

Research Article

Prevalence, Height, and Location of Antral Septa in Iranian Patients Undergoing Maxillary Sinus Lift

Masoumeh Faramarzie¹ • Amir Reza Babaloo^{2*} • Sina Ghertasi Oskouei³

¹Assistant Professor, Department of Periodontics, Faculty of Dentistry, Tabriz University of Medical Sciences, Tabriz, Iran

²Post-graduate Student, Department of Periodontics, Faculty of Dentistry, Tabriz University of Medical Sciences, Tabriz, Iran

³Research Assistant, Faculty of Dentistry, Tabriz University of Medical Sciences, Tabriz, Iran

*Corresponding Author; E-mail: amirrezababaloo@yahoo.com

Received: 10 July 2009; Accepted: 19 October 2009

J Periodontol Implant Dent 2009; 1(1):43-47

This article is available from: <http://dentistry.tbzmed.ac.ir/jpid>

© 2009 The Authors; Tabriz University of Medical Sciences

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract

Background and aim. Presence of maxillary septa has been known to be a complicating factor for sinus elevation procedure. This study was aimed at detecting the prevalence, location and height of antral septa in edentulous and dentate Iranian patients scheduled for sinus elevation procedure.

Materials and methods. A total of 132 sinuses in 66 patients (39 male and 27 female) aged 34-73 years were evaluated through a computed tomography scan analysis.

Results. The prevalence of one or more septa was 35.52% (27/76) for edentulous and 21.42% (12/56) for dentate patients (overall 29.54% [39/132]). The prevalence of septa was not significantly different between males and females. Antral septa were found in the middle (53.84% [21/39]), anterior (30.76% [12/39]), and posterior parts (15.38% [6/39]). The mean heights of septa were 6.52 ± 3.87 mm, 7.58 ± 3.56 mm and 5.33 ± 4.23 mm in medial, lateral and middle parts of maxillary antrum, respectively.

Conclusion. Antral septa may be present in any area of the maxillary sinus with variable prevalence among populations.

Key words: Antral septa, dental implants, edentulous, maxillary sinus graft elevation, posterior maxilla.

Introduction

Intraosseous dental implants are considered as an excellent safe treatment for partial and total edentulism, meeting the functional and esthetic needs of such patients.¹ However, the placement of dental implants in posterior maxillary region is considered a complicated procedure because of the presence of the maxillary sinus, as increased osteocalstic function and bone

loss following extraction of posterior maxillary teeth leads to extension of maxillary sinus towards the alveolar process, commonly called pneumatization.² As a result, posterior maxillary process in edentulous patients contains low-density cancellous and laminar cortical bone with decreased stress-bearing abilities.³ In advanced cases following long-term edentulism, a paper-thin cortex may separate maxillary sinus from the oral cavity, leaving insufficient support for the im-

plant.^{3,4} Sinus elevation or sinus lift is performed in such cases before the placement of dental implant.^{5,6} This procedure was first undertaken by Boyne & James in 1980 using autogenous bone graft to maxillary sinus floor.⁷ Several studies have assessed the different materials used in bone graft for sinus elevation.⁸⁻

¹¹ Allografts, alloplasts, and xenografts can efficiently be used as bone graft material to increase the bone matter of the sinus wall.⁷ Several complications have been associated with the sinus elevation procedure.¹²⁻¹⁵ The most common complication is the perforation of "Schneiderian" membrane, often associated with antral septa, making the elevation of the membrane difficult.^{2,3}

Antral, or "Underwood's",¹⁶ septa divide the sinus floor into multiple spaces and can be inherited or acquired.^{1,2,5} Inherited or primary septa develop throughout the sinus space as the middle face grows,⁵ and are suggested to be remnants of non-resorbed prenatal papillary projections of etmoidal infundibulum.² Atrophy of maxillary process may result in bony indentations or crests in the floor of maxillary sinus, identified as secondary septa.¹⁷ Antral septa divide the caudal sinus into multiple spaces, called "recesse", and at times, into separate spaces, called "accessory sinuses."¹⁸ As tooth loss extends, both primary and secondary septa become resorbed.¹⁹ Septa act as bearing structures for mastication forces when teeth are present, but tend to disappear as teeth are lost.

During sinus lift procedure and following removal of the bony wall of the sinus, Schneiderian membrane is lifted and the thickness of the sinus base is increased using graft material. This procedure becomes complicated in the presence of septa.²⁰ Boynet et al²¹ suggested cutting septa with a narrow chisel and removing it with a hemostat, and placing a homogenous bone graft. Tidwell et al²² tried dividing facial sinus wall into two anterior and posterior portions with reference to septa, and augmented the sinus floor with two pieces of graft material. Using this method, septum can be removed after sinus augmentation. Septum removal before sinus augmentation is a preferred procedure, as

with the septum in place, there is a high possibility of membrane perforation, resulting in the most common complication of maxillary sinusitis.²³⁻²⁵

Several studies have been performed on the prevalence of antral septa in different populations. Our knowledge of Iranian population, however, is insufficient. Therefore, the aim of the present study was to determine the prevalence, position, and height of maxillary antral septa using CT-scan among candidates of sinus lift operation.

