ACTA SCIENTIFIC DENTAL SCIENCES (ISSN: 2581-4893)

Volume 4 Issue 2 February 2020

Research Article

A Cone Beam Analysis of the Maxillary Bony Canal

Mariam Bedford*

Department Oral and Maxillofacial Radiology, Cape Town Area, South Africa.

***Corresponding Author:** Mariam Bedford, Department Oral and Maxillofacial Radiology, Cape Town Area, South Africa.

DOI: 10.31080/ASDS.2020.04.0765

Received: January 06, 2020

Published: January 27, 2020

Abstract

Aim: To determine the prevalence and diameter of the maxillary end osseous canal which carries the anastomosis of the infra alveolar artery (a branch of the posterior superior alveolar artery) and the infra- orbital artery.

Material and Methods: Data was analyzed from one hundred archived cone beam computed tomography (CBCT) images. The presence of the end osseous anastomosis in the lateral sinus wall was identified by utilizing axial views. The vessel diameter was also measured in those images where the canal was identified.

Results: The maxillary bony canal was identified in 49 (49%) of 100 maxillary sinus. 14 (14%) presented on the right hand side, 10 (10%) presented on the left hand side, 25 (25%) had a bilateral presence with a remaining 51 (51%) which cannot be identified on the imaging. From the 49 canals that were identified, 5 canals had a diameter that was 2 - 3mm wide, 19 canals had a diameter that was 1-2mm wide and the remaining 25 had a diameter that was less than 1mm.

Conclusion: A sound knowledge of the maxillary sinus vascularity is essential as severe bleeding can occur due to damage of the intra-osseous branch during sinus augmentation procedures. CBCT analysis is required as a pre-requisite for the pre-planning stages during implant treatment to prevent complications such as hemorrhage, sinus perforations or associated vascular anomalies that may arise

Keywords: Cone Beam; Maxillary Bony Canal

Introduction

Special care is needed to avoid invading vital anatomic structures during surgical procedures. Dental professionals are accustomed to the traditional dental imaging modalities such as panoramic radiography and intra oral radiography during the pre-surgical planning phase utilizing both the analogue and digital radiographic methods. However, cone beam computed tomography (CBCT) is based on the concept of multiplanar imaging and has the ability to generate images in different planes. The sinus floor represents the danger zone for dental implants [1]. Knowledge of the maxillary arterial blood supply is important during sinus augmentation procedures. Vascular anastomosis perforates the floor of the maxillary sinus and provides a potential site for the spread of disease [2]. There are several vessels that supply the maxillary sinus which must be taken into consideration because of the potential risk of hemorrhage. Anatomic variations of the maxillary artery and its concurrent anastomoses may also occur. Variations in the maxillary sinus such as septa, has been known to increase perforations of the Schneiderian membrane during sinus augmentation procedures [3].

Branching patterns of the posterior superior alveolar artery and infraorbital artery display two distinct patterns. The first type shows that both these arteries branch directly from the

MA. In second variant, these two arteries originate from a short branch of the maxillary artery [4,5]. The maxillary artery is the most vulnerable anatomical structure during craniomaxillofacial procedures [5]. The primary blood supply to the sinus is derived from the anastomoses of the dental branch of the posterior superior alveolar artery (PSAA), known as the alveolar antral artery (AAA) and the infraorbital artery (IOA), both being branches of the maxillary artery. The maxillary bony canal contains the intra osseous anastomoses between the alveolar antral artery (AAA) and the infraorbital artery (IOA).

Variation in the arterial system has been well documented within the literature. Lydia., *et al*. reported that 30.5% of cases passed superficially, 69.5% passed deep to the lateral pterygoid. Normal branching of the third part of the maxillary artery occurs at the height of the posterior lateral aspect of the maxillary sinus. The maxillary artery can be classified into four types based on the branching patterns of the sphenoplatine artery (SPA) and the descending palatine artery (DPA) which has proven to be similar in the Morton and Khan Classification (Figure 1) [4].

