

Normal Radiographic Anatomy – Maxillary Lateral Area

Carmen Elena Georgescu¹, Gabriela Tănase², Augustin Mihai³

Bucharest, Romania

Summary

Intraoral examinations are the backbone of dental radiography. Every radiographic examination should produce radiographs of optimal diagnostic quality, incorporating the following features: (a) recording the complete areas of interest on the image, (b) having the least possible amount of distortion, (c) having optimal density and contrast. Although the diagnostic information provided by radiographs may be of definite benefit to the patient, dental clinicians have to be considered when is absolutely necessarily using the radiographic examination.

The objective of this study is to present the normal radiographic anatomy of maxillary lateral area in the periapical, panoramic, occlusal, cephalometric radiographs and volumetric computed tomography.

Material and method. This study includes 17 images which present normal anatomy of the maxillary lateral area. The results show the importance of radiographs in helping the clinician to recognize normal structures and to guide the choice of proper implants in different sites of the maxillary lateral area.

The conclusion of the study encourages the use of volumetric computed tomography as a new technique that permit standard visualization and complex image analysis, especially when considering use of implants.

Key words: anatomy, maxillary lateral area, radiographs, tomography

Introduction

The goal of dental care is to preserve and improve patients' oral health while minimizing other health-related risks [1]. The decision to conduct a radiographic examination is based on the individual characteristics of the patient [2]. These include age, general health, clinical findings, and dental history. At the first patient visit it is necessary to obtain the patient's medical and dental history. After the recording of this information the patient is clinically examined. This examination may disclose dental problems that will prove crucial to decisions relevant to the radiographic examination. A radiographic examination is necessary when the history and clinical examination have not provided enough information to evaluate completely a patient's condition and formulate an appropriate treatment plan. Radiographic exposures are necessary only when the patient will potentially benefit by the discovery of clinically useful information on the radiograph [3].

Objectives

The purpose of this article is to illustrate the normal radiographic anatomy of maxillary lateral area in the periapical, panoramic, occlusal, cephalometric radiographs and finally in volumetric computed tomography [4-6].

Material and method

The maxillary lateral area is presented on the skull, in different types of radiographs and in volumetric computed tomography.

A. Maxillary Premolar Area

1) Skull Anatomy (Fig. 1, 2)

In Fig. 1 and 2 are presented anatomic structures that are visualized on the skull from lateral and bottom views.

2) Periapical radiographs (Fig. 3 and 4):

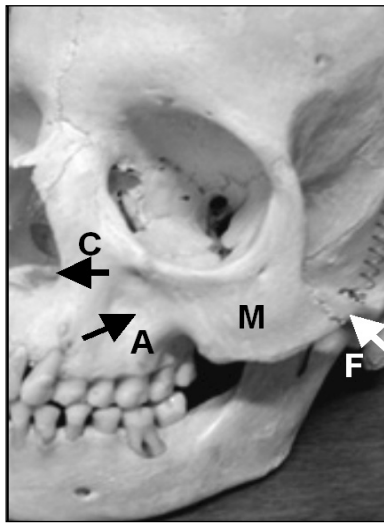
(A) In the maxillary premolar area the radiolucent **maxillary sinus (Fig. 1A, 3A, 4A)** may be

¹ DMD, MPhil, PhD student, Assist. Prof., Department of Prosthodontics Technology and Dental Materials, Faculty of Medicine, „Carol Davila” University of Medicine and Pharmacy, Bucharest

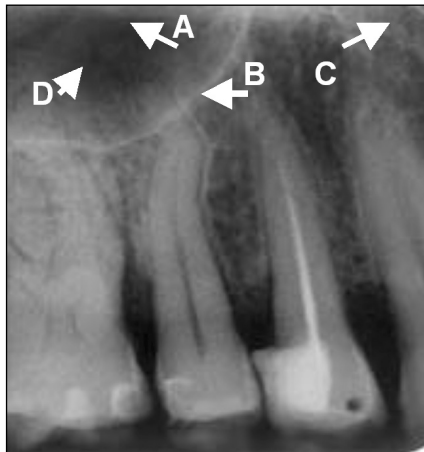
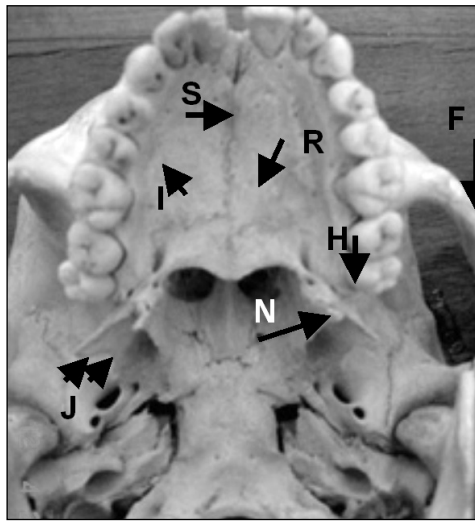
² DMD, PhD student, Assist. Prof., Department of Dental Implantology, Faculty of Medicine, „Carol Davila” University of Medicine and Pharmacy, Bucharest

