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Influence of nasal resistance on oral appliance treatment outcome in obstructive sleep apnea

Biao Zeng, MD, PhD, Andrew T. Ng, MBBS, Jin Qian, MBIomedEng, Peter Petocz, PhD, M. Ali Darendaliler, PhD, Peter A Cistulli, MBBS, PhD
SLEEP 2008; 31 (4): 543 - 547.

Centre for Sleep Health & Research, Department of Respiratory Medicine, Royal North Shore Hospital, University of Sydney, Australia.

It has been recognized that nasal airway resistance (NAR) is elevated in patients with OSA. However, little is known regarding the influence of nasal resistance on mandibular advancement splint (MAS) treatment outcome in OSA patient. We hypothesized that nasal resistance differs between MAS responders and non responders and therefore may influence treatment outcome. Thirty-eight patients with known OSA underwent polysomnography while wearing a custom-made MAS. Treatment outcome was defined as follows: Responders (R) > or =50% reduction in AHI, and Non responders (NR) as <50% reduction in AHI. NAR was measured using posterior rhinomanometry in both sitting and supine positions, with and without MAS. The mean AHI in 26 responders was significantly reduced from 29.0 +/- 2.9/h to 6.7 +/- 1.2/h; P < 0.01). In 12 non responders there was no significant change in AHI (23.9 +/- 3.0/h vs 22.0 +/- 4.3/h; P=ns). Baseline NAR was significantly lower in responders in the sitting position compared to non responders (6.5 +/- 0.5 vs 9.4 +/- 1.0 cm H₂O; P < 0.01). There was no significant change in NAR (from baseline) with MAS in either response group while in the sitting position, but in the supine position NAR increased significantly with MAS in the non responder group (11.8 +/- 1.5 vs. 13.8 +/- 1.6 cm H₂O/L/s; P < 0.01). Logistic regression analysis revealed that NAR and BMI were the most important predictive factors for MAS treatment outcome. **These data suggest that higher levels of NAR may negatively impact on treatment outcome with MAS.**

This study suggests the need for an interdisciplinary approach between ENT Surgeons and Sleep Physicians in treating OSA – a condition demonstrating a multifactorial pathophysiology.

Oral Appliance therapy in Obstructive Sleep Apnea-Hypopnea syndrome - A clinical study on therapeutic outcomes

A Hoekema

PhD thesis, University Medical Centre Groningen Department of Oral and Maxillofacial Surgery. pp 110 (2007)

Background: Oral-appliance therapy is emerging as an alternative to continuous positive airway pressure (CPAP) as therapy for the obstructive sleep apnea-hypopnea syndrome (OSAHS). In clinical practice, however, oral appliances are used primarily for patients who do not respond to CPAP therapy. We hypothesized that an oral appliance is not inferior to CPAP in treating OSAHS effectively.

Method: We randomly assigned 103 OSAHS patients to oral-appliance or CPAP therapy. After eight weeks, treatment effect was assessed with polysomnography. Follow-up review was extended for patients requiring adjustments to therapy and ended with a patient's final polysomnographic evaluation or when a patient discontinued treatment. We then determined the proportion of patients for whom oral-appliance or CPAP therapy was effective. For the difference in effectiveness (oral-appliance minus CPAP therapy), a 95% two-sided confidence interval was calculated. Non-inferiority of oral-appliance therapy was considered established when the lower boundary of this interval exceeded - 25%.

Results: Treatment was effective for 39 of 51 patients using the oral appliance (76.5%) and for 43 of 52 patients using CPAP (82.7%). The lower boundary

Conclusion: **In this randomised parallel trial, oral-appliance therapy was not inferior to CPAP as effective treatment of OSAHS. Subgroup analysis suggested that an oral appliance is particularly indicated for patients with non-severe disease.**

Dental appliance treatment for obstructive sleep apnea

Chan AS, Lee RW, Cistulli PA
CHEST. 2007 Aug; 132(2): 693-9.

