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Original Research

Prediction of pharyngeal airway changes in skeletal class III deformity patients after orthognathic surgery

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ABSTRACT

Background: Pharyngeal airway changes after orthognathic surgery in skeletal class III patients have been of concern because of the effects on breathing function.
Objectives: The aim of this study was to evaluate the pharyngeal airway changes in patients with skeletal class III deformity who underwent orthognathic surgery.
Materials and methods: Thirty-two patients who underwent orthognathic surgery at Oral and Maxillofacial Surgery Department, Mahidol University, Thailand were included in this study. The subjects were divided in two groups: group 1 underwent mandibular setback (19 patients) and group 2 underwent bimaxillary surgery (13 patients). Lateral cephalogram was taken 3 times: preoperation (T0), immediate postoperation (T1) and 6 months postoperation (T2).
Results: The mean amount mandibular setback for group 1 and group 2 were 7.3 mm and 6.5 mm, respectively. The mandibular setback group demonstrated significant decrease in pharyngeal airway dimension at both retropalatal and retrolingual level as well as oropharyngeal area. On the other hand, the bimaxillary surgery group showed no significant decrease but increase at retropalatal level. The linear regression analysis suggested that the change in C3-B distance can be a predictor for pharyngeal airway change in mandibular setback group ($r = 0.789$, $p < 0.01$).
Conclusion: Bimaxillary surgery clearly demonstrated better control on the pharyngeal airway than mandibular setback group in skeletal class III patients.

1. Introduction

Orthognathic surgery is the method to treat dentofacial deformities. Changes of pharyngeal airway have been observed following orthognathic surgery in skeletal class III patients [1,2]. Mandibular setback surgery can narrow the pharyngeal airway space (PAS) [3–6] and change the hyoid and tongue's position. Moreover, mandibular setback has been reported to be a risk to induce obstructive sleep apnea (OSA) in some patients [4,5]. The pharyngeal region has a complex musculature system. Muscles in this area do not act independently but rather act together to preserve airway equilibrium. Recently, numerous studies have examined the effects of the pharyngeal airway after orthognathic surgery in skeletal class III patients. But the predictions of pharyngeal airway changes have not been well studied.

The aim of this study was to evaluate the pharyngeal airway changes in patients with skeletal class III deformity who underwent orthognathic surgery and to establish a prediction of the pharyngeal airway changes.

2. Materials and methods

The authors conducted an observational study to retrospectively evaluate the measurements on cephalometric radiographs of class III deformity patients who underwent orthognathic surgery. The cephalometric radiographs were taken 3 times: before surgery (T0; within 1 year of surgery), immediately after surgery (T1); within 1 week of surgery), and at least 6 months after surgery (T2).

All the skeletal class III patients who underwent orthognathic surgery at Oral Maxillofacial Surgery Department, Faculty of Dentistry, Mahidol University, Thailand during the period from January

☆ Asian AOMS: Asian Association of Oral and Maxillofacial Surgeons; ASOMP: Asian Society of Oral and Maxillofacial Pathology; JSOP: Japanese Society of Oral Pathology; JSOMS: Japanese Society of Oral and Maxillofacial Surgeons; JSOM: Japanese Society of Oral Medicine; JAMI: Japanese Academy of Maxillofacial Implants.

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2010 to March 2013 with complete records and good quality cephalometry are included in the study.

All patients underwent either mandibular setback or bimaxillary surgery. All patients received the same treatment with regard to the surgical technique: Le Fort I osteotomy to allow maxillary movement and bilateral sagittal osteotomy of the mandibular ramus to allow mandibular movement. Operations were performed under general anesthesia with rigid internal fixation using titanium plates and screws. The post-operative dexamethasone is used for all patients after orthognathic surgery to control edema. The dexamethasone is normally administered for 3 days postoperation: first day – 8 mg IV q8 h; second day – 4 mg IV q8 h; and third day – 2 mg IV q8 h.

2.1. Inclusion criteria

To be included in the present study, the subjects are required to be healthy and must have underwent orthognathic surgery to correct skeletal deformities.

2.2. Exclusion criteria

Patients will be excluded if they had undergone only genioplasty, surgically assisted rapid palatal expansion alone, or had undergone previous orthognathic surgery, or had a craniofacial congenital anomaly that affected the airway.

2.3. Data collection method

Cephalometric radiographs were performed using a standardized technique by Oral and Maxillofacial Radiology Department, Faculty of Dentistry, Mahidol University with the jaws in centric occlusion, the lips relaxed, the head in the natural position, and the cephalostat in Frankfort horizontal. The cephalograms were taken at the end of expiration after swallowing.