³ DMD, Prof., Department of Dental Implantology, Faculty of Medicine, „Carol Davila” University of Medicine and Pharmacy, Bucharest

*Fig.1
Skull - lateral
view*



*Fig. 2
Skull -
bottom view*



*Fig. 3, 4. Periapical
radiographs - maxillary
premolar area*



Fig.1, 2, 3, 4: Maxillary Premolar Area: (A) Maxillary Sinus, (B) Floor of Maxillary Sinus, (C) Floor of Nasal Fossa, (D) Nutrient Canals, (E) Bony Septum, (F) Zygomatic arch, (I) Palate, (J) Pterygoid Plates, (M) Zygoma, (N) Hamulus, (R) Torus Palatinus, (S) Intermaxillary Suture

seen either superimposed on, between, or above the apices of the teeth. It is not always visible because of vertical angulation of the X-ray beam, or due to the fact that size and position of maxillary sinus may vary from one patient to another.

(B) The floor of the maxillary sinus (Fig. 3B, 4B) can be seen as a radiopaque line running horizontally at its lower border.

(C) The floor of the nasal fossa (Fig. 1C, 3C, 4C) appears as a radiopaque line running more or less horizontally at the superior portion of the maxillary sinus, depending on film placement, and is superimposed high on maxillary views. The image, a solid opaque line, frequently appears somewhat thicker than the adjacent sinus walls and septa.

(D) Nutrient canals (Fig. 3D, 4D) may be seen in the alveolar bone along with grooves for vessels in the walls of the maxillary sinus.

(E) Bony septum (Fig. 4E) may be seen in the maxillary sinus.

The **edentulous premolars maxillary** radiograph is identified by the presence of the **maxillary sinus (A)** in the mesial part of the film and the start of the radiopaque **zygomatic arch (F)** (Fig. 1F, 2F) at the distal portion of the film. In some edentulous films the shadow of the **buccinator muscle (G)** is seen. In *fig. 5* is the image of this muscle on a CT using MPR axial plan reformation.

3) Panoramic radiographs (Fig. 6):

The anatomic structures from the maxillary lateral area which are seen on the panoramic radiographs are: (A) Maxillary Sinus, (H) Maxillary Tuberosity, (E) Bony Septa in Maxillary Sinus, (F) Zygomatic Arch, (I) Palate, (J) Pterygoid Plates, and (K) Orbit.



Fig. 5 CT (G) Buccinator muscle

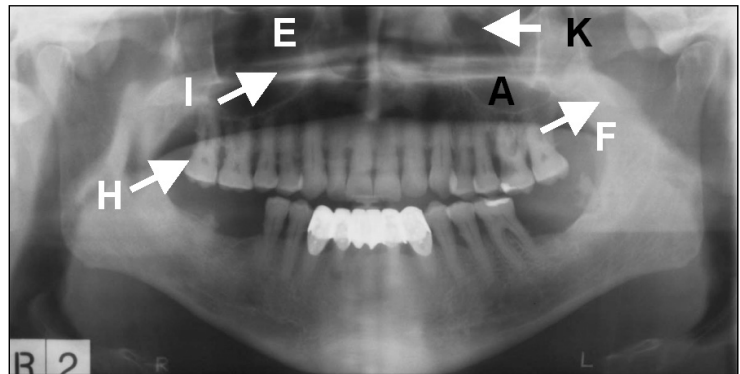


Fig. 6 Panoramic radiograph:
(A) Maxillary Sinus, (H) Maxillary Tuberosity,
(E) Bony Septa in Maxillary Sinus,
(F) Zygomatic Arch, (I) Palate,
(J) Pterygoid Plates, (K) Orbit.

