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Evaluation of Relationship Between Maxillary Sinus Mucosal Thickening And Alveolar Bone Loss In Localized Periodontitis

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Abstract

Background: Localized periodontitis in maxillary posterior region has significant impact on maxillary sinus because of close proximity of maxillary posterior teeth to maxillary sinus. Present study uses CBCT imaging to study relationship between localized periodontitis in this region & mucosal thickening of maxillary sinus. The study aims at estimation of alveolar bone loss & mucosal thickening in posterior maxilla, followed by correlation between the two.

Methodology: The study was conducted on CBCT images of maxillae.125 cases were screened and 61 cases were included in the study. Alveolar bone loss was measured in maxillary posterior region and categorized into mild, moderate and severe. Thickness of mucosal lining in floor of maxillary sinus was also measured & graded in proximity to maxillary posterior teeth. Comparison and correlation of alveolar bone loss and mucosal thickening was done.

Results: It was found that patients having alveolar bone loss had significant increase in mucosal thickening.

Moreover, severity of alveolar bone loss was proportionate to the thickness of mucosal lining.

Conclusion: The study gives an inference that periodontitis leading to alveolar bone destruction is quite prevalent in general population & periodontitis in maxillary posterior region is a common cause of Odontogenic maxillary sinusitis. The severity of periodontitis being proportionate to the severity of mucosal thickening depicts that periodontal inflammation acts as a stimulus for thickening of mucosal lining. CBCT was found to be best modality in terms of accuracy. Social relevance of these findings includes that, since periodontitis is a preventable pathology, mass awareness about periodontal health will aid in preventing Odontogenic maxillary sinusitis & its consequences, in such patients.

Keywords: Alveolar bone loss, Mucosal thickening, CBCT, Localized periodontitis.

Introduction

Periodontitis refers to inflammation of periodontium. There are two main hallmarks of periodontal disease, which are inflammation and subsequent alveolar bone loss. Gingival inflammation can resolve but once alveolar bone loss is initiated, it leads to eventual tooth mobility & tooth loss. Certain wide & complex intricate pathways operate in the pathogenesis of periodontal inflammation followed by alveolar bone destruction and tooth loss. Osteoclasts are the primary bone resorptive cells, and local stimulation of their activity is an essential requirement for alveolar bone loss.[1] It happens in response to key factors, such as M-CSF/CSF-1(Monocyte-Colony Stimulating Factor/ Colony Stimulating Factor 1), osteoclast differentiation factor (ODF/RANKL), interleukins (IL), tumor necrosis factor (TNF), and contact with mineralized bony particles.[2,3,4.]

Osteoblastic & osteoclastic regulation is balanced in normal individual. But secondary to any local or systemic factors, the balance is tipped towards either osteoblastic side or osteoclastic side. Local factors include factors like calculus deposition, gingival inflammation, foreign bodies, overhanging restorations, trauma induced by inappropriate use of interdental aids etc. Systemic factors like Diabetes mellitus, parathyroid hormone (PTH) levels, retinoic acid levels, and vitamin D3 are also found to influence bone metabolism[5]. Osteoblasts also secrete collagenase and plasminogen activator[6]. Interleukin-1, Tumor Necrosis Factor, and epidermal growth factor (EGF) have been found to deactivate osteoblasts and increase release of Colony Stimulating Factor -1(CSF-1) and RANKL.[7]

Alveolar bone loss has a wide range of classifications. Most studies suggest a distance of 2 mm from the cementoenamel junction (CEJ) to the alveolar crest (AC) to reflect normal periodontium.[8,9,10] This distance of more than 2 mm represents periodontal bone loss. Since alveolar bone is supporting bone surrounding all aspects of radicular portion, it is important to examine the bone loss in all aspects. To avoid complexity in evaluation of alveolar bone loss, a simple categorization of alveolar bone loss(considering the extent of normal level from level of CEJ to tip of the root) into mild(< 25%), moderate(25-50%) and severe (>50%) has been made. Same classification was implemented in our study.