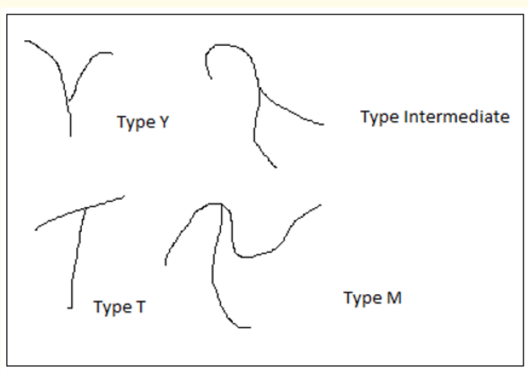

Figure 1: Morphologic classification of the Maxillary artery based on contours of the third portion.

Morton and Khan classified the morphology of the third portion of the maxillary artery based on the contour pattern [4] which are type Y, intermediate and type M. Morton and Khan also established that the various branching patterns were located in the middle third with occasional extension to the upper third of the posterolateral antral wall [5]. According to Park., *et al*. [4], it can be classified into five types namely type Y, intermediate, T, M, and other. The branching patterns of the third part of the maxillary artery were generally similar throughout the literature.

The maxillary bony canal is located on the inner surface of the maxilla. The bony canal follows a concave arch course with the first molar area being the most inferior site [6]. Sato., *et al*. [7] described the bony canal structure surrounding the PSAA using CBCT in 19 cadavers and classified them into three types namely canal-like, ditch-shaped tunnel and fragmented. Sato., *et al*. [7] reported the ditch-shape tunnel structure to be the most common (67, 6%) of all images observed. The varied appearance of the bony canal has been observed using both CT (53%) and CBCT (71.4%) [7].

Yoshida., *et al.* [8] reported that the anastomoses can be located at a height of 23 - 26mm above the alveolar ridge. Rosano and colleagues [9] identified this anastomoses at a distance of 18.9 mm to 19.66 mm from the alveolar crest. They also reported a mean vertical distance of 29mm above the alveolar crest with a canal diameter of 1mm in 53%,1 - 2 mm in 40.4% and 2 - 3 mm in 4.3%of cases examined.

According to Mardinger., *et al.* [6], the canal diameter is directly related to the age of the patient. Older patients have wider canal diameters. No correlation was found with gender, sinus position or presence/absence of teeth. This study will provide clarity on the features of the intra osseous canal as well as the relevance for practical clinical application in that no literature is available regarding visualization of these two arteries using CBCT [7].

The AIM of this study is to

Determine the frequency and characteristics of the maxillary bony canal located on the lateral border of the maxillary sinus.

The Objectives are

To investigate the prevalence of the maxillary bony canal utilizing CBCT records from an archived patient database.

To study variation in the maximum diameter size of the intraosseous canal. If present, determine if they are bilateral or unilateral.

Method and Materials

Study sample

A sample of 100 pre-operative cone beam records were analyzed from CBCT patient records that presented for placement of posterior maxillary dental implants at the Oral Health Centre, Faculty of Dentistry, University of the Western Cape, Tygerberg Campus. The first one hundred implant patient records were selected from the database. A selection of 100 patient records would yield 95% confidence limit of +/-0.10 whereas a sample size of 50 would have a width of +/-0.14. These values are based on current prevalence figures of a 60% frequency.

Inclusion criteria

Any patients requiring a CBCT as part of pre-planning stage for the placement of implants.

Exclusion criteria

Any patient with abnormalities of the mid –facial region including the maxillary sinus e.g. Malignancies, fractures, etc.

Study design

This is a retrospective cross sectional study of 100 cone beams records utilizing the New Tom VGI EXPERT suite. This specific software configuration allows all tasks which include scanning such as primary volumetric, secondary and 3D imaging reconstruction, report creating and printing.