4) Occlusal radiographs (Fig. 7):

The anatomic structures from the maxillary lateral area that are seen on the occlusal radiographs are: (A) Lateral wall of maxillary sinus, (B) Nasal fossa, (C) Lateral wall of nasal fossa, (D) Intermaxillary suture, (E) Inverted "Y".

5) Cephalometric radiographs (Fig. 8):

The anatomic structures from the maxillary lateral area which are seen on the cephalometric radiographs are:

(A) Maxillary Sinus, (H) Maxillary Tuberosity, (F) Zygomatic Arch, (I) Palate, (J) Pterygoid Plates, and (K) Orbit.

B) Maxillary Molar Area

1) Skull Anatomy (Figs. 9 and 10)

In Fig. 8 and 9 are presented anatomic struc-

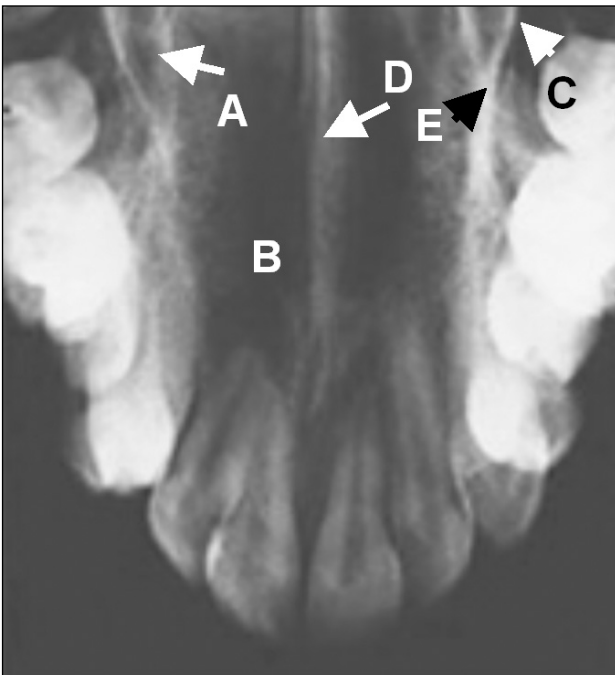


Fig. 7 Occlusal radiograph
(A) Lateral wall of maxillary sinus,
(B) Nasal fossa, (C) Lateral wall of nasal fossa,
(D) Intermaxillary suture, (E) Inverted "Y"



Fig. 8 Cephalometric radiograph:
(A) Maxillary Sinus, (H) Maxillary Tuberosity,
(F) Zygomatic Arch, (I) Hard Palate (floor of the
sinus), (J) Pterygoid Plates, (K) Orbit

tures of maxillary lateral area that are visualized on the skull from lateral view, with mandible closed and opened.

2) *Periapical radiographs (Fig. 11, 12 and 13)*

(A) The maxillary sinus (Fig. 9A, 10A, 11A, 12A, 13A, and 14A) is a radiolucent area that always appears on periapical projections on the maxillary molar region. The size of the maxillary sinus varies greatly because of age, morphology, radiographic projection, and vertical angulation used. Patient's sinuses may be asymmetric and may tend to enlarge or grow into areas of the alveolar ridge where teeth have been extracted. The process is called *pneumatization*.

The sinus may be unilocular or compartmentalized by **(E) bony septa (Fig. 11E, 13E, 14E)**. These septa represent folds of cortical bone, usually oriented vertically, varying in number, thickness, and length. Septa deserve attention because they sometimes mimic periapical pathoses, and the chambers they create in the alveolar recess may complicate the search for a root fragment.

(B) The floor of the maxillary sinus (Fig. 11B, 12B, 13B) occasionally shows small radiopaque projections or spurs, which are nodules of bone. These must be differentiated from root tips, which they resemble in shape. In contrast to a root fragment, which is quite homogenous in appearance, the bony nodules often show trabeculation. A root fragment may also be recognized by the presence of a root canal.

(D) Blood vessels or nutrient canals (Fig. 12D, 13D, 14D) are radiolucent tracts or grooves, seen in the walls of the sinus.

(H) Just distal to the third molar ridge area is the **maxillary tuberosity (Fig. 2H, 10H, 12H, 13H)**. This area of cancellous bone also may contain the posterior extension of the maxillary sinus. The large, fibrous buildup of soft tissue above the tuberosity may cause a slightly radiopaque shadow on the radiograph and is called the tuberosity pad.