Localized periodontitis in maxillary posterior region has significant impact on maxillary sinus because of close proximity of maxillary posterior teeth to maxillary sinus. The inner walls of maxillary sinus are covered by mucosal membrane also known as Schneiderian membrane. Normal thickness of Schneiderian membrane ranges from 0.13 mm to 0.5 mm.[11]Thickness of schendarian membrane >1mm is considered as mucosal thickening.[12]

Various pathologies from odontogenic and non odontogenic sources result in increase in thickness of maxillary sinus mucosal lining, localized periodontitis being one of the odontogenic causes.

In this regard, to evaluate the association between schendarian membrane thickening in patients with alveolar bone loss secondary to periodontal inflammation, accurate evaluation of the remaining bone morphology is essential for the diagnosis, treatment planning, and prognosis of periodontal diseases.[13] Cone-beam computed tomography (CBCT) provides high contrast 3D images of periodontal structures that help to determine a definite diagnosis and treatment options for successful periodontal therapy.[14]

Our study aimed at assessment of maxillary sinus mucosal thickening in patients with different grades of alveolar bone loss secondary to localized periodontitis using CBCT.

Materials and Methods

A retrospective radiographic study was carried out in the department of oral medicine and radiology,Yenepoya Dental college, Karnataka. After receiving ethical clearance for the study, the CBCT images were retrieved from the archives of patients referred to the department of oral radiology for scanning for any other reason from any department of same institution. Images of patients referred from other hospitals & private clinics for CBCT imaging were also included. Patients were not exposed solely for the sake of this study.

A documented consent of the patient is a part of imaging protocol of the department and hence documented consents of all the patients were available.Selection of cases was done by a radiologist well experienced in CBCT interpretation, after decoding and delinking of personal data of the patient completely. The criteria for sample selection were any degree of visual radiographic alveolar bone images included in the study for ease in sorting and manipulation of data related to each image. Planmeca-mid-CBCT -Romexis software was used for imaging. The CBCT images included in the study were high quality images, free of artifacts, taken in medium or large field of view (FOV). For exploration of images, variable slice thickness was considered, however it was standardized at 1mm for measurement.

125 maxillary images were subject to screening. Maxillary posterior teeth with any degree of periodontal bone loss and the cases in which one side of upper jaw had a pathology and was indicated for certain treatment, the ccontralateral side, without pathology were considered for the study. Teeth with periapical pathology in the posterior region of maxilla, implant in posterior part of maxilla, patients predisposed to seasonal or perennial allergies, partial or total opacification of maxillary sinus on that side, developmental disorders of maxilla, trauma in maxillofacial region and cases in which more than one posterior teeth were missing, were excluded from the study. An initial exploration of the images in coronal, sagittal(Image 1) and axial sections of respective maxillae was done to rule out any structural or congenital defect, presence of implants, periapical pathology or impacted or residual segment of missing teeth. Exploration of images in all planes was done to check for bone defects on all surfaces of teeth. Bone loss was measured in panoramic & cross sectional images from CEJ to deepest point(Image 2 & 3). For each bone defect, single value was measured that is the distance between CEJ to the deepest point of bony defect.

Further, the images having alveolar bone loss were explored in cross-sections of slice thickness of <1mm, to explore for the site of maximum mucosal thickening corresponding to site of maximum alveolar bone loss for each case. The alveolar bone loss was graded as[8] Mild (

the distance from the CEJ to the top of alveolar bone crest is >1mm but not beyond one third of the root(<25%), Moderate (the distance from the CEJ to alveolar bone crest is within the middle one third of the root(25-50%) and Severe (the distance from the CEJ to the alveolar bone crest reaches the apical one-third (>50%). Mucosal thickening of floor of maxillary sinus on either side or both sides, was evaluated and classified[9] as None, Normal[<1mm], Mild[2-4mm], Moderate[5-10mm] & Severe[>10mm].

