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Assessment of obstructive sleep apnoea treatment success or failure after maxillomandibular advancement

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Abstract. Maxillomandibular advancement (MMA) is an alternative therapeutic option that is highly effective for treating obstructive sleep apnoea (OSA). MMA provides a solution for OSA patients that have difficulty accepting lifelong treatments with continuous positive airway pressure or mandibular advancement devices. The goal of this study was to investigate the different characteristics that determine OSA treatment success/failure after MMA. The apnoea–hypopnoea index (AHI) was used to determine the success or failure of OSA treatment after MMA. Sixty-two patients underwent MMA for moderate and severe OSA. A 71% success rate was observed with a mean AHI reduction of 69%. A statistically significant larger neck circumference was measured in patients with failed OSA treatments following MMA ($P = 0.008$), and older patients had failed OSA treatments with MMA: 58 vs. 53 years respectively ($P = 0.037$). Cephalometric analysis revealed no differences between successful and failed OSA treatment outcomes. There was no difference in maxillary and mandibular advancements between success and failed MMA-treated OSA patients. The complications most frequently reported following MMA were sensory disturbances in the inferior alveolar nerve (60%) and malocclusion (24%). The results suggest that age and neck girth may be important factors that could predict susceptibility to OSA treatment failures by MMA

Key words: complication; maxillomandibular advancement; obstructive sleep apnoea; OSA.

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Obstructive sleep apnoea (OSA) is a chronic sleep breathing disorder that is becoming a major problem in national and international healthcare. For example in the United States the prevalence of OSA in general population is estimated between 9–38% and is higher in men, in older patients, and in patients with high body mass index (BMI)[1]. OSA severity is classified using the apnoea–hypopnoea index (AHI; events/hour), which is assessed using a polysomnography (mild OSA, AHI >5–15; moderate OSA, AHI > 15–30; severe OSA, AHI >30). The present treatment guidelines may include a mandibular advancement device (MAD) and continuous positive airway pressure (CPAP) for treating patients with OSA[2]. Maxillomandibular advancement (MMA) is an alternative therapeutic option that is highly effective for treating patients with OSA and is currently performed on a relatively small scale. Our first 10 patients were described in a report in 2013[3]. MMA provides a solution for OSA patients that have difficulty accepting lifelong treatments with CPAP or MAD. The combination of a Le Fort I osteotomy with a bilateral sagittal split osteotomy (BSSO) creates significant enlargement of the pharyngeal airway space[4]. Therapeutic success is defined according to Sher et al.[5] as postoperative AHI changes that decreased beyond 50% and <20 events/hour. MMA has demonstrated satisfactory reductions in mean AHI from 63.9 to 9.5 events/hour with a pooled surgical success rate of 86% and an OSA cure rate of 43%[6]. However, whether MMA is a success depends on more than just a decrease in AHI. For physicians working in the field of OSA, MMA is regarded as a very invasive procedure and is therefore only indicated as a last resort.

Detailed information regarding the advantages of MMA procedures is available but not on the disadvantages and complications; it is therefore unknown which variables are of influence in patient selection and what complications and side effects should be considered for predicting success or predisposition to failure in relation to OSA therapy. This investigation aims to identify which variables could influence the rate of OSA treatment failure after MMA procedures. It seems that in approximately 10–20% of OSA cases treated with MMA that AHI was not successfully decreased after surgery[7]. It is currently unknown which preoperative patient-related factors could be of importance in the selection of adequate patients for achieving OSA treatment success. Recently Zaghi et al.[7] showed that the pre-operative severity of OSA was the most reliable predictor of outcome. More specifically, the most severe cases of OSA tend to benefit most after MMA in decreasing AHI, but the cure rate was only 20% among patients with a preoperative AHI of >90 events/hour. Patients with a preoperative AHI of <30 events/hour showed cure in 56% and thus showed a higher chance for success.

MMA is a routine procedure performed in many centres in patients without OSA. In those patients the most common complications and side effects are well known (e.g. sensory disturbances from the inferior alveolar nerve) and the risk for developing complications are discussed in detail with these patients to ensure adequate patient information briefing. Studies that present large cohorts of patients treated with MMA for OSA show detailed polysomnographic results and symptom relief measured by the Epworth Sleeping Scale (ESS) or the Functional Outcome Sleep Questionnaire (FOSQ), but are inadequate in providing data on side effects and complications after MMA[8–10]. This lack of information makes evidence-based decision-making difficult in patients with OSA and it is relatively unclear what role MMA has in the guideline for OSA treatment.

The aims of this study were to identify factors that could predispose MMA failure in OSA patients and to present the findings of our centre's experience regarding complications and assessments of factors that could elicit surgical failures in relation to MMA surgery. In order to identify factors that determine the success or failure of OSA patient treatment by MMA a detailed preoperative work-up including AHI, cephalometric analysis, physical examination including neck girth measurements, as well as postoperative information on AHI, complications and side effects were analysed.

Materials and methods

The data for this single-centre observational study was obtained from patients admitted between 2011 and 2015 for elective MMA therapy for moderate and severe OSA. The institutional medical ethics review board of the Academic Medical Centre of the University of Amsterdam reviewed the research proposal and study procedures and granted permission to collect data and questionnaires (Project no. W16_006). All participants registered in this investigation's database received a detailed explanation of the study guidelines and procedures and written informed consent was obtained. This investigation was conducted in accordance with the principles established in the Declaration of Helsinki (Fortaleza, October 2013).

Study participants

Patients with moderate or severe OSA referred to the Department of Oral & Maxillofacial Surgery of the Academic Medical Centre of the University of Amsterdam for elective MMA reconstruction procedures were eligible for participation in this study. Preoperative (baseline) patient data included gender, age, BMI (kg/m^2), neck circumference (cm), AHI, and comorbidities (e.g. diabetes mellitus, smoking) represented through ASA-score.

Cephalometric work-up

Preoperative (baseline) and postoperative cephalometric analysis was performed using skeletal landmarks that include the sella (S), nasion (N), A-point (A), B-point (B), and posterior airway space (PAS; distance between the base of the tongue and the posterior pharyngeal wall, derived from a line connecting B-point to gonion in millimetres). The following reference lines were placed on all cephalometric tracings to create descriptive linear measurements of interest, a constructed horizontal plane (S–N line, 7°) and *x*-axis (vertical at S, perpendicular to constructed horizontal plane). Using points S, N, A, and B, the maxilla mandible and the skeletal relationship between maxilla and mandible was computed. SNA indicates whether or not the maxilla is normal, prognathic, or retrognathic. SNB assesses the mandible in a similar way (normal, prognathic, and retrognathic) and ANB defines the skeletal relationship as a class I (+2 degrees), class II (+4 degrees or more) or class III (0 or negative). The distance between points A and B was measured with respect to the *x*-axis (Ax and Bx) to assess the horizontal movement of the maxilla and the mandible. Similarly, the distance of points A and B to the constructed horizontal plane was measured (Ax′) to assess the vertical movement of the maxilla (see Fig. 1).

Polysomnography

Standard polysomnographic evaluation pre- (baseline) and postoperative was based on electroencephalography, electro-oculography, chin and leg electromyography, and electrocardiography.

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