Evaluation of Mandibular Wing Osteotomy in Obstructive Sleep Apnea Cases with Retrognathia

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Abstract

Objective The aim of this study is to evaluate the efficacy of wing osteotomy for treating obstructive sleep apnea (OSA).

Materials and Methods We performed mandibular wing osteotomy in subjects who had an apnea-hypopnea index (AHI) of more than 15, a previous unresponsive conservative treatment for the OSA, moderate to severe retrognathia and no suggested conventional orthognathic surgery because of dentition or lack of willingness. The subjects were evaluated using the Epworth Sleepiness Scale (ESS), AHI and posterior airway space (PAS) before and 1 year after surgery.

Results We evaluated 10 subjects (4 males, 6 females) who underwent wing mandibular osteotomy. The mean age of the subjects was 37.8 ± 7.26 years. Analysis of the data demonstrated a significant change in ESS and AHI 1 year after operation. However, PAS was not changed 1 year after surgery. Results did not show any correlation between age, ESS and AHI before and 1 year after surgery.

Conclusion Mandibular wing osteotomy is a novel procedure that improves signs of OSA. It may be a surgical option in retrognathic patients with OSA who are not candidates for conventional maxillomandibular advancement.

Keywords Obstructive sleep apnea · Mandible · Wing osteotomy · Epworth Sleepiness Scale

Introduction

Surgery is an effective treatment option when applicable conservative therapies are unsuccessful or intolerable for patients with a facial deformity that contributes to obstructive sleep apnea (OSA) [1]. Surgical procedures include: uvulopalatopharyngoplasty, laser midline glossectomy and lingualplasty to reduce the size of a bulky tongue and therefore increase the space behind the tongue for breathing, inferior sagittal mandibular osteotomy and genioglossal advancement with hyoid myotomy and suspension, maxillomandibular osteotomy and advancement, and tracheotomy. Phase I treatment refers to all procedures with the lowest morbidity, major surgical options are considered during phase II treatment. Phase I treatment options are quite varied, and the choice of which one or ones to use is based on the anatomic source suspected by the clinician. Phase I treatment might consist of a septoplasty or a genial osteotomy. Continuous positive airway pressure (CPAP) is almost always initiated as part of first-line treatment of OSA and has been the mainstay of therapy for decades. Phase II procedures generally affect multiple areas over a larger cross-section of the airway at one time and represent the best opportunity to effectively treat the disease process occurring throughout the airway [1].

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In the early 1980s several studies reported improvement in polysomnographic parameters in patients treated with mandibular osteotomy with advancement [2, 3]. Advancement of the anterior mandible with the attached genial musculature, when done in combination with a hyoid bone suspension, has been shown to dramatically relieve the retrolingual obstruction in patients suffering from OSA [4]. Mandibular wing osteotomy is an innovative surgical approach to correct retrognathia in patients who have not undergone conventional orthognathic surgery. Triaca A introduced the mandibular wing osteotomy in 2009 [5]. Although wing osteotomy provides good aesthetic results in OSA patients, it is questionable. The aim of the study is to evaluate the efficacy of wing osteotomy for treating OSA.

Materials and Methods

This is a prospective study. The study sample was derived from the population of OSA patients who presented to the Department of Oral and Maxillofacial Surgery. The research committee of the medical ethics group of Shiraz Medical Science University approved this study. Subjects eligible for study had an apnea-hypopnea index (AHI) of more than 15, a previous unresponsive conservative treatment for the OSA, moderate to severe retrognathia and no suggestion of conventional conventional maxillomandibular advancement because of dentition or lack of willingness. Subjects were excluded from the study if they had a previous maxillomandibular advancement surgery, a previous orthodontic treatment or were candidates for orthognathic surgery. A consent form was signed by all subjects.

An otolaryngologist visited subjects for ruling out nasal problems or pathological problems in the upper airway. Conventional radiographies were taken for each subject consisting of OPG and lateral cephalometry in one center. Lateral cephalometries standardized by obtaining films at both end-tidal volume (ETV) and during a modified Mueller manoeuvre (forced inspiration against a closed mouth and nose, to simulate UA collapse associated with negative inspiratory forces generated during OSA events). Posterior airway space (PAS) was measured before surgery and a final evaluation after 1 year. We evaluated the subjects using Epworth Sleepiness Scale (ESS), AHI and PAS before and 1 year after surgery (Fig. 1). All complications during and after surgery were documented.

