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Research Paper

Estimation and Comparison of the Thickness of the Maxillary Antral Floor in Sagittal and Coronal Sections Using CBCT Images - A Retrospective Study

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ABSTRACT:
Aim: *To estimate and compare the thickness of the maxillary antral floor in sagittal and coronal sections using CBCT images*
Methodology: *The study included 100 retrieved CBCT scans which were analyzed retrospectively using CARESTREAM CBCT software with 50 mm diameter and 37 mm height scan volume. The thickness of the floor of maxillary sinus in the sagittal and coronal sections were analyzed and compared and the scans were analyzed by a single observer.*
Statistical analysis : ANNOVA and SPSS version 15.0 were applied.
Results: *There was a positive correlation observed between coronal and sagittal values when the correlation was assessed by using Karl Pearson's Correlation Coefficient.*
Conclusion: *The significant difference between the thickness of the schneiderian membrane when measured in coronal and sagittal section reflects the need for taking into consideration the measurements of both the sections and obtaining an average of them when placing an implant in the maxillary posterior region to avoid perforation of the sinus membrane.*
Keywords: *Coronal section ; Sagittal section ; Floor of maxillary sinus*

I. INTRODUCTION

The maxillary sinus consists of a pyramidal shaped cavity in the facial skull with its base at the lateral nasal wall and its apex extending into the zygomatic process of the maxilla. After birth, it undergoes two periods of rapid growth, first between birth and 3 years of birth, and then between ages 7 and 18 years. The Schneiderian membrane lines the inner walls of the sinus, which is represented by ciliated columnar cells, goblet cells, and basal cells resting on the basement membrane. The membrane's thickness varies but is generally 0.3 - 0.8 mm in unfixed, fresh cadavers without sinusitis [1]. A study with cone beam computed tomography has showed that individuals vary greatly in the thickness of their Schneiderian membranes from 0.16 to 34.61 mm and the highest mean values have been found in the mid-sagittal aspect [2]. It is essential to check the Schneiderian membrane thickness so as to plan for the sinus augmentation procedure required for the implant placement [3]. This membrane is fragile and an important structure to be dealt with as it should be kept intact. Perforation of the sinus membrane is the most common complication associated with Sinus floor elevation (SFE) / augmentation, occurring in approximately 20% of all cases [4,5,6]. SFE/augmentation is routinely performed to facilitate dental implant placement in the atrophic posterior maxilla. Objective of both the techniques (direct or indirect sinus lift) is to achieve sufficient elevation of the membrane lining of the sinus floor, to allow bone augmentation and/or implant placement. Cone beam computed tomography (CBCT) is an advanced imaging modality which is now-a-days commonly used in the dental practice.

CBCT is suited for use where cost and dose considerations are important, space is often at a premium and scanning requirements are limited to the head. All CBCT units provide correlated axial, coronal and sagittal images. The value of CBCT imaging in implant planning has been reported [7,8,9]. Therefore, preoperative knowledge of membrane characteristics, particularly thickness, can be of great value to the operator. For accurate measurements, both the coronal and sagittal sections should be observed. Very few literature is available for comparison of the thickness of the maxillary antral floor in sagittal and coronal sections. So the aim of the current study was to estimate and compare the thickness of the maxillary antral floor in sagittal and coronal sections using CBCT images.

II. METHODOLOGY

100 patients with maxillary CBCT images of edentulous patients for implant placement in 15-17 and 25-27 region were taken randomly. Patients with age group 20 to 60 years, with maxillary CBCT images with respect to 15-17 and 25-27 region and willing for CBCT diagnostic scan for implant placement were included in the study. Patients with periapical pathology, periodontal infections, maxillary sinus pathology and oro-antral fistula were excluded from the study. Thicknesses of schneiderian membrane in both sagittal and coronal sections were measured using the CARESTREAM CBCT software. The measurement tool was activated and the measurement was taken from the superior most point of the membrane to the inferior most part of it just apical to the floor of maxillary sinus.

Standardization for selection of site -

Implant simulation was done which was common for same patient for both the planes which guided the exact site for measuring the membrane thickness.

Statistical analysis -

Comparison of coronal and sagittal values was done by student's unpaired t-test and correlation between coronal and sagittal values was done by Karl Pearson's Correlation Coefficient.

III. RESULTS

A total of 100 CBCT images of patients were taken in the study which extended from October 2015 to December 2015. For all the CBCT images, thicknesses of schneiderian membrane thickness were taken in both the coronal and sagittal planes using the CARESTREAM CBCT software by activating the measurement tool. For the measurements recorded in coronal section, the minimum was noted as 0.20 mm and the maximum was noted as 0.8 mm as shown in Table 1. For the measurements recorded in sagittal section, the minimum was noted as 0.40 mm and the maximum was noted as 0.9 mm as shown in Table 1. The mean thickness recorded in coronal section was 0.44 mm and in sagittal section was 0.69 mm. It was found that there was statistically significant difference present in between the thickness of schneiderian membrane when measured in sagittal and coronal sections when the comparison of coronal and sagittal values were done by student's unpaired t-test as shown in Table 2. The graphical representation is shown in Graph 1. There was a positive correlation observed between coronal and sagittal values when the correlation was assessed by using Karl Pearson's Correlation Coefficient as shown in Table 3. The graphical representation is shown in Graph 2.