Centre for Sleep Health and Research, Royal North Shore Hospital, St Leonards NSW 2065, Australia.

Oral appliances for the treatment of obstructive sleep apnea (OSA) are worn during sleep to maintain the patency of the upper airway by increasing its dimensions and reducing its collapsibility. Oral appliances are a simpler alternative to continuous positive airway pressure (CPAP). Over the last decade, there has been a significant expansion of the evidence base to support the use of oral appliances, with robust studies demonstrating their efficacy. This work has been underpinned by the recognition of the importance of upper airway anatomy in the pathophysiology of OSA. The updated practice parameters of the American Academy of Sleep Medicine now recommend their use for mild-to-moderate OSA, or for patients with severe OSA who are unable to tolerate CPAP or refuse treatment with CPAP. Oral appliances have been shown to have a beneficial impact on a number of important clinical end points, including the polysomnographic indexes of OSA, subjective and objective measures of sleepiness, BP, aspects of neuropsychological functioning, and quality of life. Elucidation of the mechanism of action of oral appliances has provided insight into the factors that predict treatment response and may improve the selection of patients for this treatment modality. Longitudinal studies to characterize the long-term adverse effects of oral appliance use are now beginning to emerge. Although less efficacious than CPAP for improving the polysomnographic indexes of OSA, **oral appliances are generally preferred by patients. This has the potential to translate to better patient adherence and may provide an equivalent health outcome.**

Use of flow-volume curves to predict oral appliance treatment outcome in obstructive sleep apnea

Zeng B, Ng AT, Darendeliler MA, Petocz P, Cistulli PA.
Am J Respir Crit Care Med. 2007 Apr 1;175(7):726-30.

Centre for Sleep Health and Research, Department of Respiratory Medicine, Royal North Shore Hospital, University of Sydney, Sydney, Australia.

Background: It has been recognized that mandibular advancement splint (MAS) treatment is effective in some, but not all, patients with obstructive sleep apnea (OSA). Hence there is a need for a simple and reliable clinical tool to assist in the differentiation of treatment responses. We hypothesized that abnormalities of flow-volume curves, together with other clinical variables, may have clinical utility in the prediction of MAS treatment outcome.

Methods: Fifty-four patients with known OSA underwent MAS treatment. Expiratory and inspiratory flow-volume curves were measured in the erect and supine positions to derive midinspiratory flow (MIF(50)) and the ratio of expiratory to inspiratory flow at 50% of vital capacity (MEF(50):MIF(50)). Multivariable logistic regression was performed to identify additional significant clinical variables in the prediction of treatment outcome.

Results: The mean (\pm SD) apnea-hypopnea index (AHI) in 35 responders was significantly reduced from 28.9 \pm 13.7 to 6.7 \pm 5.8/hour ($p < 0.001$). In 19 nonresponders there was no significant change in AHI. MIF(50) was lower (6.04 \pm 1.80 vs. 6.88 \pm 1.08 L/second; $p = 0.035$) and the MEF(50):MIF(50) ratio was higher (0.82 \pm 0.23 vs. 0.61 \pm 0.15; $p = 0.001$) in responders than nonresponders. Logistic regression analysis revealed that the MEF(50):MIF(50) ratio was the most important predictive factor for MAS treatment outcome, but that body mass index, age, and baseline AHI were also contributory.

Conclusions: **These data suggest that flow-volume curves, in combination with other factors such as body mass index, age, and baseline AHI, may have a useful clinical role in the prediction of treatment outcome with MAS.**

Position paper on the use of mandibular advancement devices in adults with sleep-related breathing disorders

Susanne Schwarting & Ulrich Huebers & Markus Heise & Joerg Schlieper & Andreas Hauschild

Published online: 27 April 2007 # Springer-Verlag 2007

A position paper of the German Society of Dental Sleep Medicine (Deutsche Gesellschaft Zahnärztliche Schlafmedizin, DGZS)