Radiological interpretation

CBCT records will be analyzed by one observer with experience of examining CBCT images and will be noted on a separate form to indicate the prevalence.

The maximum diameter will be measured by two observers and then compared. These two values will be added together and then used to calculate the mean.

Data record

100 CBCT records were selected from the CBCT database.

Each patient record, which was selected, has a unique folder number.

The folder will then be allocated an individual record number which will be used as the first index data set.

This index data set will be kept separate and used to ensure confidentiality as well as a cross reference.

The second index data set would then contain the allocated record number together with ten axial views of each patient.

These axial views will be selected from the original CBCT record and saved in the second index data The selected axial view will start at the floor of the maxillary sinus and be measured in increments of 1mm. The ten axial views will be measured from inferior to superior (as indicated in Figure 2 to 5).

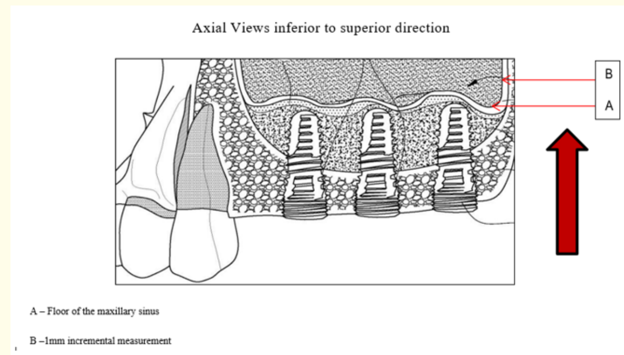

Figure 2: Incremental measurements to be made.

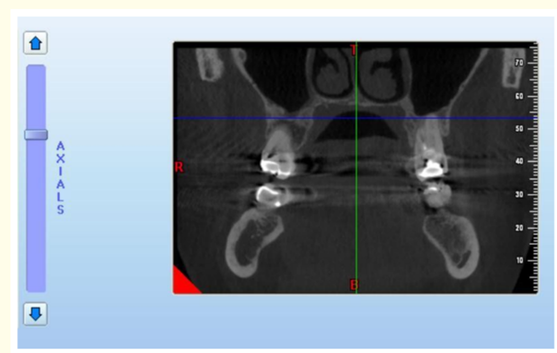

Figure 3: Baseline for initial measurements.

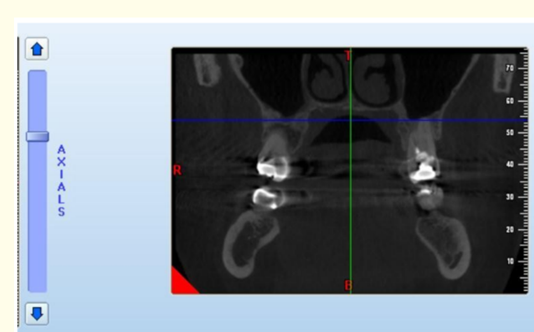

Figure 4: Incremental measurements made on CBCT.

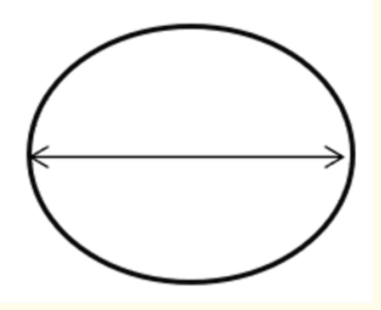

Figure 5: Diagram indicating maximum diameter.

This applies for both left and right sides.

Data will then be recorded on Form A.

Upon completion, data will be entered into statistic software for analysis.

Data analysis

Data will be analyzed by entering the statistics into the Epi-Info Version 3.4.3 database. Data will be analyzed using descriptive statistics such as the observer prevalence with a 95% confidence limit. The mean would also be calculated for the maximum diameter in descriptive analysis of data.