Materials and Methods

In this study, 66 subjects (39 male and 27 female) aged 34-73 years old (mean age 52 years) were evaluated. All subjects were candidates for implant placement in posterior maxillary region. Thirty-eight cases were edentulous and 28 cases were dentate. A written informed consent was taken from all patients to participate in this study. Spiral CT-scan was performed on all patients. CT-scan images of axial, coronal, and panorama sections in 1 mm intersections were saved on compact disk for each patient and analyzed using the appropriate computer software (Figure 1).

In order to assess the presence of any antral septum, axial and coronal CT images were used to measure the height of the septum in medial, middle and lateral regions using the appropriate software. Bony projections with a height more than 2.5 mm from the sinus floor were considered septum and included in the statistical analysis. The position of the each septum was determined as follows: anterior position: mesial to second premolar; middle position: second premolar to second molar; and posterior position: distal to second molar.

To evaluate the differences in height of the septa in different positions (medial, middle, and lateral; and anterior, middle, and posterior), ANOVA was employed. For assessment of differences in presence of septum and its size between males and females, and between patients with severe bone resorption and those without severe resorption, chi-square and *t*-test were used. A P value of < 0.05 was considered statistically significant.



Figure 1. Axial CT view of maxillary sinus showing no septa (a); axial CT view of maxillary sinus showing antral septa in left sinus (b); post-operative panoramic radiograph of left maxillary region following sinus lift and implant placement (c).

Results

From the total of 132 sinus cases evaluated, 46 cases (34.84%) had an available bone amount of less than 10 mm (severe bone resorption group), and 86 cases (65.15%) had more than 10 mm available bone (without severe resorption group).

In the present study, the frequency of presence of antral septa was 29.54% (39/132) (19% in males and 20% in females). The antral septum was found in 35.52% (27/76) of edentulous and 21.42% (12/56) of dentate patients. A total of 44 septa were seen in 27% of patients. The frequency of antral septa was 33% in the severe resorption group and 23% in the group without severe resorption. 21 patients (31.8%) had antral septa. One septum was seen in 18 patients and two septa were present in three cases; none of the subjects had more than two septa.

Analysis of the position of the total 39 septa revealed that 12 (30.76%) septa were in the anterior region, 21 (53.84%) were in the middle region, and 6 cases (15.38%) were in posterior region (Figure 2).

The mean height of septa in the three regions of the sinus was different (medial 6.52 mm \pm 3.87, middle 5.33 mm \pm 4.23, and lateral 7.58 mm \pm 3.56). Mean height of the septa was 4.67 mm in the anterior region, 5.78 mm in the middle, and 4.76 mm in the posterior region. Mean height of septa in different regions of the sinus did not show any significant differences between groups. The prevalence of antral septa was not statistically significant between males and females.

Discussion

Maxillary sinus septum has a 13-36% incidence in general population.^{16,17,26-29} Although, panoramic radiography and CT-scan are the most commonly used diagnostic adjuncts for implant treatment planning.^{19,26,27} computerized tomography scan (CT-scan) is

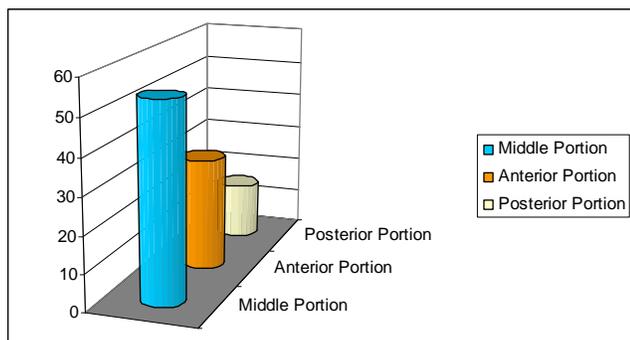


Figure 2. Distribution of septa around various location of maxillary antrum.

the preferred approach in determining antral septa, since panoramic radiograph has a 26.5% false positive or false negative result.²⁹

The prevalence of maxillary sinus septa was relatively high in this study, where the prevalence of at least one septum was 29.5% (35.5% of edentulous subjects and 21.4% of dentate cases). Similar studies have reported the prevalence of antral septa in complete edentulous subjects to be 33.3% and 31.7%.^{16,22} This figure in partial/complete edentulism is reported 26%, 24% and 25% in different studies.^{19,30,31} Considering these findings, it seems the prevalence of antral septa is higher in complete edentulous subjects compared to the cases of partial edentulism. This can be explained by the fact that completely edentulous implant candidates usually report a rather long history of removable prosthesis use, which leads to the atrophy of maxillary alveolar process and formation of secondary septa. The longer period of edentulism further intensifies the situation in completely edentulous patients compared to partially edentulous individuals.