Abstract Custom-made mandibular advancement devices are an effective treatment option for snoring, upper airway resistance syndrome, and obstructive sleep apnea (OSA). Evidence-based data indicates their efficacy, and international sleep societies recommend oral appliance (OA) therapy for patients with sleep-related breathing disorders. The following position paper by the German Society of Dental Sleep Medicine (DGZS) is to guide the interdisciplinary team (sleep physician and sleep disorder dentist) in detail when to prescribe oral appliances. This position paper supports the responsible use of OA as an effective treatment option for patients with sleep-related breathing disorders. The paper advises of proper indication regarding OSA severity, body mass index (BMI), and dentition. **It emphasizes the interdisciplinary approach of oral appliance therapy and suggests treatment under the guidance of dentists trained in dental sleep medicine.**

Oral appliances for obstructive sleep apnoea - Cochrane Database

Lim J, Lasserson TJ, Fleetham J, Wright J.
Cochrane Database Syst Rev. 2006 Jan 25

Royal Surrey County Hospital, Guildford, Surrey, UK.

Background: Obstructive sleep apnoea-hypopnoea (OSAH) is a syndrome characterised by recurrent episodes of partial or complete upper airway obstruction during sleep that are usually terminated by an arousal. Nasal continuous positive airway pressure (CPAP) is the primary treatment for OSAH, but many patients are unable or unwilling to comply with this treatment. Oral appliances (OA) are an alternative treatment for OSAH.

Objectives: The objective was to review the effects of OA in the treatment of OSAH in adults. SEARCH STRATEGY: We searched the Cochrane Airways Group Specialised Register. Searches were current as of June 2005. Reference lists of articles were also searched.

Selection criteria: Randomised trials comparing OA with control or other treatments in adults with OSAH.

Data collection and analysis: Two authors independently extracted data and assessed trial quality. Study authors were contacted for missing information.

Main results: Sixteen studies (745 participants) met the inclusion criteria. All the studies had some shortcomings, such as small sample size, under-reporting of methods and data, and lack of blinding. OA versus control appliances (six studies): OA reduced daytime sleepiness in two crossover trials (WMD -1.81; 95% CI -2.72 to -0.90), and improved apnoea-hypopnoea index (AHI) (-10.78; 95% CI -15.53 to -6.03 parallel group data - five studies). OA versus CPAP (nine studies): OA were less effective than CPAP in reducing apnoea-hypopnoea index (parallel group studies: WMD 13 (95% CI 7.63 to 18.36), two trials; crossover studies: WMD 7.97; (95% CI 6.38 to 9.56, seven trials). However, no significant difference was observed on symptom scores. CPAP was more effective at improving minimum arterial oxygen saturation during sleep compared with OA. In two small crossover studies, participants preferred OA therapy to CPAP. OA versus corrective upper airway surgery (one study): Symptoms of daytime sleepiness were initially lower with surgery, but this difference disappeared at 12 months. AHI did not differ significantly initially, but did so after 12 months in favour of OA.

Authors' conclusions: There is increasing evidence suggesting that OA improves subjective sleepiness and sleep disordered breathing compared with a control. CPAP appears to be more effective in improving sleep disordered breathing than OA.

The difference in symptomatic response between these two treatments is not significant, although it is not possible to exclude an effect in favour of either therapy. Until there is more definitive evidence on the effectiveness of OA in relation to CPAP, with regard to symptoms and long-term complications, **it would appear to be appropriate to recommend OA therapy to patients with mild symptomatic OSAH, and those patients who are unwilling or unable to tolerate CPAP therapy**. Future research should recruit patients with more severe symptoms of sleepiness, to establish whether the response to therapy differs between subgroups in terms of quality of life, symptoms and persistence with usage. Long-term data on cardiovascular health are required.

Practice Parameters for the Treatment of Snoring and Obstructive Sleep Apnea with Oral Appliances: An Update for 2005

Kushida CA; Morgenthaler TI; Littner MR et al.