Ethical clarity

Permissions to access the records were obtained from the Head of the Department of Maxillofacial Radiology and Diagnostics. Patient confidentiality was maintained by the creation of an index data set which links the patient folder number to the allocated record number. Consent was not to be obtained because the records are archived.

No conflict of interest was declared.

Results and Data analysis

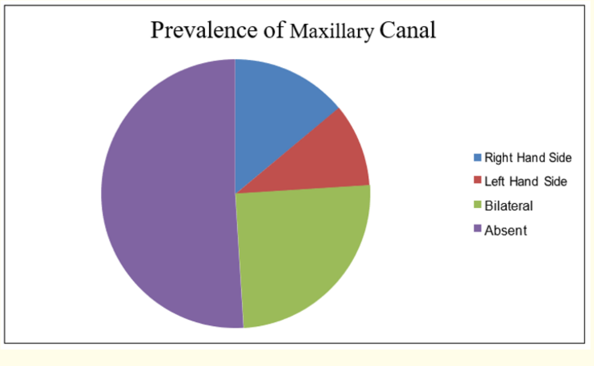

Figure 6: Prevalence of the maxillary canal in 100 patient records.

The figure above indicates the following

14% prevalence on the right hand side with a confidence interval of 7, 9% to 22%. 10% prevalence on the left hand side with a confidence interval of 49% to 17, 6% 25% presented bilaterally with a confidence interval of 16, 9% to 7% 51% had complete absence thereof with a confidence interval of 40.8% to 61.1% Previous results show a detection rate of 52.9% [11]. Mardinger., *et al*. [6] detected a prevalence of 55%. Kim., *et al.* [5] had a detection rate of 67.5%. Elian., *et al.* [10] stated that although the vessel is only evident in 53%, it is present 100% of the time. Woo., *et al*. [11] detected the canal in 54.8% which is similar to the expression in previous studies.

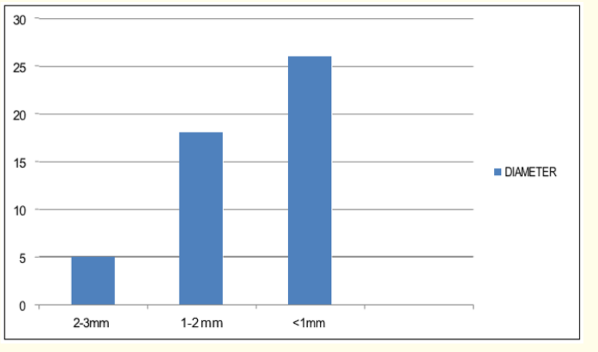

Figure 7: Number of cases.

Diameter

The diameter readings were calculated according to the diameter size found in the forty nine patients who presented with the canal either bilaterally or unilaterally. The following results were found:

- 2-3mm category : 5 (10.2%)
- 1-2mm category: 18 (36.7%)
- <1mm category: 26 (53. 1%).

Guncu., *et al.* [12] reported that mean diameters were 1.6mm in origin, with a range of 1.2 mm to2.7mm. When a mean was calculated for each sinus, 4.9% of the vessels had a diameter of < 2 mm. Mardinger., *et al.* [6] reported that 6.7% of the vessels examined had a vessel of > 2mm. This may explain why there is a very low incidence of bleeding.

Discussion

According to this study, a maxillary canal was identified in 49% of examined CBCT patient records. The results do correlate with previous studies mentioned in the literature. According to Mardinger., *et al*. [6], a study done by Traxler in 2007 found a 100% presence which means that an undetected bony canal in a CT does not exclude its absence, but is rather indicative of its small diameter. The distance of this anastomoses runs a concave course with distances which range between 5mm and 29mm to the alveolar crest [6]. Solar., *et al.* reported distances to be between 17mm and 23mm. The differences between these two studies are most likely due to the smaller number of cases examined in the study conducted by Solar., *et al.* [13].