Antral septum has been reported to be prevalent in anterior (mesial to second premolar)^{19,22} and posterior sinus (distal of second molar).¹⁶ In addition, similar to our findings, studies have shown the presence of antral septa in the middle portion of the maxillary sinus (distal of second premolar to distal of second molar), where the majority of the sinus space resides.²⁷ The difference between the results of these studies could be attributed to anatomic variations. The sequence of tooth extraction can also affect the formation of antral septa in different regions of the sinus.

The height of the septa is reported to be 6.4–12.7 mm in different studies.^{16,19,21,22} The results of our study are in line with these findings. Velasquez-Plata et al³⁰ have also reported the height of the septa in different areas: lateral region: 0–15.7 mm (mean 3.54 mm \pm 3.35); middle region: 0–17.3 (mean 5.89 mm \pm 3.14); and the medial region: 0–20.6 mm (mean 7.59 mm \pm 3.76). It should be noted that determining the height of antral septa from the study of radiographs can be influenced by the technique used, distortion, measuring devices, and observer errors. In addition, considering the facts that the length of the edentulism period affects bone loss and formation of secondary septa, and that less mastication forces cause resorption of antral septa, the length of edentulism can be one of the influencing factors on the height of the maxillary sinus septa.

In the present study, the prevalence of septa did not show any significant difference between males and females. Midilli et al³² studying 206 male and 258 female subjects did not find a significant association between anatomic variations of paranasal sinuses and the

gender of subjects. In a study on 1024 edentulous individuals, Shibli et al² also did not find a significant association between the presence of maxillary sinus septa and the age and the gender of the patients.

The prevalence, height, location, and anatomic morphology of maxillary sinus are highly variable, and the bone atrophy is a contributing factor to these variations. In order to avoid complications of sinus lift procedure, it is necessary to have a good knowledge of anatomic structure variations of maxillary sinus. CT-scan and other imaging techniques help clinician in achieving this goal; however, since panoramic radiographs are a commonly prescribed radiography, further studies are suggested to compare panoramic radiographs with CT-scan regarding their accuracy in implant treatment planning. Cadaveric studies can also be beneficial. More recent techniques like cone beam computed tomography which has higher resolution and uses lower radiation dose compared to conventional CT should also be further investigated.