An American Academy of Sleep Medicine Report —AASM Practice Parameters. An Update for 2005. SLEEP 2006; 29(2): 240-243

These practice parameters are an update of the previously published recommendations regarding use of oral appliances in the treatment of snoring and Obstructive Sleep Apnea (OSA). **Oral appliances (OAs) are indicated for use in patients with mild to moderate OSA who prefer them to continuous positive airway pressure (CPAP) therapy, or who do not respond to, are not appropriate candidates for, or who fail treatment attempts with CPAP.** Until there is higher quality evidence to suggest efficacy, CPAP is indicated whenever possible for patients with severe OSA before considering OAs. Oral appliances should be fitted by qualified dental personnel who are trained and experienced in the overall care of oral health, the temporomandibular joint, dental occlusion and associated oral structures. Follow-up polysomnography or an attended cardiorespiratory (Type 3) sleep study is needed to verify efficacy, and may be needed when symptoms of OSA worsen or recur. Patients with OSA who are treated with oral appliances should return for follow-up office visits with the dental specialist at regular intervals to monitor patient adherence, evaluate device deterioration or maladjustment, and to evaluate the health of the oral structures and integrity of the occlusion. Regular follow up is also needed to assess the patient for signs and symptoms of worsening OSA. Research to define patient characteristics more clearly for OA acceptance, success, and adherence is needed.

Treatment of snoring and obstructive sleep apnea with mandibular repositioning appliances

Peter A. Cistulli, Helen Gotsopoulos, Marie Marklund and Alan A. Lowe

Sleep Med Reviews, Vol 8 Iss 6 pp 427-499 (2004) Copyright © 2005 Elsevier Ltd. All rights reserved.

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Australia, Department of Orthodontics, Umea University, Umea, Sweden, Division of Orthodontics, Department of Oral Health Sciences, Faculty of Dentistry, University of British Columbia, Vancouver, BC, Canada Snoring and obstructive sleep apnea form part of a spectrum of sleep disordered breathing affecting a significant proportion of the general population and particularly the middle aged. The consequences can be severe and even life threatening for both the individual directly affected and those more remotely involved. Adverse sequelae can manifest themselves acutely or in the longer term as a result of obstructive breathing induced hypersomnolence, neurocognitive deficits and cardiovascular abnormalities. The combination of anatomical and neuromuscular risk factors in the pathogenesis of OSA has resulted in a varied approach to its management. One such treatment option is mandibular repositioning appliances (MRA), which mechanically stabilize the airway. Whilst the efficacy of this simple intervention has been rigorously proven quite recently in a significant proportion of patients with varying disease severity, individual patient selection in its application remains uncertain. **Short-term side-effects are common but usually transient,** whilst in the long-term minor permanent adverse developments on the dentition and occlusion have been reported. Considering both the medicolegal implications of snoring and OSA and the increasing popularity of MRA, it is recommended that skilled multidisciplinary respiratory and dental personnel form the primary care team.

Case Control Study in the Treatment of Obstructive Sleep-Disordered Breathing with a Mandibular Protrusive Appliance

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English version revised by Carol Cürten, Freiburg/Br. Received: July 2, 2004; accepted: September 6, 2004

Background: Mandibular protrusive appliances have long been used to treat obstructive sleep apnea/hypopnea syndrome (OSAHS). Their efficacy regarding respiration during sleep varies greatly and remains difficult to predict. In this study the efficacy of a two-splint appliance on nocturnal breathing disorders, sleep profile, and daytime sleepiness were evaluated according to a specially-designed treatment process. **Patients and Methods:** In this study 42 consecutive OSAHS patients who had been fitted with a mandibular protrusive appliance according to a preset treatment regimen were included in a follow-up analysis. The diagnosis and the degree of severity of OSAHS were determined by polysomnography in the sleep laboratory. The treatment regimen was established with the sleep laboratory physician. Treatment regimen included the diagnostic procedure in the sleep laboratory, each patient's dental requirements, the fabrication of the appliance used, and the titration of the mandibular protrusion. After having grown accustomed to the appliance for 24.5 ± 7.8 days, 34 patients underwent overnight polysomnography.