Surgical Approach

We made an incision from the ramus of the mandible to the contralateral ramus. A horizontal bicortical chin osteotomy

Epworth Sleepiness Scale

Name: _____

Date: _____

Your age: (Yr) _____ Your sex: ☐ Male ☐ Female

How likely are you to doze off or fall asleep in the situations described below, in contrast to feeling just tired?

This refers to your usual way of life in recent times.

Even if you haven't done some of these things recently try to work out how they would have affected you.

Use the following scale to choose the most appropriate number for each situation:

0 = Would never doze
1 = Slight chance of dozing
2 = Moderate chance of dozing
3 = High chance of dozing

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

Score:

0-10 Normal range

10-12 Borderline

12-24 Abnormal

Fig. 1 The Epworth Sleepiness Scale is a self-reported questionnaire that can be used to confirm pathologic sleepiness and validate post treatment improvement in patients with OSA. A score above 10 is considered to be abnormal

was performed about 1 cm anterior to the mental foramen. The bicortical horizontal osteotomy became a monocortical vertical osteotomy. The osteotomy was completed below the estimated path of the inferior alveolar nerve with a saw positioned in a sloping direction from superior to inferior. The osteotomy line extended posteriorly to the ramus and finished at the lower border of the angle of the mandible. The osteotomy segment was mobilized using two large chisels, taking particular care to avoid the fracture around the mental foramen. An autologous iliac crest graft was then placed to fill the region of the gap and the cut fragment of bone was fixed in the correct position (Fig. 2).

Statistical Analyses

The statistical analyses were performed using the statistical package SPSS for Pc, version 19 (IBM, USA). A Pearson's correlation test was used to evaluate the correlation between age, AHI, PAS and ESS before and after the operation. We used the paired sample t test to assess changing ESS, PSA and AHI after osteotomy.

Fig. 2 **a** A 48 year-old female with moderate OSA and previous chin augmentation with silastic. **b** Lateral cephalometry view shows retrognathia with resorption of chin due to alloplast. **c** 3-D CT scan view of the patient. **d** Lateral cephalometry view of the patient after wing osteotomy. **e** Patient's 3-D CT scan view after wing osteotomy. **f** Patient's profile view 4 months after wing osteotomy. **g** Intraoral view of the patient after finishing of the osteotomy

Table 1 The subjects' information and data

Study variables	Pre-operation	Post-operation	Paired t test
ESS	16.5 ± 1.64	10.70 ± 1.76	$P < 0.001$
AHI	19.9 ± 2.60	12.2 ± 2.25	$P < 0.001$
PAS (mm)	9.93 ± 1.01	10.3 ± 1.09	$P > 0.005$

Table 2 Descriptive of the study

Study variables	Descriptive
Age (years)	37.8 ± 7.26
Sex	4 Males, 6 Females
ESS	Pre-operation: 16.5 ± 1.64, post-operation: 10.70 ± 1.76
AHI	Pre-operation: 19.9 ± 2.60, post-operation: 12.2 ± 2.25
PAS (mm)	Pre-operation: 9.93 ± 1.01, post-operation: 10.3 ± 1.09

Results

We evaluated 10 subjects (4 males, 6 females) who underwent wing mandibular osteotomy (Table 1). The mean age of the subjects was 37.8 ± 7.26 years (Table 2). Results demonstrated that ESS was 16.5 ± 1.64 before operation and 10.70 ± 1.76 by 1 year after surgery. The mean of ESS change was 6 ± 2.74 . Assessment of the results did not demonstrate any correlation between age and ESS change ($P > 0.05$). Analysis of the data showed a significant difference between pre and post operation ESS ($P < 0.001$). The mean of pre operation AHI was 19.9 ± 2.60 and 1 year after operation was 12.2 ± 2.25 . The mean of AHI change was 8.4 ± 2.67 . Assessment of the data did not show any correlation between age and AHI ($P > 0.05$). AHI was significantly changed 1 year after surgery ($P < 0.001$). The mean of PAS was 9.93 ± 1.01 in pre-operation and 10.3 ± 1.09 in 1 year after operation

(Table 2). Evaluation of the data did not show any significant changing in PAS after operation ($P > 0.05$). The surgical complications consisted of paraesthesia (20 %) after 1 year and one bad split during the osteotomy which was fixed using a miniplate. Infection or dehiscence was not seen after any operation.