References

- Kim MJ, Jung UW, Kim CS, Kim KD, Choi SH, Kim CK, et al. Maxillary sinus septa: prevalence, height, location, and morphology. A reformatted computed tomography scan analysis. *J Periodontol* 2006;77:903-8.
- Shibli JA, Faveri M, Ferrari DS, Melo L, Garcia RV, d'Avilas, et al. Prevalence of maxillary sinus septa in 1024 subjects with edentulous upper jaws: a retrospective study. *J Oral Implantol* 2007;33:293-6.
- Smiler DG, Johnson PW, Lozard JL, Misch C, Rosenlicht Jr, Tatum OH Jr, et al. Sinus lift grafts and endosseous implants. Treatment of the atrophic posterior maxilla. *Dent Clin North Am* 1992;36:151-86.
- van den Bergh JP, ten Bruggenkate CM, Disch FJ, Tuinzing DB. Anatomical aspects of sinus floor elevations. *Clin Oral Implants Res* 2000;11:256-65.
- Chanavaz M. Maxillary sinus: anatomy, physiology, surgery, and bone grafting related to implantology—eleven years of surgical experience (1979-1990). *J Oral Implantol* 1990;16:199-209.
- van den Bergh JP, ten Bruggenkate CM, Tuinzing DB. Maxillary sinus floor elevation: a valuable pre-prosthetic procedure. *Periodontol* 1998;17:176-82.
- Newman MG, Takei HH, Klokkevold PR, Carranza FA. *Carranza's Clinical Periodontology*, 10th ed. Philadelphia: Saunders Elsevier; 2006: 1148-60.
- Boëck-Neto RJ, Gabrielli MF, Shibli JA, Marcantonio E, Lia RC, Marcantonio E Jr. Histomorphometric evaluation of human sinus floor augmentation healing responses to placement of calcium phosphate or Ricinus communis polymer associated with autogenous bone. *Clin Implant Dent Relat Res* 2005;7:181-8.
- Boëck-Neto RJ, Gabrielli MF, Shibli JA, Marcantonio E, Lia RC, Marcantonio E Jr. Histomorphometrical analysis of bone formed after maxillary sinus floor augmentation by grafting with a combination of autogenous bone and demineralized freeze-dried bone allograft or hydroxyapatite. *J Periodontol* 2002;73:266-70.
- Hallman M, Cederlund A, Lindskog S, Lundgren S, Sennerby L. A clinical histologic study of bovine hydroxyapatite in combination with autogenous bone and fibrin glue for maxillary sinus floor augmentation. Results after 6 to 8 months of healing. *Clin Oral Implants Res* 2001;12:135-43.
- De Leonardis D, Pecora GE. Prospective study on the augmentation of the maxillary sinus with calcium sulfate: histological results. *J Periodontol* 2000;71:940-7.
- Beaumont C, Zafiropoulos GG, Rohmann K, Tatakis DN. Prevalence of maxillary sinus disease and abnormalities in patients scheduled for sinus lift procedures. *J Periodontol* 2005;76:461-7.
- Kasabah S, Krug J, Simůnek A, Lecaro MC. Can we predict maxillary sinus mucosa perforation? *Acta Medica (Hradec Kralove)* 2003;46:19-23.
- Maksoud MA. Complications after maxillary sinus augmentation: a case report. *Implant Dent* 2001;10:168-71.
- Ueda M, Kaneda T. Maxillary sinusitis caused by dental implants: report of two cases. *J Oral Maxillofac Surg* 1992;50:285-7.
- Underwood AS. An Inquiry into the Anatomy and Pathology of the Maxillary Sinus. *J Anat Physiol* 1910;44:354-69.
- Vinter I, Krmpotić-Nemanić J, Hat J, Jalsovec D. [Does the alveolar process of the maxilla always disappear after tooth loss?] *Laryngorhinootologie* 1993;72:605-7.
- Miles AE. The maxillary antrum. *Br Dent J* 1973;134:61-3.
- Krennmair G, Ulm CW, Lugmayr H, Solar P. The incidence, location, and height of maxillary sinus septa in the edentulous and dentate maxilla. *J Oral Maxillofac Surg* 1999;57:667-71.
- Wood RM, Moore DL. Grafting of the maxillary sinus with intraorally harvested autogenous bone prior to implant placement. *Int J Oral Maxillofac Implants* 1988;3:209-14.
- Boyne PJ, James RA. Grafting of the maxillary sinus floor with autogenous marrow and bone. *J Oral Surg* 1980;38:613-6.
- Tidwell JK, Blijdorp PA, Stoelinga PJ, Brouns JB, Hinderks F. Composite grafting of the maxillary sinus for placement of endosteal implants. A preliminary report of 48 patients. *Int J Oral Maxillofac Surg* 1992;21:204-9.
- Quiney RE, Brimble E, Hodge M. Maxillary sinusitis from dental osseointegrated implants. *J Laryngol Otol* 1990;104:333-4.
- Ueda M, Kaneda T. Maxillary sinusitis caused by dental implants: report of two cases. *J Oral Maxillofac Surg* 1992;50:285-7.
- Zimble MS, Lebowitz RA, Glickman R, Brecht LE, Jacobs JB. Antral augmentation, osseointegration, and sinusitis: the otolaryngologist's perspective. *Am J Rhinol* 1998;12:311-6.
- Ozyuvaci H, Aktas I, Yerit K, Aydin K, Firatli E. Radiological evaluation of sinus lift operation: what the general radiologist needs to know. *Dentomaxillofac Radiol* 2005;34:199-204.
- Krennmair G, Ulm C, Lugmayr H. Maxillary sinus septa: incidence, morphology and clinical implications. *J Craniomaxillofac Surg* 1997;25:261-5.
- Ulm CW, Solar P, Krennmair G, Matejka M, Watzek G. Incidence and suggested surgical management of septa in sinus-lift procedures. *Int J Oral Maxillofac Implants* 1995;10:462-5.
- Kasabah S, Slezák R, Simůnek A, Krug J, Lecaro MC. Evaluation of the accuracy of panoramic radiograph in the definition of maxillary sinus septa. *Acta Medica (Hradec Kralove)* 2002;45:173-5.
- Velásquez-Plata D, Hovey LR, Peach CC, Alder ME. Maxillary sinus septa: a 3-dimensional computerized tomographic scan analysis. *Int J Oral Maxillofac Implants* 2002;17:854-60.
- González-Santana H, Peñarrocha-Diago M, Guarinos-Carbó J, Sorní-Bröker M. A study of the septa in the maxillary sinuses

- and the subantral alveolar processes in 30 patients. *J Oral Implantol* 2007;33:340-3.
32. Midilli R, Aladağ G, Erginöz E, Karci B, Savaş R. Anatomic

variations of the paranasal sinuses detected by computed tomography and the relationship between variations and sex. *Kulak Burun Bogaz Ihtis Derg* 2005;14:49-56.