneas) or reduced breathing phases (hypopneas). If sustained long enough, both events trigger an emergency situation for the body. The body reacts with a central arousal, which disturbs the physiological sleep by a release of catecholamines. The latter lead to a strain upon the cardiovascular system via an increase in the tone of the sympathetic system.

In the case of UARS, the muscle tone is still sufficient to keep a partial lumen. The respiratory resistance is thus increased to an extent needing elevated respiratory efforts. After a certain amount of time this breathing impairment is interrupted by the same central nervous activation that is seen when apneas are terminated. The result is an increased occurrence of respiratory arousals without detectable apneas [184].

In contrast to primary snoring, OSA and UARS have an adverse effect on the daytime life quality. Cardinal symptoms of OSA are intermittent snoring (94 %), daytime sleepiness (78 %) and diminished intellectual performance (58 %). Further symptoms are personality changes (48 %), impotence in men (48 %), morning headaches (36 %), and enuresis nocturna (30 %) [182].

Obstructive sleep apnea is a widespread disorder affecting up to 10.9 % and 6.3 % of the male and female populations respectively [237, 584]. OSA is associated with serious adverse consequences for afflicted individuals, such as myocardial infarction [227], stroke [117], hypertension [382], and traffic accidents [508].

In other words, primary snoring is merely an irritating annoyance, whereas OSA and UARS represent diseases with a significant morbidity and mortality. This implies that distinct therapy goals are warranted. Therefore, we consider it vital that a precise diagnosis is established before the initiation of any therapy. The necessary diagnostic work-up includes an anamnesis using standardized questionnaires, a physiological and otolaryngological assessment, and a sleep lab evaluation. For details see the relevant literature [8–10, 13, 143].

General Aspects of Therapy

2

The severity of sleep-disordered breathing (SDB) is crucial in deciding which therapy is most suitable for which patient. The simple snorer is not ill. Therefore, the goal of treatment in the case of primary snoring lies in the reduction of both the duration and the intensity of snoring to a socially acceptable level. In principle, it needs to be kept in mind that: (1) a treatment should not harm the patient, (2) a treatment should be carried out only if the patient has explicitly articulated such a wish, and (3) after any treatment nasal ventilation therapy should remain possible [11]. This last aspect is important because the incidence of obstructive sleep apnea (OSA) increases with age [302]. Especially after aggressive soft palate surgery, many cases have been described in which nasal ventilation therapy was no longer possible due to the development of a nasopharyngeal insufficiency or stenosis [346]. In many places, these cases have seriously impaired the trust in soft palate surgery.

In the case of upper airway resistance syndrome (UARS) and OSA, the goal of treatment is complete elimination of all apneas, hypopneas, desaturations, arousals, snoring and other related symptoms in all body positions and at all sleep stages. Of course, it should also be stressed that in principle a treatment should not harm the patient. But it must be pointed out that in the case of UARS and OSA, a disease with corresponding symptoms is already manifest. Therefore, in order to achieve the therapeutic goal, one will be less reluctant to consider a more invasive therapy with a heightened morbidity and complication rate, a decision that would be indefensible in the case of harmless primary snoring.

In general, the severity of OSA is classified according to the apnea hypopnea index (AHI; the number of apneas plus the number of hypopneas per hour of sleep). Unfortunately, especially in the case of the mild forms of SDB, the AHI is not necessarily correlated to the clinical symptoms of the patients. Furthermore, the AHI is age-dependent. A widespread consensus exists that an AHI ≥ 2 is to be assessed as pathological in children. Newborns should not have any obstructive apneas. No generally accepted consensus exists in adults. In an examination of 385 men with SDB, He et al. [194] demonstrated that the mortality risk rises significantly above an apnea index of 20. In our sleep lab we therefore use the following distinction:

mild OSA	$10 \leq$ AHI <20
moderate OSA	$20 \leq$ AHI <40
severe OSA	$40 \leq$ AHI

Below an AHI of 10 it is necessary to make a differential diagnosis between harmless primary snoring and a potentially health-impairing UARS. It should be taken into account that the above values are applicable to 30-year-olds. A 70-year-old patient with a maximum AHI of 15 is not necessarily in need of treatment if he or she does not have any daytime symptoms.

Apart from the AHI, the ailments of the patient play a role. That is, a patient with a UARS and an AHI of significantly below 10, but suffering from intense daytime sleepiness, may already be in need of treatment, whereas an older patient with an AHI of 15 may be fine without treatment. The concomitant diagnoses also need to be taken into account. Since SDB constitutes risk factors for myocar-