Results: The mean apnea/hypopnea index decreased significantly from 19.6 ± 12.8 to 3.3 ± 7.8 events per hour to 83%; the apnea index also improved significantly, as did minimal oxygen saturation and the desaturation index. Changes in sleep profile did not reach statistical significance; the arousal index ($p < 0.02$) and the subjectively-assessed daytime sleepiness ($p < 0.02$) decreased significantly. A therapeutically-required AHI of below 5 events per hour was achieved in 88.2% of the patients.

Conclusion: **A significant improvement in the respiratory situation of the vast majority of OSAHS patients, particularly in their AHI, can be achieved when one applies the procedural steps* and employs the mandibular protrusive appliance we describe herein.**

* Selection of patients who exhibited BMI < 30, AHI < 25 and good dentition.

Oral appliance therapy reduces blood pressure in obstructive sleep apnea: a randomized, controlled trial

Gotsopoulos H, Kelly JJ, Cistulli PA.
Sleep. 2004 Aug 1;27(5):934-41.

Department of Respiratory & Sleep Medicine, St George Hospital, The University of New South Wales, Sydney Australia.

Study objective: To investigate the short-term effect (4 weeks) of oral appliance therapy for obstructive sleep apnea on blood pressure.

Setting: Multidisciplinary sleep disorders clinic in a university teaching hospital. **PATIENTS:** Sixty-one patients diagnosed with obstructive sleep apnea on polysomnography (apnea hypopnea index ≥ 10 per hour and at least 2 of the following symptoms--daytime sleepiness, snoring, witnessed apneas, fragmented sleep; age > 20 years; and minimum mandibular protrusion of 3 mm).

Intervention: A mandibular advancement splint (MAS) and control oral appliance for 4 weeks each.

Measurements and results: Polysomnography and 24-hour ambulatory blood pressure monitoring were carried out at baseline and following each 4-week intervention period. Patients showed a 50% reduction in mean apnea hypopnea index with MAS compared with the control and a significant improvement in both minimum oxygen saturation and arousal index. There was a significant reduction with the MAS in mean (\pm SEM) 24-hour diastolic blood pressure (1.8 \pm 0.5 mmHg) compared with the control ($P = .001$) but not in 24-hour systolic blood pressure. Awake blood-pressure variables were reduced with the MAS by an estimated mean (\pm SEM) of 3.3 \pm 1.1 mmHg for systolic blood pressure ($P = .003$) and 3.4 \pm 0.9 mmHg for diastolic blood pressure ($P < .0001$). There was no significant difference in blood pressure measured asleep.

Conclusion: Oral appliance therapy for obstructive sleep apnea over 4 weeks results in a reduction in blood pressure, similar to that reported with continuous positive airway pressure therapy.

Effect of oral appliance therapy on upper airway collapsibility in obstructive sleep apnea.

Ng AT, Gotsopoulos H, Qian J, Cistulli PA.
Am J Respir Crit Care Med. 2003 Jul 15;168(2):238-41

Department of Respiratory Medicine, St. George Hospital, Belgrave Street, Kogarah, NSW 2217, Australia.

Oral appliance therapy is emerging as an alternative to continuous positive airway pressure for the treatment of obstructive sleep apnea (OSA). However, its precise mechanisms of action are yet to be defined. We examined the effect of a mandibular advancement splint (MAS) on upper airway collapsibility during sleep in OSA. Ten patients with proven OSA had a custom-made MAS incrementally adjusted during an acclimatization period until the maximum comfortable limit of mandibular advancement was reached. Polysomnography with the splint was then performed. After a 1-week washout period, upper airway closing pressures during sleep (with and without MAS) were determined. Significant improvements with MAS therapy were seen in the apnea/hypopnea index (25.0 \pm 3.1 vs. 13.2 \pm 4.5/hour, $p < 0.03$) and upper airway closing pressure in Stage 2 sleep (-1.6 \pm 0.4 vs. -3.9 \pm 0.6 cm H₂O, $p < 0.01$) and in slow wave sleep (-2.5 \pm 0.7 vs. -4.7 \pm 0.6 cm H₂O, $p < 0.02$) compared with no therapy. **These preliminary data indicate that MAS therapy is associated with improved upper airway collapsibility during sleep.** The mediators of this effect remain to be determined.

