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ORIGINAL ARTICLE

Is There a Relationship between Maxillary Sinus Findings and Skeletal Malocclusion?

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ABSTRACT

Objective: No study has investigated the relationship between maxillary sinus findings and skeletal malocclusion based on cone-beam computed tomography (CBCT). The aim of the present study was to determine the relationship between the frequency of sinus findings and patients' skeletal malocclusion classification.

Methods: A total of 105 CBCT scans were examined and divided into three groups according to skeletal classification. Two experienced observers reviewed the CBCT images and recorded all the maxillary sinus findings. The patients' skeletal malocclusion, thickness of the Schneiderian membrane, and pathological sinus findings were evaluated.

Results: The sinus findings were classified into four groups: 0=no finding, 1=mucosal thickening, 2=partial opacification with liquid accumulation, and 3=total opacification. Statistical analysis showed that there was no correlation between the skeletal malocclusion and pathological sinus findings. However, there were significant differences in the Schneiderian membrane thickness between the groups.

Conclusion: The Schneiderian membrane thickness was significantly different in Class II and Class III patients. There was no relationship between pathological sinus findings and skeletal malocclusions.

Keywords: Sinus, membrane, tomography, malocclusion

INTRODUCTION

Cone-beam computed tomography (CBCT) is used for three-dimensional (3D) imaging in orthodontics. It provides detailed and essential data about dentomaxillofacial structures. Unlike computed tomography, CBCT involves lower radiation doses for patients.[1] This advantage is important for choosing the appropriate imaging technique. When children are treated, radiographs produced for orthodontic purposes contribute to the radiation burden in young adults.[2] By selecting the ideal imaging system and the smallest field of view (FOV), which is the extent of the observable area, the "as low as reasonably achievable" (ALARA) principle may be satisfied. ALARA is a radiation safety principle for minimizing radiation doses and a regulatory requirement for all radiation safety applications.

Data on the frequency of incidental findings related to maxillary sinus with CBCT imaging are limited in the orthodontic literature. The prevalence of mucosal thickening and the prevalence of cystic lesion occurrence for maxillary sinus have been reported to be 27% and 9%, respectively.[3] Researchers evaluated the findings of 500 CBCT scans and concluded that the ratio of incidental findings for orthodontic patients was 24.6%.[4] Another study, performed with magnetic resonance imaging, reported that the second highest prevalence was observed for maxillary sinuses.[3]

Sinus pathologies such as rhinosinusitis or sinusitis have many symptoms, including nasal congestion, nasal discharge, nasal purulence, and nasal obstruction.[5] Several etiological factors such as incorrect breathing patterns and airway obstructions may contribute to the development of malocclusions.[6] Agren et al.[7] reported that with abnormal breathing, a growing child can reveal problems with craniofacial growth, such as vertical facial

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pattern and skeletal Class II malocclusion. The retrognathic mandible induces the backward position of the tongue and hyoid bone, which can lead to a reduction in the upper airway volume.[8] Therefore, in this study, one of our objectives (the second objective) was to check for a correlation between skeletal malocclusion and sinus pathologies.

The increased use of CBCT by dentists and orthodontists offers an opportunity for the assessment of the prevalence of maxillary sinus findings, allowing further evaluation. Signs of inflammation, obstruction, or acute infection in the maxillary sinus are relevant when a dentist or orthodontist plans orthodontic treatment or prevention of relapse after treatment.[9]

To the best of our knowledge, no study has evaluated the relationship between skeletal malocclusions and maxillary sinus on CBCT scans. Therefore, the first objective of our study was to analyze the Schneiderian membrane thickness (the thickness of the lower part of the sinus membrane) and sinus pathologies. The second objective was to determine whether there is a correlation between skeletal malocclusions and the sinus findings.

METHODS

All the CBCT scans performed for general dental purposes from March 2012 to March 2014 at the Faculty of Dentistry, Bezmialem Vakif University, were eligible for inclusion into this study (n=164). The study protocol was approved by the Bezmialem Vakif University, Ethics Committee of Human Studies. Data presenting cleft lip and palate were excluded from the study (n=11). Additionally, poor quality scans of the mandible only or scans of only the upper jaw without the maxillary sinuses were excluded from the study (n=48). Thus, a total of 105 CBCT scans related to 105 patients were eligible for further evaluation. The CBCT scans were divided into three groups according to the skeletal malocclusions: Class I, II, and III. Each group consisted of 35 patients. The mean age of the patients was 24.5±6.9 years. Gender classification revealed more men (n=55) than women (n=50).

All the CBCT images were taken using a small FOV (6 × 6 or 8 × 8 cm; Promax 3D, Planmeca Oy, Helsinki, Finland) and a voxel size of 0.125 mm. The data were reconstructed in 1:1 scaled slices and examined slice by slice in all three planes with the help of the Romexis viewer (Planmeca Oy, Helsinki, Finland). When needed, a magnifier and the ruler tool of the viewer were used.

Two observers reviewed all the CBCT scans independently. The reviewers checked and recorded all the sinus findings and determined the patients' skeletal malocclusions via the CBCT scans (according to the Steiner analysis and Wits appraisal). The pathological findings were classified into the following categories as described by Pazera et al.[10]: 0=no finding, 1=mucosal thickening, 2=partial opacification with liquid accumulation, and 3=total opacification. The two reviewers agreed in 98 of the 105 cases, which resulted in an interrater classification agreement higher than 90%.