(L) The zygomatic process of the maxilla (Fig. 11L, 12L, 13L) is seen as a U-shaped radiopaque line superimposed on the roots of the first and second molars and the maxillary sinus. The size and width of the zygomatic process are quite variable, depending on the angle at which the beam was projected.

(M) The malar bone (zygoma) (Fig. 9M, 10M), which is a continuation of the zygomatic process, appears as a broad, uniform radiopaque band that extends posteriorly. It can be identified as

a uniform gray or white radiopacity over the apices of the molars. Therefore, the amount of details supplied by radiograph depends on the degree of aeration (pneumatization) of zygoma that has occurred, on the bony structure, and on the orientation of the X-ray beam.

(N) The hamular process (hamulus) (Fig. 2N, 12N) is the radiopaque projection that extends downward distal to the posterior surface of the maxillary tuberosity. It is the inferior end of the medial pterygoid plate of the sphenoid bone and can show trabeculae. There are many intraoral radiographs where the medial and lateral plates do not appear at all.

The radiolucent area between the tuberosity and the hamular process is referred as **(O) the hamular notch (Fig. 12 O)**.

In the distal inferior portion of maxillary molar radiographs a large radiopaque structure may be seen. This is **(P) the coronoid process of the mandible (Fig. 10P, 11P, 13P)**. When is an edentulous radiograph, this landmark is helpful in determining which is the most distal of the maxillary radiographs.

(R) The maxillary torus (torus palatinus) (Fig. 2R, 14R) is a lobulated bony growth in the middle of the palate, located side of **intermaxillary suture (Fig. 2S, 14S)**. On a periapical radiograph, the maxillary torus appears as a dense, well-demarcated, radiopaque area.

Results

With the introduction of new and advanced imaging techniques as computed tomography (CT) scanning, magnetic resonance imaging (MIR), digital imaging, the field of dental radiology has greatly expanded [7]. These new techniques can be used by dental professionals to analyze dental images in ways that were before unobtainable. The use of CT scans for diagnosing lesions and planning implant cases and the use of MRI to visualize soft tissues of temporomandibular joint and evaluate pathologic components are now accepted as standard procedures in dental radiology. Volumetric computed tomography is the newest method of analysing and discussing with the patient the treatment plan aprior or using dental implants, and it makes possible to check the results [8].

The further images show the maxillary lateral area structures on volumetric computed tomography (Fig. 15, 16 and 17).

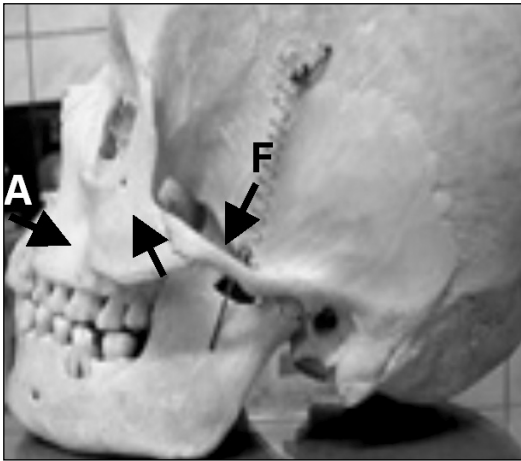


Fig. 9 Skull closed mouth - lateral view

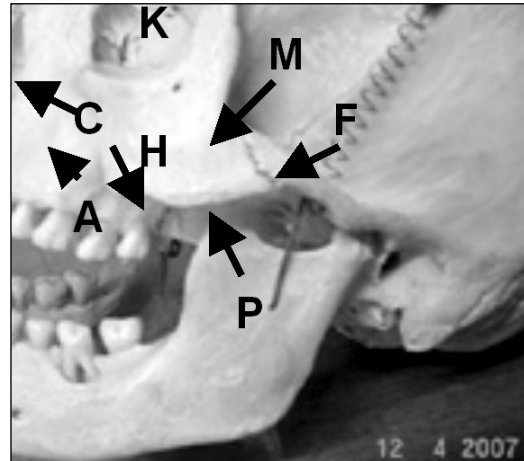
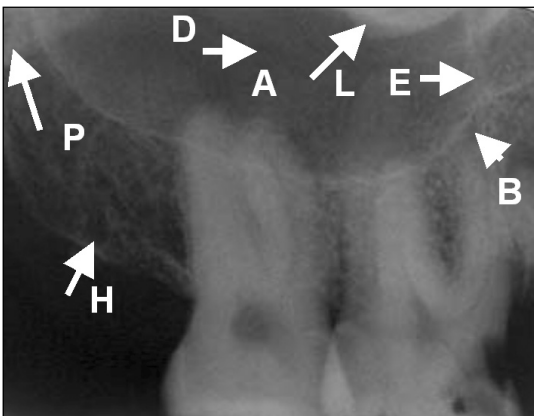
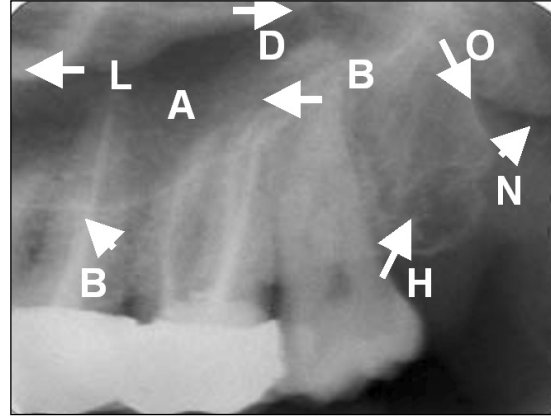