Effect of vertical dimension on efficacy of oral appliance therapy in obstructive sleep apnea

Andrew J. Pitsis, M. Ali Darendeliler, Helen Gotsopoulos, Peter Petocz and Peter A. Cistulli

Am. J. Respir. Crit. Care Med. 2002 Sep 15;166 (6): 860-4

Department of Respiratory Medicine, Centre for Sleep Disorders and Respiratory Failure, St. George Hospital, University of New South Wales, Kogarah; Discipline of Orthodontics, Faculty of Dentistry, University of Sydney; and Department of Mathematical Sciences, University of Technology, Sydney, New South Wales, Australia

The aim of this study was to assess the effect of bite opening induced by a mandibular advancement splint (MAS) on efficacy and side effects in the treatment of obstructive sleep apnea. In a randomized crossover fashion, 23 adult patients received either MAS-1 (4 mm of interincisal opening) or MAS-2 (14 mm of interincisal opening) for 2 weeks, followed by the alternate treatment for 2 weeks, with an intervening 1-week washout. Complete response was defined as a resolution of symptoms and a reduction in apnea/hypopnea index (AHI) to less than 5 per hour. Partial response was defined as improved symptoms and a reduction in AHI of 50% or more, with the AHI remaining at a value of 5 or more per hour. Both MAS-1 and MAS-2 produced similar reductions in mean (\pm SEM) AHI from baseline: 21 ± 2 versus 8 ± 1 /hour and 21 ± 2 versus 10 ± 2 /hour, respectively ($p < 0.001$). Either complete response or partial response occurred in 74 and 61% of patients with MAS-1 and MAS-2, respectively. Subjective improvements were reported with both appliances by the majority of patients. Patients preferred MAS-1 (78 versus 22%, $p = 0.007$). **This study suggests that the amount of bite opening induced by MAS does not have a significant impact on treatment efficacy but does have an impact on patient acceptance.**

An individually adjustable oral appliance vs continuous positive airway pressure in mild-to-moderate obstructive sleep apnea syndrome

Randerath WJ, Heise M, Hinz R, Ruehle KH. Klinik Ambrock, Hagen, CHEST. 2002 Aug;122

Germany.

Background: For the treatment of nonsevere obstructive sleep apnea syndrome (OSAS), mandibular advancement devices (MADs) are employed as an alternative to nasal continuous positive airway pressure (CPAP) therapy. However, very few specific data on the effectiveness of MADs in this group of patients are available. We therefore compared an individually adjustable intraoral sleep apnea device (ISAD) that permits movements of the lower jaw in three dimensions, with CPAP in the treatment of patients with an apnea/hypopnea index (AHI) $<$ or $=$ 30/h.

Methods: In a randomized crossover study, 16 men and 4 women (mean \pm SD age, 56.5 \pm 10.2 years; body mass index, 31.2 \pm 6.4; AHI, 17.5 \pm 7.7/h) were treated for 6 weeks with each modality.

Results: In the initial phase, a significant improvement in AHI (baseline, 17.5 \pm 7.7/h; ISAD, 10.5 \pm 7.5/h [$p < 0.05$]; CPAP, 3.5 \pm 2.9/h [$p < 0.01$]) and in breathing-related arousals (baseline, 8.9 \pm 6.1/h; ISAD, 3.7 \pm 3.3/h [$p < 0.01$]; CPAP, 1.4 \pm 1.6/h [$p < 0.01$]) was achieved with both modalities. Considering all 20 subjects, after 6 weeks of treatment, normalization of the respiratory parameters was seen only with CPAP. However, 30% of the patients had a lasting reduction in AHI to $<$ 10/h with the ISAD also. The patients considered the ISAD to be easier to use (scale of 1 to 6: ISAD, 1.8 \pm 1.1; CPAP, 3.1 \pm 1.5 [$p < 0.05$]), and indicated greater utilization of the device in comparison with CPAP.