Variations only exist in the position and diameter of the canal [7]. However the following parameters have also been discussed and compared in previous studies which may have an effect in detecting the canal as well as relate to characteristics of this anatomical landmark. They are:

Gender: Mardinger., *et al*. [7] could not find a difference between men and women in the diameter of the canal.

Age range: According to Elian., *et al.* [10], the vessel diameter is reduced in older patients. Mardinger., *et al.* [7] contradicts this statement stating that diameter of the artery did not change according to age. Mardinger., *et al.* [7] discovered a relationship but found the diameter to be wider in older patients.

Dentate versus edentulous specimens

Several theories have been suggested to explain alveolar crest atrophy. These include functional upload, ischemia, pressure and local inflammation. According to Nimegean., *et al.* [1], three subantral classes (SAC) were discussed based on the average height of the available bone in the edentulous maxilla as well as the age of edentulism. They are:

- **SAC 1:** Bone height 10mm with no edentulism older than five years.
- **SAC 2:** Bone height 5 - 10mm with edentulism5 - 10 years old without prosthetic treatment.
- **SAC3:** Bone height 0 - 5mm with edentulism more than ten years old without prosthetic treatment.

In the event that the alveolar ridge is severely resorbed, there is a likelihood that the anastomosing vessel will be in closer proximity to the alveolar crest than the reported value of 16.4mm [10] and 16.9mm [6]. However, such data can be misleading because the height of the residual bony ridge, the class of maxillary atrophy and the presence of teeth plays a pivotal role in determining the location of this vessel [9]. According to Woo., *et al*. [11], the posterior superior alveolar anastomosis is shorter in edentulous groups compared to non-edentulous groups. This then confirms that the more resorbed the ridge, the higher the violation risk of this vessel during augmentation procedures. Extreme caution must be exercised when the residual ridge height is < 3mm [9]. The clinical challenge is further exacerbated by post extraction ridge resorption associated with increased pneuamatization creating proximity to the antral floor [14].

Cone beam and other techniques

In the field of dental implantology, assessment of the surrounding alveolar bone and dentition is largely dependent on two dimensional imaging modalities which include both digital and conventional radiography.it is evident that panoramic radiography cannot illustrate the width of the bucco-lingual alveolar ridge or the angle for the placement of future dental implants.

Intraoral periapical (IOPA) and panoramic radiographs are not accurate in revealing true ridge morphology specifically defects located in the labial cortical plates [15]. Periapical radiography is limited because information is two dimensional. Interpretation becomes difficult in the posterior maxillary region where the roots of the teeth overlap as well as the presence of anatomic structures (maxillary sinus, zygomatic buttresses) are present.

Panoramic radiography cannot be eliminated in cases without complications when the number of future implants is considerably low [16]. Panoramic imaging as a two dimensional imaging modality possesses limitations in the assessment of the implant site alone. Pathologies in the maxillary sinus are often over projected such and cannot determine a three dimensional architecture [17].

Methods used in the past for implant programs had limited use and only allowed bi- dimensional and inexact analysis [16]. It is for this reason that three- dimensional modalities have proven to be superior in detecting change in the maxillary sinus [18] recent radiographic imaging such as Computed tomography (CT), magnetic resonance imaging (MRI) and CBCT have become necessities in adequate assessment of the jaws.

Computed tomography (CT)

CT is a form of digital imaging that enable the differentiation and quantification of hard and soft tissues. Initially, CT has revolutionized bone analysis and treatment planning. CT creates a three dimensional reconstruction of any anatomical area of interest in an axial, sagittal and frontal planes.

Medical CT utilizes a fan-shape beam which acquires individual image slices with a number of rotations. Each slice requires a separate scan and reconstruction. CT imaging is very often non-isotrophic which implies that the resolution is not equal for all three directions in space.

The resolution of one slice can be less than 1mm. the spaces between the various slices are usually within the range of one millimeter or more [18].

