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Use of Denta Scan for Assessment of maxillary posterior teeth roots to maxillary sinus and adjacent structures

Dr. Samir Jain[1], Dr. Kumar Gaurav Dubey[2], Dr. Sapna Jain[3]
[1] Professor, Department of Dentistry, ANM Medical College and Hospital Gaya, Bihar, India
[2] Senior Resident, Department of Dentistry, ANM Medical College and Hospital Gaya, Bihar, India
[3] BDS, Swastik Dental Clinic, Gaya, Bihar, India
[*] Corresponding author: Dr. Kumar Gaurav Dubey

Abstract
Dental implants are rapidly gaining acceptance as the replacement therapy of choice in orthodontic surgery. In order for implants to be successful, the orthodontic surgeon needs a thorough understanding of the underlying bone structure and its viability. CT scanning offers detailed information on orthodontic anatomy that can aid in developing an effective therapy. DentaScan performs real time Oblique and Panorex reformations specific to CT dental imaging. DentaScan offers innovative features that assist clinicians with both routine and difficult clinical cases. The present study was planned to assess the relationships and distance between maxillary root tips and the maxillary sinus floor by using DentaScan.
The study was conducted on the 25 patients admitted to Department of the Dentistry in ANM Medical College and Hospital Gaya, Bihar. The patients enrolled patients having normally erupted right and left maxillary first premolar to maxillary second molar.
Hence from present findings will be helpful for knowledge of anatomical positions of molar root tips against maxillary sinus floor, for pre-endodontic and pre-implantation strategy making. A different relationship was observed between the maxillary posterior teeth and floor of maxillary sinus with the buccal and palatal roots.

Keywords: Maxillary sinus, Molar teeth, DentaScan, maxillary posterior teeth etc

Introduction
The pyramid-shaped maxillary sinus (or antrum of Highmore) is the largest of the paranasal sinuses, and drains into the middle meatus of the nose [1]. It is the largest air sinus in the body. Found in the body of the maxilla, this sinus has three recesses: an alveolar recess pointed inferiorly, bounded by the alveolar process of the maxilla; a zygomatic recess pointed laterally, bounded by the zygomatic bone; and an infraorbital recess pointed superiorly, bounded by the inferior orbital surface of the maxilla. The medial wall is composed primarily of cartilage. The ostia for drainage are located high on the medial wall and open into the semilunar hiatus of the lateral nasal cavity; because of the position of the ostia, gravity cannot drain the maxillary sinus contents when the head is erect (see pathology). The ostium of the maxillary sinus is high up on the medial wall and on average is 2.4 mm in diameter; with a mean volume of about 10 ml [1, 2]. Stand near the person during an extraoral examination to visually inspect and bilaterally palpate the maxillary sinuses [3].
The sinus is lined with mucoperiosteum, with cilia that beat toward the ostia. This membrane is also referred to as the "Schneiderian Membrane", which is histologically a bilaminar membrane with pseudo stratified ciliated columnar epithelial cells on the internal (or cavernous) side and periosteum on the osseous side. The size of the sinuses varies in different skulls, and even on the two sides of the same skull [2]. The infraorbital canal usually projects into the cavity as a well-marked ridge extending from the roof to the anterior wall; additional ridges are sometimes seen in the posterior wall of the cavity and are caused by the alveolar canals.
The mucous membranes receive their postganglionic parasympathetic nerve innervation for mucous secretion originating from the greater petrosal nerve (a branch of the facial nerve). The superior alveolar (anterior, middle, and posterior) nerves, branches of the maxillary nerve provide sensory innervation. Maxillary sinusitis is inflammation of the maxillary sinuses. The symptoms of sinusitis are headache, usually near the involved sinus, and foul-smelling nasal or pharyngeal discharge, possibly with some systemic signs of infection such as fever and weakness. The skin over the involved sinus can be tender, hot, and even reddened due to the inflammatory process in the area. On radiographs, there is opacification (or cloudiness) of the usually translucent sinus due to retained mucus [3].
Maxillary sinusitis is common due to the close anatomic relation of the frontal sinus, anterior ethmoidal sinus and the maxillary teeth, allowing for easy spread of infection. Differential diagnosis of dental problems needs to be done due to the close proximity to the teeth since the pain from sinusitis can seem to be dentally related [1]. Furthermore, the drainage orifice lies near the roof of the sinus, and so the maxillary sinus does not drain well, and infection develops more easily. The maxillary sinus may drain into the mouth via an abnormal opening, an oroantral fistula, a particular risk after tooth extraction.
Traditionally the treatment of acute maxillary sinusitis is usually prescription of a broad-spectrum cephalosporin antibiotic resistant to beta-lactamase, administered for 10 days. Recent studies have found that the cause of chronic sinus infections lies in the nasal mucus, not in the nasal and sinus tissue targeted by standard treatment. This suggests a beneficial effect in treatments that target primarily the

underlying and presumably damage-inflicting nasal and sinus membrane inflammation, instead of the secondary bacterial infection that has been the primary target of past treatments for the disease. Also, surgical procedures with chronic sinus infections are now changing with the direct removal of the mucus, which is loaded with toxins from the inflammatory cells [citation needed], rather than the inflamed tissue during surgery. Leaving the mucus behind might predispose early recurrence of the chronic sinus infection. If any surgery is performed, it is to enlarge the ostia in the lateral walls of the nasal cavity, creating adequate drainage [3].