Conclusion: Even in patients with mild-to-moderate OSAS, CPAP is the more effective long-term treatment modality. **In the individual case, the better compliance seen with the ISAD may be advantageous.**

4-year follow-up of treatment with dental appliance or uvulopalatopharyngoplasty in patients with obstructive sleep apnea: a randomized study.

Walker-Engström ML, Tegelberg A, Wilhelmsson B, Ringqvist I.
CHEST. 2002 Mar;121(3):739-46.

Center for Clinical Research, Central Hospital, Västerås, Uppsala University, Sweden.

Study objectives: To evaluate the effects of treatment with a dental appliance or uvulopalatopharyngoplasty (UPPP) on somnographic variables in patients with mild-to-moderate obstructive sleep apnea (OSA) followed up for 4 years, and compliance and complementary treatment. DESIGN: Randomized study.

Patients: Ninety-five male patients with confirmed mild-to-moderate OSA (apnea index [AI] > 5 and < 25) were randomized to treatment with a dental appliance or UPPP. Sleep studies were performed before and 1 year and 4 years after intervention. Thirty-two patients in the dental-appliance group and 40 patients in the UPPP group completed the 4-year follow-up.

Results: The success rate (percentage of patients with at least 50% reduction in AI) in the dental-appliance group was 81%, which was significantly higher than in the UPPP group, 53% ($p < 0.05$). Normalization (AI < 5 or apnea/hypopnea index < 10) was observed in 63% of the dental-appliance group and 33% of the UPPP group after 4 years. The difference between the groups was significant ($p < 0.05$). The compliance to use of the dental appliance was 62% at the 4-year follow-up. Thirty patients (75%) in the UPPP group continued without complementary treatment. The dental appliances had few adverse effects on the stomatognathic system, and the number of adjustments and repairs of the appliances over time was moderate. Pronounced complaints of nasopharyngeal regurgitation of fluid and difficulty with swallowing after UPPP were reported by 8% and 10%, respectively.

Conclusions: The dental-appliance group showed significantly higher success and normalization rates regarding the somnographic variables compared to the UPPP group, but the effectiveness of the dental appliance was partly invalidated by the compliance of 62% at the 4-year follow-up. However, the appliances had few adverse effects on the stomatognathic system and required only moderate adjustments. **Use of a dental appliance with regular follow-up can be recommended for long-term treatment of OSA.**

Oral appliance therapy improves symptoms in obstructive sleep apnea: A randomised, controlled trial

Helen Gotsopoulos, Carol Chen, Jin Qian and Peter A. Cistulli
Am. J. Respir. Crit. Care Med., Vol 166. pp. 743-748, (2002) © 2002 American Thoracic Society

Department of Respiratory Medicine, Centre for Sleep Disorders and Respiratory Failure, St. George Hospital, University of New South Wales, Kogarah, Australia

The aim of this study was to evaluate the effect of a mandibular advancement splint (MAS) on daytime sleepiness and a range of other symptoms in obstructive sleep apnea (OSA). Using a randomized crossover design, patients received 4 weeks of treatment with MAS and a control device (inactive oral appliance), with an intervening 1-week washout. At the end of each treatment period, patients were reassessed by questionnaire, polysomnography, and multiple sleep latency test. Fifty-nine men and 14 women with a mean (\pm SD) age of 48 ± 11 years and proven OSA experienced a significantly improved mean (\pm SEM) sleep latency on the multiple sleep latency test (10.3 ± 0.5 versus 9.1 ± 0.5 minutes, $p = 0.01$) and Epworth sleepiness scale score (7 ± 1 versus 9 ± 1 , $p < 0.0001$) with the MAS compared with the control device after 4 weeks. The proportion of patients with normal subjective sleepiness was significantly higher with the MAS than with the control device (82 versus 62%, $p < 0.01$), but this was not so for objective sleepiness (48 versus 34%, $p = 0.08$). Other OSA symptoms were controlled in significantly more patients with the MAS than with the control device. **MAS therapy improves a range of symptoms associated with OSA.**