Discussion

We investigated the efficacy of mandibular wing osteotomy during the phase I treatment in OSA patients. Mandibular wing osteotomy is an innovative approach to correct retrognathia without changing the occlusion. The goal of surgical treatment for OSA syndrome is to enlarge the velo-oropharyngeal airway by anterior/lateral displacement of the soft tissues and musculature by maxillary, mandibular, and genioglossus advancement [6]. Anterior reposition of the mandibular base can pull soft tissues into a forward position that is hypothesized to increase airway.

Our study showed that the ESS score and AHI decreased after surgery in all subjects. Institute for Clinical Systems Improvement (ICSI) states that a diagnosis of mild OSA requires an AHI score of 5–15; AHI scores of 16–30 indicate moderate OSA; and those greater than 30 indicate severe OSA [1]. Results of our study demonstrated a partial improvement in OSA because of AHI >5. However, wing osteotomy did not have any effect on PAS. It can be hypothesized that a forward pulling of geniohyoid muscles was responsible for improvement.

It is well documented that a maxillomandibular advancement improves OSA [7, 8]. The effect of genioplasty on OSA has been studied [9], but no study has investigated the mandibular wing osteotomy in OSA patients. Generally, genioplasty was done in conjunction with other treatment options such as a maxillomandibular advancement [10, 11]. It is believed that the advancement of the mandibular base can pull geniohyoid muscles in a forward position and improve airway patency in patients

Table 3 Comparison of ESS, AHI and PAS before surgery and 1 year after operation

Case	Age	Sex	Pre.ESS	Post.ESS	Pre.AHI	Post.AHI	Pre.PAS	Post.PAS
1	36	F	18	9	25	14	9.8	9.8
2	41	M	16	10	22	9	9	9.5
3	28	F	19	8	20	12	11	12
4	49	F	15	10	18	12	10	9
5	34	M	18	12	18	10	12	12
6	42	F	16	12	20	12	9	10
7	28	F	18	10	22	16	10.5	10
8	35	M	16	14	20	15	9	9.5
9	48	F	14	10	16	10	10	9.5
10	37	M	15	12	18	12	9	9

with retrognathia. Senato et al. studied polysomnography, physical examination and cephalometric analysis in 10 non-obese patients, who presented with mild or moderate OSA, an apnea-hypopnea index (AHI) between 5 and 30, hypopharynx obstruction and mandibular retrognathia. They concluded that genioplasty for genioglossus advancement seemed to reduce OSA signs, so it is a surgical treatment option in patients with hypopharynx obstruction [12]. Riley et al. [13] studied 55 patients with OSA following inferior mandibular osteotomy with hyoid myotomy and suspension. Patients were objectively examined by a polysomnography before and 6 months following the surgical procedure. Thirty-seven patients (67 %) had a good response to surgery, and 18 patients (33 %) were considered non responders. Lung disease, mandibular deficiency, and obesity affected the success of surgical treatment. The main concept of this procedure is a forward advancement of the anteroinferior aspect of the mandible with its associated musculature while maintaining continuity of the mandible. This allows repositioning the segment attached to the genioglossus more anteriorly, forward advancing the tongue base, and improving the hypopharyngeal airway [1].

Mandibular wing osteotomy provides maximal mandibular base advancement and more stable operation because of bone graft. In conclusion, mandibular wing osteotomy is a novel procedure that improves signs of OSA. It is a surgical option in retrognathic patients with OSA who are not candidates for conventional maxillo-mandibular advancement (Table 3).

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