Statistical Analysis

Categorical data was analyzed using Chi-square test and variables were expressed in terms of counts or percentages. Students't test was used for comparison. Pearson`s correlation was used to analyze the continuum data. Data was analyzed using SPSS version 22. Results of the study were interpreted to withdraw observational results. *p*-value of <0.05 was considered to be statistically significant.

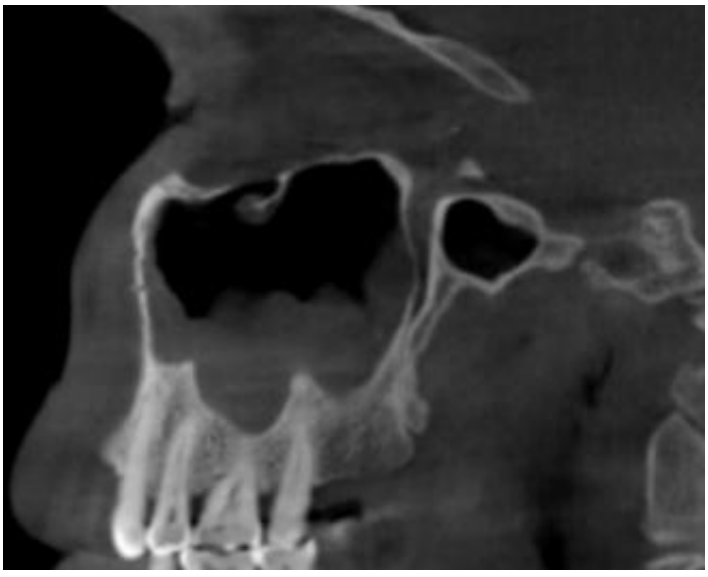

Figure 1: Sagittal view showing alveolar bone loss & mucosal thickening.

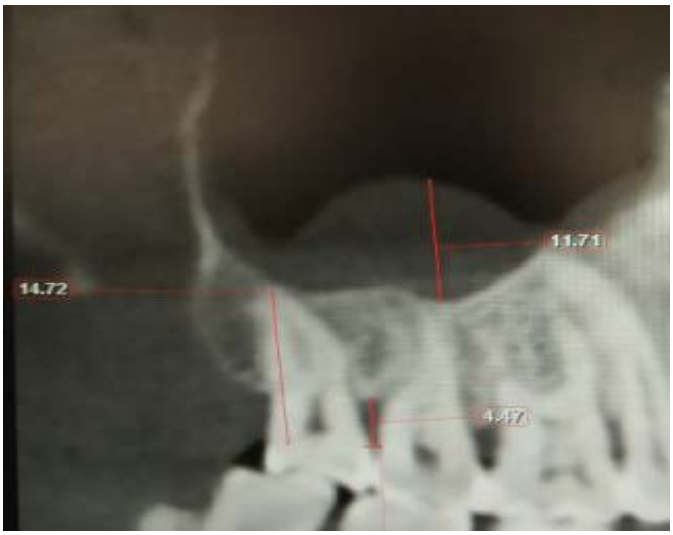

Figure 2: Panoramic view showing measurement of bone loss & mucosal thickening.

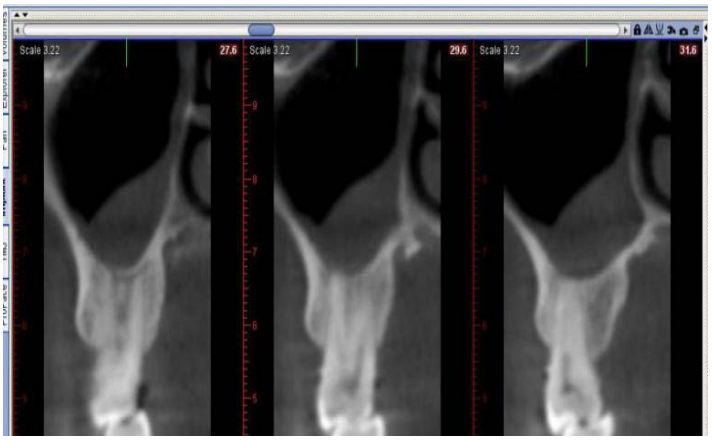

Figure 3: Cross sectional view showing bone loss on buccal & palatal cortex.