IV. DISCUSSION

The restoration of edentulous spaces in the mouth with endosseous dental implants is gradually becoming more common. The success of dental implants is dependent upon several important considerations. A key challenge for implant placement is the requirement of adequate bone height and thickness of schneiderian membrane at the proposed implant site, which is a very common problem encountered in the rehabilitation of the edentulous posterior maxilla with dental implants. Bone volume in this region is inadequate due to the presence of the maxillary sinus and its continuous pneumatization, and the progressive resorption of alveolar bone height. One of the most effective ways to manage reduced vertical bone height in the posterior maxilla is the SFE / augmentation of maxillary sinus. Therefore a pre-operative knowledge of the thickness of membrane, is of great value to the operator to avoid perforation of the membrane. For accurate measurements, both the coronal and sagittal sections should be observed.

In the current study thus a total of 100 maxillary CBCT images of edentulous patients for implant placement in 15-17 and 25-27 region were included in the study.

In all the CBCT images studied the dimensions of the membrane was taken in both sagittal and coronal sections and it was found that the mean thickness recorded in the sagittal section was greater than the coronal sections in all the CBCT images. Similarly in a study conducted by Simone F. M et al. the authors tried to determine the dimensions of the Schneiderian membrane using limited cone beam computed tomography (CBCT) in individuals referred for dental implant surgery along with factors influencing the mucosal thickness. They concluded that there is a great inter individual variability in the thickness of the schneiderian membrane with gender seems to be the most important parameter influencing mucosal thickness in asymptomatic patients [2]. So there is a variability in the thickness of the membrane considering various parameters.

According to Dula et al. in 2001 and Harris et al. in 2002, due to the complex anatomical situation in the posterior maxilla, cross-sectional imaging (CT scan) has been proposed as the standard radiographic method for preoperative planning of dental implant placement [10,11].

V. CONCLUSION

In the current study, there was statistically significant difference between the thickness of the schneiderian membrane when measured in coronal and sagittal section which reflects the need for taking into

consideration the measurements of both the sections and obtaining an average of them when placing an implant in the maxillary posterior region to avoid perforation of the sinus membrane. To the best of our knowledge there is no literature available on comparison of the thickness of the schneiderian membrane when measured in coronal and sagittal section.

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Tables and Graphs

	Sagittal	Coronal
Minimum (mm)	0.40	0.20
Maximum (mm)	0.90	0.80
Mean (mm)	0.69	0.44
SD	0.15	0.17

Table 1 : Summary of the measurements of the schneiderian membrane in coronal and sagittal sections

Groups	Mean	SD	t-value	p-value
Sagittal	0.69	0.15		
Coronal	0.44	0.17	11.0446	0.0001*

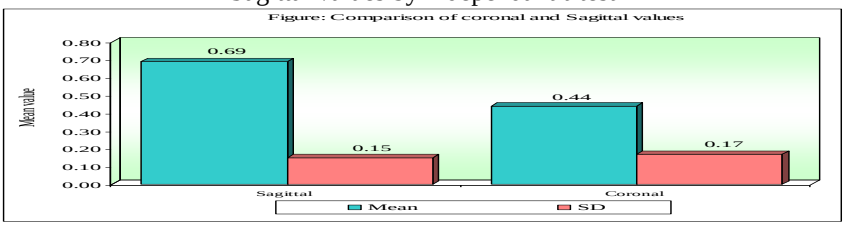
*p<0.05

Table 2 : Comparison of coronal

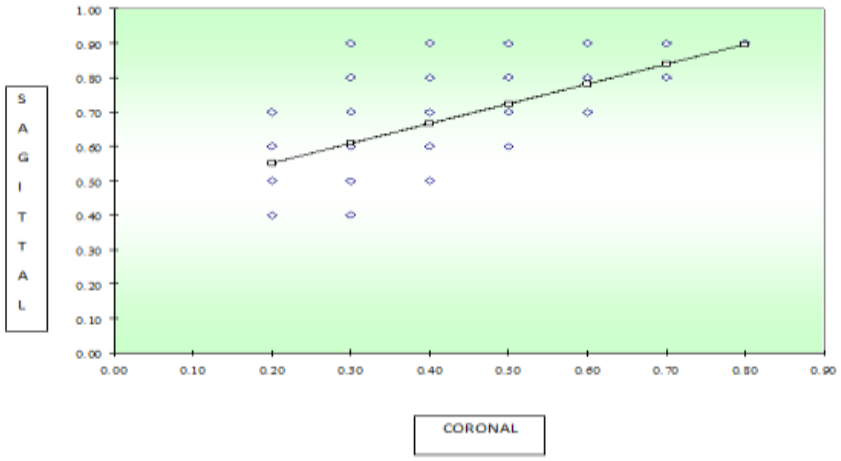
Variables	Correlation between coronal with		
	r-value	t-value	p-value
Sagittal values	0.6820	9.2304	0.0001*

*p<0.05

Table 3 : Correlation between coronal and Sagittal values by Karl Pearson's correlation coefficient method and Sagittal values by independant t-test



Graph 1 : Comparison of Coronal and Sagittal values by Independant t-test



Graph 2 : Correlation between Coronal and Sagittal values by Karl Pearson's Correlation Coefficient Method