A randomised, controlled study of a mandibular advancement splint for obstructive sleep apnea

Atul Mehta, Jin Qian, Peter Petocz, M. Ali Darendeliler, And Peter A. Cistulli
Am. J. Respir. Crit. Care Med., Volume 163, Number 6, May 2001, 1457-1461

Centre for Sleep Disorders and Respiratory Failure, Department of Respiratory Medicine, St George Hospital, University of New South Wales, Discipline of Orthodontics, Faculty of Dentistry, University of Sydney, and School of Mathematical Sciences, University of Technology, Sydney, Australia

Although there is increasing interest in the use of oral appliances to treat obstructive sleep apnea (OSA), the evidence base for this is weak. Furthermore, the precise mechanisms of action are uncertain. We aimed to systematically investigate the efficacy of a novel mandibular advancement splint (MAS) in patients with OSA. The sample consisted of 28 patients with proven OSA. A randomized, controlled three-period (ABB/BAA) crossover study design was used. After an acclimatization period, patients underwent three polysomnographs with either a control oral plate, which did not advance the mandible (A), or MAS (B), 1 wk apart, in either the ABB or BAA sequence. Complete response (CR) was defined as a resolution of symptoms and a reduction in Apnea/Hypopnea Index (AHI) to $< 5/h$, and partial response (PR) as a 50% reduction in AHI, but remaining $5/h$. Twenty-four patients (19 men, 5 women) completed the protocol. Subjective improvements with the MAS were reported by the majority of patients (96%). There were significant improvements in AHI ($30 \pm 2/h$ versus $14 \pm 2/h$, $p < 0.0001$), MinSaO_2 ($87 \pm 1\%$ versus $91 \pm 1\%$, $p < 0.0001$), and arousal index ($41 \pm 2/h$ versus $27 \pm 2/h$, $p < 0.0001$) with MAS, compared with the control. The control plate had no significant effect on AHI and MinSaO_2 . CR ($n = 9$) or PR ($n = 6$) was achieved in 62.5% of patients. **The MAS is an effective treatment in some patients with OSA, including those patients with moderate or severe OSA.**

Treatment of obstructive sleep apnea syndrome by rapid maxillary expansion

Cistulli PA, Palmisano RG, Poole MD.
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The precise role of maxillary constriction in the pathophysiology of obstructive sleep apnea (OSA) is unclear. However, it is known that subjects with maxillary constriction have increased nasal resistance and resultant mouth-breathing, features typically seen in OSA patients. Maxillary constriction is also associated with alterations in tongue posture which could result in retroglossal airway narrowing, another feature of OSA. Rapid maxillary expansion (RME) is an orthodontic treatment for maxillary constriction which increases the width of the maxilla and reduces nasal resistance. The aim of this pilot study was to investigate the effect of rapid maxillary expansion in OSA. We studied 10 young adults (8 male, 2 female, mean age 27 ± 2 [sem] years) with mild to moderate OSA (apnea/hypopnea index-AHI 19 ± 4 and minimum SaO_2 $89 \pm 1\%$), and evidence of maxillary constriction on orthodontic evaluation. All patients underwent treatment with RME, six cases requiring elective surgical assistance. Polysomnography was repeated at the completion of treatment. Nine of the 10 patients reported improvements in snoring and hypersomnolence. There was a significant reduction in AHI (19 ± 4 vs 7 ± 4 , $p < 0.05$) in the entire group. In seven patients, the AHI returned to normal (i.e., < 5); only one patient showed no improvement. **These preliminary data suggest that RME may be a useful treatment alternative for selected patients with OSA.**



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