Results and Observations

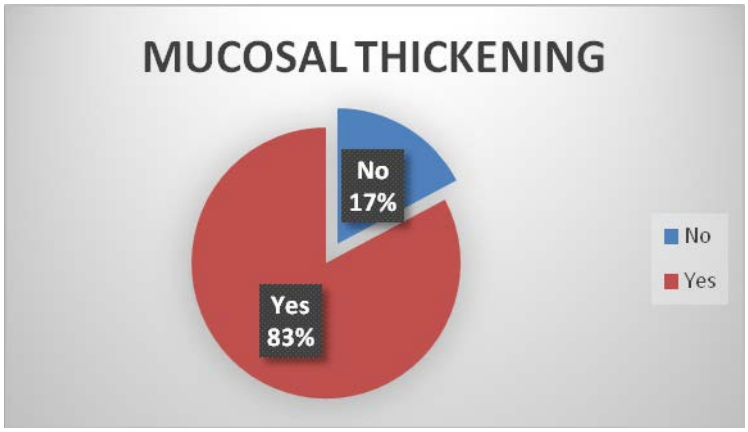

Chart 1: Relative distribution of cases with & without mucosal thickening.

Table 1: Bone Loss

BONE LOSS		Number of cases
Mild	Count	30
	%	48.4%
Moderate	Count	19
	%	31.1%
Severe	Count	12
	%	20.5%
Total	Count	61
	%	100.0%

Table 2: Mucosal Thickening

Grades Of Mucosal Thickening			Total
Mucosal Thickening	Nil	Count	21
		%	17.2%
	<1 mm	Count	19
		%	15.6%
	1 -5 mm	Count	49
		%	40.2%
	5 -10 mm	Count	22
		%	18.0%
	>10mm	Count	11
		%	9.0%
Total		Count	122
		%	100.0%

Table 3: Correlation of Bone Loss & Mucosal Thickening

Posterior Maxillae			Mucosal Thickening					Total
			Nil	<1 mm	1 -5 mm	5 -10 mm	>10mm	
Boneloss	Mild	Count	4	4	10	3	3	24
		%	44.4%	50.0%	50.0%	20.0%	33.3%	39.3%
	Moderate	Count	5	3	6	5	2	21
		%	55.6%	37.5%	30.0%	33.3%	22.2%	34.4%
	Severe	Count	0	1	4	7	4	16
		%	0.0%	12.5%	20.0%	46.7%	44.4%	26.2%
Total		Count	9	8	20	15	9	61
		%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Discussion

Periodontal inflammation progressing to alveolar bone loss is a common oral health issue. Odontogenic infections with sinus involvement may produce only a minimal, often asymptomatic local reaction in the maxillary antral floor periosteum or mucosa for months to years. Even though the infection is asymptomatic most of the times, the pathologically altered mucosa is impaired and less resistant than an intact one to the infection, and is a pathogenic factor in the progression to rhinosinusitis. Inflammed sinus mucosa also contributes to increased incidence of implant failure in such cases because inflammatory mediators alter osseointegration. Periodontal infections are a common cause of thickening of mucosal lining in maxillary sinus. The progression of mucosal thickening can to be related to the severity & chronicity of the bone loss. As the bone loss progresses from milder to severe grade, the thickening of mucosal lining can tend to accentuate.