Magnetic Resonance Imaging

MR images are based on the application of electromagnetic fields and radiofrequency waves which are believed to be harmless to the body making it biologically safe. All data acquired is from the concentration of hydrogen atoms in the body. MR allows for the formation of representative images only of the structures formed in the layers of pre-selected images and pre-orientated in space. It is possible to scan each plane of interest without further reconstruction of the image.

MR provides a high resolution image of the implant site. It produces an image which gives three dimensional information on the spatial relationship of important structures. MR provides good definition of detail which allows for complete flexibly in the alignment of the image slices. This allows the operator to move the acquisition plan as appropriate.

Another advantage of MR imaging in implantology is the use of a permanent magnet of 0.2 Tesla. This produces a lower noise produced by the scanners due to the reduced vibration forces acting on the magnetic coil gradient. The application of using a low-field MR with a Tesla means cost is reduced. All relevant structures are well displayed.

However, additional studies are deemed necessary to determine the technical advantages of resonance at lower magnetic fields compared to those of CT. MR images in comparison to CT is so exact that it even shows clot formation in the empty alveolus. For future application of MR, the use of open low intensity magnetic field scanners could ultimately reduce costs and extend the use of this technique without exploitation of the few scanners that are available for the study of serious disease [19].

Cone beam computed tomography

CBCT provides a three dimensional image and can provide vital information about morphology. CBCT offers increased precision lower radiation doses to the patient. CBCT has several advantages some of which are listed below [17]:

- Rapid scan time as compared to normal panoramic radiography.
- Complete 3D reconstruction when taken at any angle.
- Beam collimation limits radiation to area of interest.
- Patient radiation dose is five times less than normal CT.
- Image resolution ranges from 0.4mm to as low as 0.076mm voxel.
- The data projected provides images in axial, sagittal and coronal planes.
- Volumetric datasets allow for multiplanar reconstruction.
- 3D volume rendering is made possible by either the direct or indirect technique.
- Patient positioning is made easy by means of the three positioning beams.
- Reduction in image artefacts.

It has been reported that CBCT provides diagnostic accuracy of 61%, Digital radiography 39% and conventional radiographs 44% [20]. It was also found that CBCT systems provided intra- and interobserver agreement higher than that of conventional radiographs. According to Hu., *et al*. [20], digital panoramic radiography can be used during the pre-surgical planning in the mandible, but cannot be used in the maxilla when evaluation of a structure in a bucco-lingual location is required. CBCT provides information about the bucco-lingual relationship which cannot be obtained from digital panoramic radiography. CBCT has limitations such as specific artifacts, limited volume and the lack of soft tissue information [21-37].

Conclusion

It is important to have a comprehensive knowledge of the maxillary artery and its distribution in order to avoid intraoperative bleeding. Variations occur in the position, diameter and length of the canal. The studies confirm that a small diameter of an intra-bony canal does not exclude existence, but may be the reason that it is not detected [6].

As with emerging imaging modalities, CBCT scanners has been both criticized and acclaimed. The technology is limited by lack of user experience as well as the availability of the small body of related literature [17]. The application of CBCT is still limited due to the inferior quality when compared to CT [17]. CBCT is an essential tool in both implant selection and placement [17].

It is therefore clinically important for dental specialists to be aware of the localization of the anastomoses in order to prevent vascular complications that can arise from surgical procedures in an anatomically demanding area. Both radiologists and dental specialists must be familiar with the normal anatomy in this area as well as anatomic changes that may occur after surgery [2]. Parameters such as the existence of a large diameter anastomoses, the dimension of the lateral wall of the maxillary antrum, the nature of the sinus membrane and presence of maxillary septa must also benoted.