Fig. 10 Skull opened mouth – lateral view



Figs. 11, 12, 13 Periapical radiographs – maxillary molar area

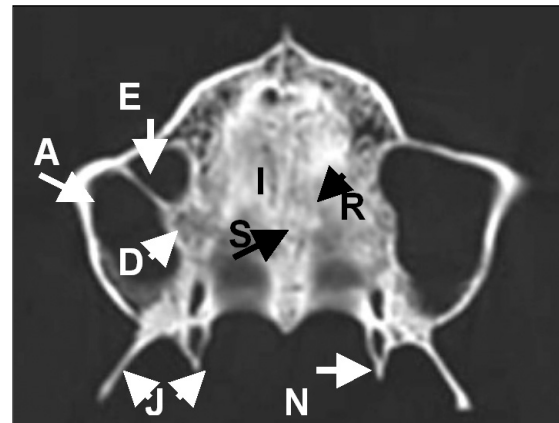


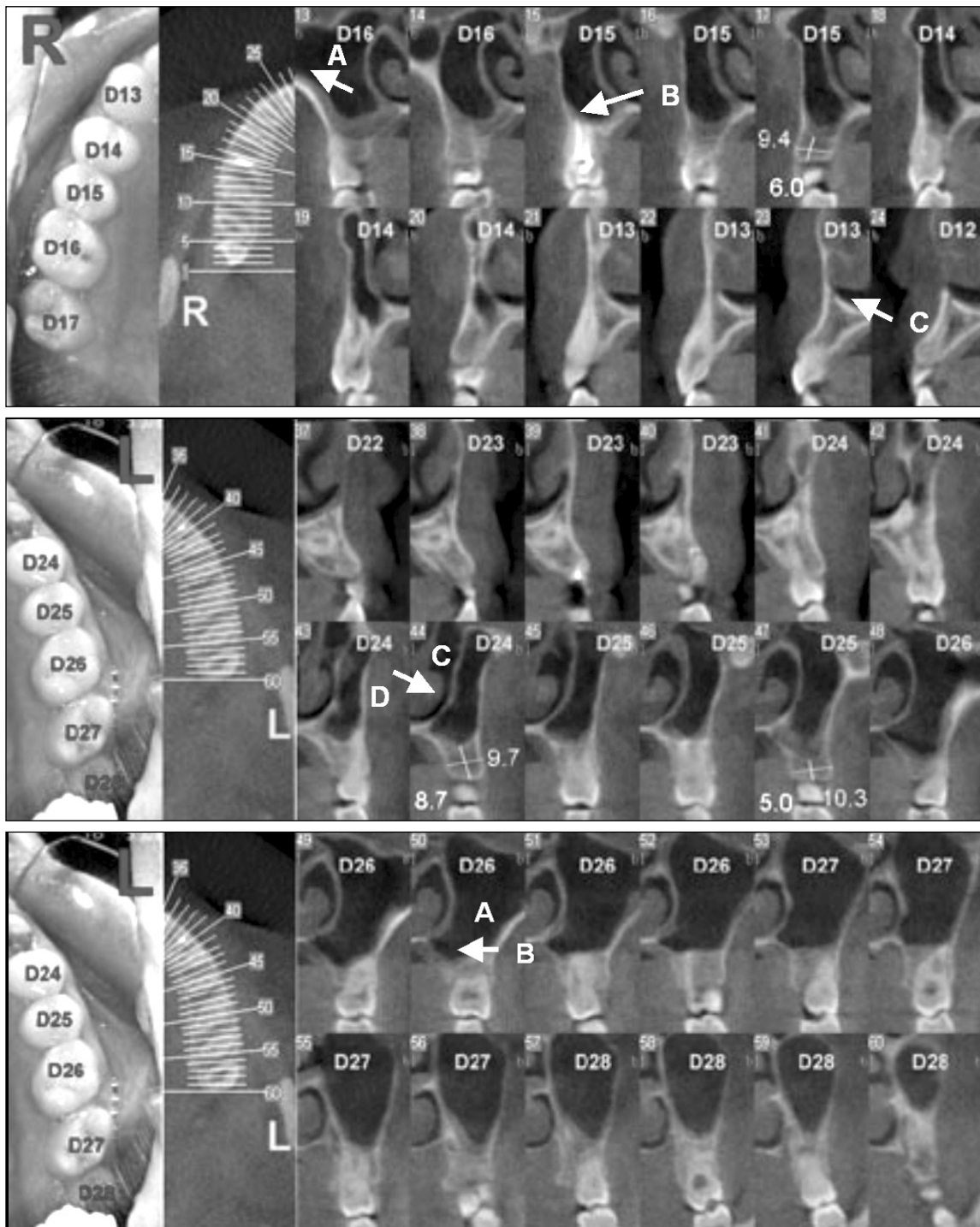
Fig. 14 CT – maxillary molar area

Fig. 9, 10, 11, 12, 13, 14: Maxillary Molar Area: (A) Maxillary Sinus, (B) Floor of Maxillary Sinus, (C) Floor of Nasal Fossa, (D) Nutrient Canals, (E) Bony Septum, (F) Zygomatic arch, (H) Maxillary Tuberosity (I) Palate, (J) Pterygoid Plates, (K) Orbit, (L) Zygomatic process of Maxilla (M) Zygoma, (N) Hamulus, (O) Hamular Notch, (P) Coronoid Process (R) Torus Palatinus, (S) Intermaxillary Suture

Discussion

An increasingly common method of replacing missing teeth is with osseointegrated implants. Preoperative planning is crucial to ensure success

of the implants. The dentist must evaluate the adequacy of the height and thickness of bone for the desired implant; the quality of the bone, including the relative proportion of medullary and cortical bone; the location of anatomic structures such as



Figs. 15, 16, 17: Maxillary lateral area: Sections of 1 mm 1.4 – 1.7 and 2.4 – 2.8 (A) Maxillary Sinus, (B) Sinus Floor, (C) Nasal Fossa, (D) Inferior Concha

the mandibular canal or maxillary sinus; and the presence of structural abnormalities such as undercuts that may affect placement or angulation of the implant.

Standard periapical and panoramic radiographs can supply information regarding the ver-

tical dimensions of the bone in the proposed implant site. However, volumetric computed tomography is recommended before implant placement for visualization of important anatomic landmarks, determination of size and path of insertion of implant, and evaluation of the adequacy of the