The DentaScan is a software package used to create a cross referenced set of composite axial, Panorex, and Oblique planar images of the mandible and maxilla from computed tomography x–ray scans of the jaw and mouth area. It is intended for use in pre-surgical evaluation for dental implants, and for diagnosis of diseases of the mandible and maxilla. DentaScan is a software visualization tool which provides Oblique and Panorex real time reformation of CT dental images. It is used to assist Radiologists with mandibular and maxillar 2D viewing.

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The present study was planned to assess the relationships and distance between maxillary root tips and the maxillary sinus floor by using DentaScan.

Methodology

The study was conducted on the 25 patients admitted to Department of the Dentistry in ANM Medical College and Hospital Gaya, Bihar. The patients enrolled patients having normally erupted right and left maxillary first premolar to maxillary second molar.

The approval of the institutional ethical committee was taken prior to conduct of the study. All the patients were informed consents. The aim and the objective of the study were informed to them.

Following was the inclusion and exclusion criteria of the study.

Inclusion Criteria: Patients who have having signed consent forms for participation in the study, having had a complete dentition in the maxilla and they were between 15-45 years old.

Exclusion Criteria: Patients having previous maxillofacial trauma, orthognathic surgery, reconstructive surgery, and implant procedures in the posterior of the maxilla.

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Results and Discussion

The data from the 25 patients undergone the DentaScan were collected and presented as below. The patients enrolled patients having normally erupted right and left maxillary first premolar to maxillary second molar.

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Table 1: Relationship between root apex of maxillary posterior teeth and floor of maxillary Sinus

Tooth	Type 0 No. of Cases	Type 1 No. of Cases	Type 2 No. of Cases	Type 3 No. of Cases
Maxillary first premolar				
B	24	1	-	-
P	1	1	-	-
Maxillary second premolar				
B	17	7	-	1
P	16	8	-	-
Maxillary first molar				
MB	8	15	4	2
DB	9	12	4	-
P	10	11	3	-
Maxillary second molar				
MB	7	15	-	1
DB	14	10	-	-
P	16	8	-	-

Table 2: Mean Distance

Tooth	Mean Distance from the floor of maxillary sinus to apex of root (in mm)	Mean distance from root of maxillary posterior teeth to their respective cortical plate (in mm)
Maxillary first premolar		
B	6.50	0.6
P	6.00	1.2
Maxillary second premolar		
B	2.50	1.6
P	2.80	1.8
Maxillary first molar		
MB	0.75	1.05
DB	0.91	1.75
P	1.12	1.25
Maxillary second molar		
MB	0.80	2.15
DB	1.9	2.40
P	2.1	1.80

Appropriate knowledge of the distance and relationship between the posterior maxillary teeth roottips and the maxillary sinus is important when endodontic and pre-prosthetic surgical procedures are planned. Protrusion of the maxillary molar root apices results in post-extraction pneumatization which causes reduction in bone thickness required for implantation.

This assessment is critical when endodontic procedures are performed for maxillary molar teeth. In a study conducted by Ali and colleagues they compared the distance between molar root tips and maxillary sinus floor measured by CT imaging and panoramic radiography. Their study demonstrated that those roots which are detected to be protruding into the sinus cavity in panoramic radiography may be found non-protruding in CT scan evaluations [4]. There is lack of evidence to show the correlation of thickness of maxillary sinus floor and other skeletal factors. Determining the effects of skeletal variations on the distance between molar root tips and the maxillary sinus floor helps the surgeons have better estimation of the risks and cautions which come along the desired procedure. Our study showed the roots of the first molar had more distance to the maxillary sinus floor than the second molars in all groups. This finding addressed the same results by Eberhardt *et al*. [5] The same results were described by Pagin *et al*. [6] Also, Huang *et al*. reported that the first molar roots had more risk to displace the maxillary sinus rather than other posterior teeth [7].

There has been a clear finding that indicated importance of the relationships of the maxillary molars and the maxillary sinus. Kretzschmar and Obayashi demonstrated infections originating from the first and second maxillary molars could directly spread to the maxillary sinus. Protrusion of the root-tips into the maxillary sinus significantly increases post endodontic sinusitis and inflammations of maxillary sinus [8].

Conclusion

Hence from present findings will be helpful for knowledge of anatomical positions of molar root tips against maxillary sinus floor, for pre-endodontic and pre-implantation strategy making. A different relationship was observed between the maxillary posterior teeth and floor of maxillary sinus with the buccal and palatal roots.

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