Therefore, my research is relevant because knowledge of the maxillary arterial supply is of utmost importance when placing posterior maxillary implants which may involve sinus augmentation. Although accidental laceration of the vessels is not life threatening, Visualisation may be impaired which will compromise the procedure. Preservation of this anastomosis is also important in supporting bone graft neoangiogenesis, its concomitant relationship with the sinus membrane especially when the diameter is constant.

Bibliography

1. Nimegean V., *et al*. "The maxillary sinus floor in the oral implantology". *Romania Journal of Morphology and Embryology* 49.4 (2008) 485-489.

2. Abrahams JJ., *et al*. "Sinus lift procedure of the maxilla in patients with inadequate bone for dental implants: radiographic appearance". *American Journal of Roentgenology* 174.5 (2000): 1289-1292.

3. Lee W., *et al*. "Analysis of location and prevalence of maxillary sinus septa". *Journal of Periodontal and Implant Science* 40 (2010): 56-60.

4. Park W., *et al*. "Study on the position of the posterior superior alveolar artery in relation to the performance of the maxillary sinus bone graft procedure in a Korean Population". *Journal of the Korean Association of Oral and Maxillofacial Surgeons* 38 (2012): 71-77.

5. Kim JK., *et al*. "Anatomical Variability of the Maxillary Artery". *Archives of Otolaryngology - Head and Neck Surgery* 136.8 (2010): 813-818.

6. Mardinger O., *et al*. "Prevalence, diameter and course of the maxillary intraosseous vascular canal with relation to sinus augmentation procedure: a radiographic study". *International Journal of Oral and Maxillofacial Surgery* 36.8 (2007): 735-738.

7. Sato I., *et al*. "Observing the bony canal structure of the human maxillary sinus in Japanese cadavers using cone beam CT". *Okajimas Folia Anatomica Japonica* 87.3 (2010):123-128.

8. Yoshida S., *et al*. "Evaluation of the blood and nerve supply patterns in the molar region of the maxillary sinus in Japanese cadavers". *Okajimas Folia Anatomica Japonica* 87.3 (2010): 12.

9. Rosano G., *et al*. "Maxillary sinus vascular anatomy and its relation to sinus lift surgery". *Clinical Oral Implants Research* 22 (2011): 711-715.

10. Elian N and Wallace S. "Distribution of the maxillary artery in relation to sinus floor augmentation". *The International Journal of Oral and Maxillofacial Implants* 20 (2005): 784-787.

11. Woo I. "Maxillary Sinus Elevation: Review of Anatomy and two techniques". *Implant Dentistry* 13.1 (2004): 28-32.

12. Guncu G., *et al*. "Location of posterior superior alveolar artery and evaluation of maxillary sinus anatomy with computerized tomography: a clinical study". *Clinical Oral Implants Research* 22 (2011): 1164-1167.

13. Solar P., *et al*. "Blood Supply to the Maxillary Sinus relevant floor elevation". *Clinical Oral Implants Research* 10.1 (1999): 34-44.

14. Toffler M. "Short Implants: A Viable Treatment Option in the Anatomically Challenged" Patient. Inside Dentistry January Ulm, C.W., Solar, P., Krennmair, G., Matejka, M., Watzek, G., Incidence and suggested surgical management of septa in sinus-lift procedures". *The International Journal of Oral and Maxillofacial Implants* 10 (1995): 462-465.

15. Arora S., *et al*. "Role of Cone Beam Computed Tomography in Rehabilitation of a Traumatised Deficient Maxillary Alveolar Ridge Using Symphyseal Block Graft Placement". *Case Reports in Dentistry* (2013): 7488405.

16. Georgescu C., *et al*. "Cone beam computed tomography as a method of quantitative analysis of alveolar crest in the frontal mandibular area". *Romanian Journal of Morphology and Embryology* 51.4 (2010): 713-717.

17. Mohan R., *et al*. "Three-dimensional Imaging in periodontal diagnosis-Utilization of cone-beam computed tomography". *Journal of Indian Society of Periodontology* 15.1 (2011): 11-17.