The data collection method was performed in three steps. All cephalometric radiographs were traced manually on acetate paper by the same person and were scanned. Before digitizing, all tracings and landmarks were verified by a senior. The landmarks were digitized, and all variables were measured and analyzed by Image J computer software (National Institutes of Health, USA). The magnification factor was taken into account for each cephalometric radiograph.

2.4. Measurements

The craniofacial landmarks are selected to study the position of maxilla, mandible and related structures to the skull and cervical vertebra as described in previous studies [7].

Seven degrees to the Sella-Nasion (SN) plane through Sella point was taken as the horizontal reference plane (HR) and perpendicular to HR through S point was taken as the vertical reference plane (VR) (Fig. 1) [8]. The magnitude of horizontal and vertical changes was measured according to HR and VR to evaluate the skeletal movement of maxilla (Anterior Nasal Spine (ANS) and A) and mandible (B and Pg) [9]. Positive values were set to anterior and inferior movements.

The conventional cephalometric measurements were done. The cervical vertebra changes were evaluated by 6 measurements (Fig. 1). The pharyngeal airway dimensions were measured at 3 levels: nasopharynx (Pm-UPW), oropharynx (U-MPW), and hypopharynx (V-LPW), as well as the greatest constriction at retrolingual (PAS-t) and retropalatal (PAS-p) level (Fig. 2; Table 1). Vertical airway length (VAL) was measured as a distance between Pm and V. Areas of pharyngeal airway were measured at retropalatal, retrolingual and oropharyngeal regions (Fig. 3).

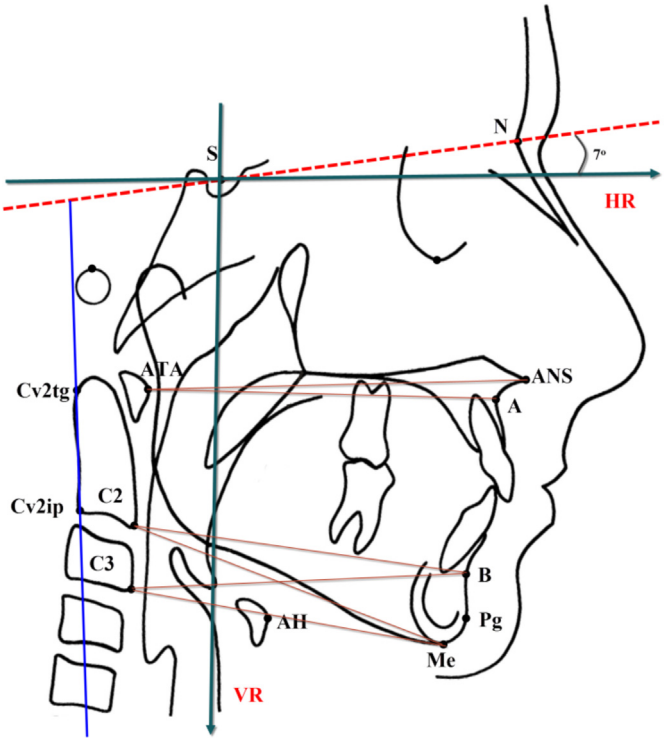

Fig. 1. Reference lines and cervical vertebra measurements. Illustration of analysis method done on cephalometric data by Image J software. Seven degrees to the Sella-Nasion (SN) plane through Sella point was taken as the horizontal reference plane (HR) and perpendicular to HR through S point was taken as the vertical reference plane (VR). The cervical vertebra changes were evaluated by 6 measurements. First cervical vertebra: ANS-ATA, A-ATA; Second cervical vertebra: C2-B, C2-Me; Third cervical vertebra: C3-B, C3-Me.

2.5. Statistical method

Random 15 cephalometric radiographs were retraced and remeasured after 1 month by the same investigators. The reliability of the measurement was evaluated. The results were calculated using SPSS statistical software version 18.0.

Descriptive statistics including the mean, standard deviation and percentage were computed. The normality of data was tested by Kolmogorov–Smirnov test.

Dependent T test was used to evaluate the changes in paired parameters in each group. The correlation between the airway changes and surgical movement was evaluated by Pearson and Spearman's rank test. The regression analyses were done to study the prediction model of the airway changes.

3. Results

Thirty-two patients were included in this study. Among them 23 patients were male and 9 patients were female. Mandibular set back was done in 19 patients and bimaxillary surgery was done in 13 patients. The mean age of the participants was 27 years. The mean Body Mass Index (BMI) was 20.92 ± 2.96.

3.1. Reliability

The correlation coefficient revealed that the repeatability for lateral cephalometric measurements is on average 96.2% (range