bone for anchorage of the implant. Postoperative evaluation of implants may be needed at later times to judge healing, complete seating of fixtures, and continued health of the surrounding bone.

In evaluating a potential implant site, particular attention should be given both to the quality and quantity of bone required for placement of the fixture. The bone must have the necessary dimensions and quality to provide support the implant fixture. The thicker the cortical bone, the greater the likelihood of osseous integration and subsequent success [9]. Bone quantity is assessed by documenting the height and width of available alveolar bone, as well as the morphology of the ridge.

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Conclusion

The first step in image analysis is to use a systemic approach to identify all the normal anatomy present in an image. A profound knowledge of the variation of normal appearance is required to be able to recognize an abnormal situation. The best learning method is to identify normal anatomy in every radiograph analyzed. If the images are of poor quality, it might be prudent to obtain better quality images before proceeding to the analysis.

Practitioners should avoid limiting their attention to one particular region of the film. Therefore all aspects of each image should be examined systematically.

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Correspondence to: Dr. Carmen Elena Georgescu, DMD, MPhil, PhD student, Assist. Prof., Department of Prosthodontics Technology and Dental Materials, Faculty of Medicine, „Carol Davila” University of Medicine and Pharmacy, Bucharest. Address: Bd. Regina Maria, no. 98, Bl. 119, Sc. 1, Apt.18, sector 4, Bucharest, Romania. E-mail: gecarmen2003@yahoo.com