18. Neugebauer J. "Evaluation of Maxillary Sinus Anatomy by Cone-beam CT prior to sinus floor elevation". *International Journal of Oral and Maxillofacial Surgery* 25 (2010): 258-265.

19. Pompa V., *et al*. "A Comparative study of the Magnetic Resonance and Computed Tomography in the pre- implant evaluation". *Annali di Stomatolgia* 3 (2010): 33-38.

20. Hu K., *et al*. "Reliability of two different presurgical preparation methods for implant dentistry based on panoramic radiography and cone-beam computed tomography in cadavers". *Journal of Periodontal and Implant Science* 42 (2012): 39-44.

21. Lana J., *et al*. "Anatomic Variations and lesions of the maxillary sinus detected in cone beam computed tomography for dental implants". *Clinical Oral Implants Research* 23 (2011):1398-140.

22. Ardekian L and Mactei E. "The clinical significance of sinus membrane perforation during augmentation of the Maxillary Sinus". *Journal of Oral and Maxillofacial Surgery* 64 (2006): 277-282.

23. Beretta M., *et al*. "Schneiderian Membrane Elevation in Presence of Sinus Septa: Anatomic Features and Surgical Management". *International Journal of Dentistry* (2012).

24. Flanagan D. "Arterial supply of the maxillary sinus and potential bleeding". *Implant Dentistry* 14.4 (2005): 336-338.

25. Gosau M., *et al*. "Maxillary Sinus Anatomy: A Cadaveric Study with Clinical Implications". *The Anatomical Record* 292 (2009): 352-354.

26. Janner S., *et al*. "Characteristics and dimensions of the Scneiderian membrane: a radiographic analysis using cone beam computed tomography in patients referred for dental implant surgery in the posterior maxilla". *Clinical Oral Implants Research* 22 (2011): 1446-1453.

27. Krennmair G. "The incidence, location, and height of maxillary sinus septa in the edentulous and dentate maxilla". *Journal of Oral and Maxillofacial Surgery* 57 (1999): 667-667.

28. Lawson W., *et al*. "The Development and Pathologic Processes that Influence Maxillary Sinus Pneumatization". *The Anatomical Record* 291 (2008): 1554-1563.

29. Meleo D., *et al*. "Management of the Scheiderian membrane perforation during the maxillary sinus elevation procedure: a case report". *Annali di Stomatolgia* 3.1 (2012): 24-30.

30. Otake I., *et al*. "Clinical Anatomy of the Maxillary Artery". *Okajimas Folia Anatomica Japonica* 87.4 (2010): 155-164.

31. Rege I., *et al*. "Occurrence of Maxillary sinus abnormalities detected by cone beam CT in asymptomatic patients". *BMC Oral Health* 12 (2012): 30.

32. Rosano G., *et al*. "Maxillary Sinus Vascularization: A cadaveric Study". *The Journal of Craniofacial Surgery* 20 (2009): 1-4.

33. Serkerci A., *et al*. "Aberrant Anatomical Variation of Maxillary sinus Mimicking Periapical Cyst: A report of two cases and Role of CBCT in diagnosis". *Case Reports in Dentistry* (2013).

34. Sekine H., *et al*. "Dental Implant Treatment with Different Techniques for Sinus Floor Elevation- A Case Report". *The Bulletin of Tokyo Dental College* 48.2 (2006): 87-91.

35. Testori T. "Maxillary sinus surgery: Anatomy and advanced diagnostic imaging". *International Dentistry African Edition* 2.5 (2013): 6-15.

36. Testori T. "Prevention and Treatment of Postoperative Infections after sinus elevation Surgery: Clinical Consensus and Recommendations". *International Journal of Dentistry* (2012).

37. Underwood AS. "An inquiry into the anatomy and pathology of the maxillary sinus". *Journal Anatomy Physiology* 44 (1910): 354-369.