Table 1. Descriptives of the groups for the Schneiderian membrane

Group	n	Mean	SD	Minimum	Maximum	ANOVA
I	35	1.025	0.43	0.19	1.98	ab
II	35	0.932	0.51	0.08	1.77	a
III	35	1.27	0.36	0.70	2.52	b

SD: standard deviation

Table 2. Pathological finding percentages in maxillary sinuses

	Group I	Group II	Group III
0	75	72	51
1	16	16	20
2	6	9	26
3	3	3	3

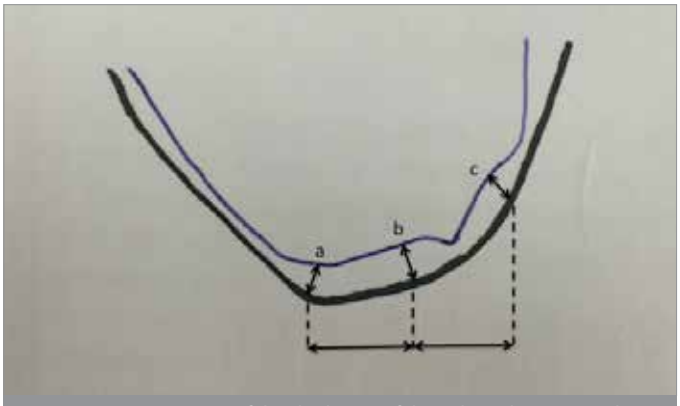

Figure 1. Measurement of the thickness of the Schneiderian membrane at three locations on a schematic coronal view of the maxillary sinus. (b) Deepest point of the recess of the maxillary sinus; (a-c) 5 mm to the facial or palatal side

The Schneiderian membrane thickness was recorded at three representative positions (a, b, c) in the coronal plane. The distance b was measured at the deepest point of the recess of the maxillary sinus. The distances a and c were measured 5 mm buccally and palatally based on line b (Figure 1).

Statistical Analysis

The significance level for all the tests was $p<0.05$. All the statistical analyses were performed with Statistical Packages for the Social Sciences software (SPSS 17.0, Chicago, IL, USA).

RESULTS

The mean membrane thickness was calculated for each patient, and the mean overall membrane thickness was calculated for each group (Table 1). There were significant differences between Group 2 and Group 3. There was no difference between Group 1 and the other groups.

The percentages of total opacification were similar in all groups (3%) (Table 2). In all the groups, only mucosal thickening had high percentages. The highest percentages of mucosal thickening and partial opacification were observed in Group III.

Figure 2. An example of acute sinusitis

Figure 3. An example of polypoidal mucosal thickening

DISCUSSION

The aim of this study was to determine the relation between skeletal malocclusion and maxillary sinus findings. Three types of pathological sinus findings were observed: flat mucosal thickening, polypoid mucosal thickening, and signs of sinusitis (Figure 2, 3).

The season during which the CBCT scans were performed may have affected the development of sinus pathologies. One may expect to find higher frequencies in winter or autumn. However, according to Pazera et al.,[10] the seasons do not affect the frequency of sinus pathologies. The researchers also reported that maxillary sinus findings are not related to gender.

Researchers who have performed CT imaging have confirmed the high prevalence of incidental findings without clinical symptoms. Havas et al.[11] reported that a radiologic abnormality in paranasal sinuses occurred in up to 42.5% of CT scans of asymptomatic patients.Another study reported that patients presenting with symptomatic sinus are more likely to have positive sinus CT findings compared to asymptomatic patients.[12] In our study, we did not consider the clinical history of the scanned patients, because it has been previously revealed that there is only a weak correlation between radiologic airway findings and clinical symptoms.

CT and MRI studies revealed that the coronal view is appropriate for evaluating the mucosal thickness in the maxillary sinus. The measurements have always been performed perpendicular to the underlying bone.[13,14] Two millimeters is an applicable threshold for pathological swellings.[15] Our results confirmed the great interindividual variability related to the Schneiderian membrane thickness, with values ranging from 0.19 to 5.27.

In our study, no signs of osteomyelitis or bone malignancy were observed. However, these kinds of pathologies with a low incidence rate can be present in a patient group. Bornstein et al.[16] revealed a case of Ewing's sarcoma in a young female patient whose CBCT examination showed the proliferation of soft tissue in the maxillary sinus.

In our study, there was no statistical difference between Class I and the other malocclusion groups in the Schneiderian membrane thickness. However, there was a significant difference between the Class II and Class III groups, meaning that the malocclusion might trigger changes in the sinus membrane thickness. The lowest value for the membrane thickness was recorded in the Class II malocclusion group. These patients may present more respiratory problems caused by the backward mandibular position. Similarly, Nunes and Di Francesco[17] stated that adenoid and tonsil enlargements are more often seen with Class II malocclusion.

CONCLUSION

Within the limitations of this study, it can be concluded that there is no relation between the pathological sinus findings and skeletal malocclusion. The only statistical difference in the Schneiderian membrane thickness was recorded between the Class II and Class III malocclusion groups. Therefore, a relationship was found between skeletal malocclusion and incidental maxillary sinus findings.

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