During evaluation of alveolar bone loss secondary to periodontal inflammation, accuracy in terms of form & extent of bone defects is essential for the diagnosis, treatment planning, and prognosis of periodontal diseases.[13] Clinical probing and intraoral radiography are still the basic diagnostic tools in periodontology. Cone-beam computed tomography (CBCT) provides high contrast 3D images of periodontal structures at sub millimetric level that help to determine a definite diagnosis and treatment options for successful periodontal therapy.[14] Comparing CT & CBCT in various aspects, it is found to be more preferable diagnostic modality owing mainly to low radiation dose to patient in CBCT compared to CT.[15,16]

The images obtained by intra oral techniques were compared with CT as well as CBCT and it was concluded

that these 3D imaging modalities were superior to the 2D modalities.[17]

Our study was a radiographic study carried out on CBCT images of maxillae. In our study radiographic criteria of periodontitis, that is alveolar bone loss was taken into consideration. It was not based on clinical criteria of periodontitis. Bone loss was assessed in all the three dimensions. Most of the cases were having horizontal bone loss. Severity of bone loss was described in terms of mild, moderate, and severe. It was found that, in majority of cases the bone loss was mild (Table 1). Mild level of disease in the majority of patients is of great clinical relevance. It depicts that in majority, the disease progression can be prevented easily and treatment at this stage is less complicated as well.

Images showing bone loss were further analyzed for presence of mucosal thickening in the floor of maxillary sinus. It was found that only 17.2% of cases were free of mucosal thickening (Chart II. Table 2).That means in majority of cases periodontal inflammation has direct influence on mucosa of antrum. Majority of cases had MT between 1-5mm, followed by 5-10mm. Severe grade of MT (>10mm) was least common.(Table 2)

Correlation of different levels of severity of bone loss and mucosal thickening was made (Table 3). p value in this comparison was equivalent to 0.051. From this finding, an important inference can be withdrawn that the degree of MT is directly related to severity of alveolar bone loss. The result is in concordance with another study that was conducted in 2014 to characterize and measure the Schneiderian membranes of individuals with periodontal diseases in China and to analyse the factors impacting maxillary sinus mucosal thickness using cone-beam computed tomography (CBCT). Their study concluded that the thickness of Schenedarian membrane increased with worsening of alveolar bone loss.

This can be clearly understood that severity of bone loss is a manifestation of aggressiveness and chronicity of periodontal pathology. Hence resulting is higher degree of mucosal thickening in such regions. This infers that inflammatory process in periodontium acts as a stimulus and is a contributor for maxillary sinus pathology and is an avoidable cause.

The result of our study was also in accordance with the study[18] in Chinese population (2015) which demonstrated that mucosal thickening of maxillary sinus mucous membrane was more prevalent in patients with periodontal disease.

Conclusion

Localized periodontitis leading to alveolar bone loss is a common pathology. Since, maxillary posterior teeth are in close approximation to floor of maxillary sinus, any pathology related to these teeth affects the maxillary sinus. Periapical and periodontal inflammation being most common pathology. The so called Odontogenic maxillary sinusitis leads to variety of consequences. Different types of imaging modalities have been used for assessment of periodontal bone loss and maxillary sinus mucosal thickening. Since most of the periodontal bone defects are three dimensional, these two dimensional images do not give accurate estimate. With introduction of CBCT in maxillofacial imaging, it was found to have immense use in determining the relationship between 3D periodontal bone loss and maxillary sinus mucosal thickening with greater precision & accuracy.

Our study concluded that, positive correlation exists between alveolar bone loss and thickening of maxillary sinus mucosa. In majority of cases, the alveolar bone loss was mild. In cases with mild bone loss, the mucosal thickening ranged between 1-5mm (mild) while as in cases with severe bone loss it was found in the range of 5-10mm or more than 10mm. This lead to inference that the

severity & chronicity of inflammation is directly related to severity of mucosal thickening. The inferences made from this study clearly states that periodontitis leads to odontogenic maxillary sinusitis. During the course of this study, it was found that bone loss is quite prevalent problem. This inference is of great clinical significance in a way that periodontitis leads to odontogenic sinusitis & the measures to reduce the progression of gingival inflammation to periodontal inflammation should be stressed upon. This can be easily carried out by public awareness programs & campaigns highlighting the risk factors for periodontal diseases and the consequences of periodontal diseases.

