

An acoustical analysis of the effects of maxillary sinus augmentation on voice quality

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Objective. Increased experience in sinus lifting procedures has led to a number of literature reports, but the potential effects of sinus lifting on voice quality is not clearly addressed in clinical studies. The aim of this study was to objectively investigate the effects of sinus lifting on alterations in voice quality and, in particular, on vocal resonance.

Study Design. A total of 17 patients who were in need of bilateral sinus augmentation were recruited. Acoustic analyses were performed before and after surgery. Volume changes in the sinuses were recorded before and after surgery using dental volumetric tomography. The Friedman test with Bonferroni correction was used to analyze the data.

Results. Changes in the perturbation parameters of acoustic sound analysis were found to be statistically significant.

Conclusions. We recommend that all patients (especially voice professionals) be informed about the possible effects of sinus lifts on speech and voice alterations. (Oral Surg Oral Med Oral Pathol Oral Radiol 2013;115:175-184)

Sinus lift procedures have allowed implants to be placed in atrophic maxillas with high success rates. After the first description of this approach by Boyne and James,¹ numerous modifications have been published and different graft materials used, all aimed at technique improvements and more predictable outcomes.^{1,2}

However, increased experience in intraoperative and postoperative sinus lifting procedures over time has led to a number of literature reports on altered physiology of the paranasal sinuses, including a detailed analysis of side effects and possible surgical complications. The potential effects of sinus lifting on voice quality have yet to be clearly addressed in these reported studies.

With the largest volume in the maxillary sinuses, the paranasal sinuses have a significant impact on sound resonance and are evaluated as a first resonator.³ In an experimental study in vitro, Maeda⁴ showed that the maxillary sinuses have special importance regarding resonance of the “i” and “u” sounds. In addition, Tobey and Linkcs⁵ showed that nasal resonance completely disappeared in maxillectomy patients. Sinus volume

was routinely reduced after preprosthetic sinus floor elevation, resulting in decreased resonant volume of the paranasal sinus system. As such, sinus lifting procedures can affect the quality of sound.⁶

Alterations in sound quality are rarely tolerated well by patients, because they often create discomfort. Sound is important in professional life, and some patients may even change professions. Even minor changes can be a predicament for those whose professions are based on their voices, such as singers, announcers, actors, and speech therapists. Hoseman et al.⁷ suggested that audio professionals should be warned before paranasal sinus surgeries of potential alterations in sound quality.

The present study was designed to determine the effect of changes in sinus volume on the quality of sound in patients requiring sinus augmentation, vis-a-vis sinus pneumatization and implant therapy in the posterior maxilla.

MATERIALS AND METHODS

A total of 17 patients (12 male and 5 female) aged 36-64 years (mean age 44.2 years) were enrolled in this study. All of the patients had an edentulous region between 2 teeth or an edentulous distal extension in the

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Statement of Clinical Relevance

In this study, acoustic analyses revealed that sinus augmentation procedure altered the voice quality. All patients (especially voice professionals) should be informed about the possible effects of sinus lifts on speech and voice alterations.

molar and/or the premolar areas of the maxilla. All of the patients wanted dental implants for prosthetic rehabilitation and required bilateral sinus augmentation. Preoperative dental volumetric tomography scans were taken to evaluate the residual bone height and sinus pathosis 2 weeks before surgery. None of the patients had significant sinus pathoses. The need for sinus augmentation was decided based on the Cawood and Howell⁸ classification, and accordingly class V and VI cases were included in the study. The residual bone height of the edentulous sites for implant placement ranged from 2 to 8 mm (mean 4.2 mm).

Three conditions were identified for the patients included in the study:

The absence of any systemic problems that affect sound quality (e.g., cleft lip or palate, mental retardation, physiologic and pathologic formations that may affect sound quality, and speech disorders).

The ability to read and write.

The presence of insufficient bone height depending on bilateral sinus pneumatization in the maxilla.

A total of 34 sinus lifts were performed for the patients. In all, 62 dental implants measuring 3.7-4.8 mm in width and 12-14 mm in length were placed concurrently with the sinus lifts. Four implants each were inserted in grafted regions of 11 patients, whereas 3 implants each were inserted in the grafted regions of 6 other patients. Radiographic reassessments were conducted with dental volumetric tomography 1 month after surgery.

The study was conducted with approval from the Ankara University Faculty of Dentistry Research Ethics Committee.

Surgical method

All surgeries were performed under local anesthesia (Ultracain DS Forte). With a midcrestal incision and vertical releasing incision, a mucoperiosteal flap was elevated to expose the sinus wall. The preparation of the bone window was first accomplished with a round steel bur and completed with a round diamond bur to avoid damage to the sinus membrane. The sinus membrane was then elevated, with the use of elevators, from the occlusal and buccal aspects toward the nasal portion without disruption. When the prepared window reached a horizontal position, the process was terminated. Right and left maxillary sinus augmentation was performed in the same session. The implant sockets were then prepared and the dental implants placed. One-half of the graft material (Tutogen-Biologics, Nuenkirchen, Germany) was placed on the palatal wall of the sinus before placement of the implants, and the remainder was used to fill the sinus cavity once the implants were placed. After the end of the graft placement, the flap was closed

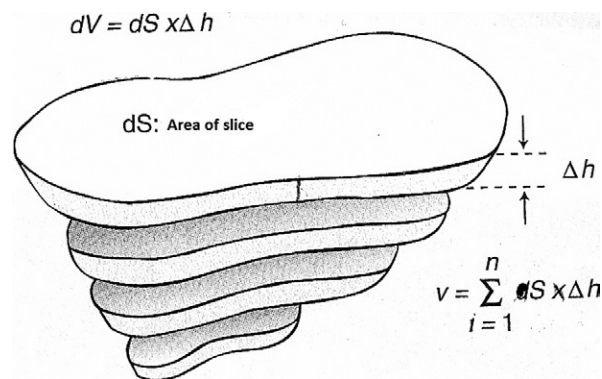


Fig. 1. Method for measurement of maxillary sinus.

and sutured with 3/0 silk suture. A standard prescription of an antibiotic containing amoxicillin and sulbactam (Augmentin, 1,000-mg oral tablet), an analgesic containing naproxen sodium (Apranax Fort Tablet, 550 mg), and a mouthwash with chlorhexidine were suggested to the patients after the surgical treatment.

Radiographic evaluation

Radiographic evaluations of patients were carried out with the use of Iluma cone-beam computerized tomography (CBCT). Immediately before and 1 month after the operation, 2 dental volumetric tomographies were obtained. The changes in sinus volume that occurred before and after the sinus lifting procedure were evaluated in axial sections obtained from the tomographies. The method developed by Uchida et al.⁹ was used to calculate the maxillary sinus volume (Figure 1). According to this method, the maxillary sinus area was calculated in each of the axial sections, with the section volumes later calculated by multiplying with the thickness of the section areas (slice thickness 2 mm). After the volumes of all sections were calculated, the total sinus volume was obtained by adding the volumes of all sections. The same method was used to calculate the volumes of the grafted regions and changes in sinus volume.

Acoustic analyses

Audio recordings of all patients were obtained by Prof. Dr. N. Akyildiz Hearing, Speech, Voice, and Balance Disorders Diagnosis, Treatment, and Rehabilitation Center Sound Analysis Laboratory of Gazi University. The multidimensional voice program parameter (MDVP) of a Kay Elemetrics CSL (model 4300B) was used for the audio analysis (Figure 2). According to this analysis, the following perturbation parameters were evaluated:

- Absolute jitter (Jita): the ratio of the change of timbre in voice at short periods.

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