References

1. J.L. Saffar, J.J. Lasfargues,M. Cherruau.Alveolar bone and the alveolar process: the socket that is never stable. Periodontology 2000;14(1): 76–90.
2. H. I. Roach.Why does bone matrix contain non-collagenous proteins? The possible roles of osteocalcin, osteonectin, osteopontin and bone sialoprotein in bone mineralisation and resorption. Cell Biology International 1994;18(6):617–628.
3. Z. Bar-Shavit.The osteoclast: a multinucleated, hematopoietic-origin, bone-resorbing osteoimmune cell. Journal of Cellular Biochemistry 2007;102(5):1130–1139.
4. D. Liu, J. K. Xu, L. Figliomeni. Expression of RANKL and OPG mRNA in periodontal disease: possible involvement in bone destruction. International Journal of Molecular Medicine 2003; 11(1):17–21.
5. S. H.Wiebe,M.Hafezi,S.Sandhu,M.Sims,J. Dixon. Osteoclast activation in inflammatory periodontal diseases. Oral Diseases 1996; 2(2):167–180.
6. S. Bord,A. Horner,M. Hembry,J. Reynolds,J. E. Compston.Production of collagenase by human osteoblasts and osteoclasts in vivo. Bone 1996;19(10): 35–40.
7. R. Garant. Oral Cells and Tissues. Quintessence 2003;
8. Hausmann E, Allen K, Clerehugh V. What alveolar crest level on a bite-wing radiograph represents bone loss?. J Periodontol 1991;62:570-2.
9. Källestål C, Matsson L. Criteria for assessment of interproximal bone loss on bite-wing radiographs in adolescents. J Clin Periodontol 1989;16:300-4.
10. Regan JE, Mitchell DF. Roentgenographic and dissection measurements of alveolar crest height. J Am Dent Assoc 1963;66:356-9.
11. Tiziano Testori, Massimo del fabbro, Roberto Weinstein, stephen wallace. **A**natomy of maxillary sinus.Maxillary sinus surgery and alternatives in treatment chapter 02: p 10.
12. Cagici C, Yilmazer c, Hurcan C et al. Appropriate interslice gap for screening coronal paranasal sinus tomography for mucosal thickening. Eur Arch Otorhinolarynol 2009; 266: 519-525.
13. Langen HJ, Fuhrmann R, Diedrich P, Gunther RW. Diagnosis of infra-alveolar bony lesions in the dentate alveolar process with high-resolution computed tomography: Experimental results. Invest Radiol 1995;30:421-6.
14. Goller-Bulut D, Sekerci AE, Köse E, Sisman Y. Cone beam computed tomographic analysis of maxillary premolars and molars to detect the relationship between periapical and marginal bone loss and mucosal thickening of maxillary sinus. Med Oral Patol Oral Cir Bucal. 2015;20(5):e572–579. doi: 10.4317/medoral.20587.))
15. K de Faria Vasconcelos,KM Evangelista,CD Rodrigues,C Estrela.Detection of periodontal bone

loss using cone beam CT and intraoral radiography.Dentomaxillofacial Radiol. 2012 Jan; 41(1): 64–69.

16. Maya Sanjeev Indurkar, Renu Verma.Evaluation of the prevalence and distribution of bone defects associated with chronic periodontitis using cone-beam computed tomography: A radiographic study.journal of interdisciplinary dentistry 2016; 6(3):104-109.
17. Akshaya Bhupesh Ban.Evaluation of accuracy of cone beam computed tomography for measurement of periodontal defects: A clinical study.Journal of Indian Society of Periodontology 2015;19(3).
18. Duygu Goller-Bulut, Ahmet-Ercan Sekerci, Emre Kose, Yildiray Sisman. Cone Beam computed tomographic analysis of maxillary premolars and molars to detect the relationship between periapical and marginal bone loss and mucosal thickness of maxillary sinus.Med Oral Patol Oral cir Bucal.2015 sep 1;20(5):e 572-9.