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Review Article

Radiographs in Prosthodontics- A Review

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Abstract

Radiographic examinations are one of the primary diagnostic tools used in dentistry to determine disease states and formulate appropriate treatment. Digital imaging, plain and computed tomography, magnetic resonance imaging and other techniques such as cone beam CT are now part of the armamentarium in this specialty. Improvement in the understanding of disease states have also been the result of efforts by this specialty.

Keywords: lntraoral Radiography, Extraoral Radiography, Panoramic Radiogra phy, Computed Tomography, Magnetic Resonance Imaging, Cone-Beam Computed Tomography, Digital Radiograph, Specialized Radiographic Techniques.

Introduction

A critical phase in modern medicine and dentistry is the diagnostic pathway, which is the sum total and correlation of the history, the clinical findings and the results of various methods of special investigations. In all areas of medicine and dentistry, the first step in patient management is the diagnosis of the patient's problem and medical/ dental radiography plays an important role in achieving this [1]. The history of dental radiography begins with discovery of X-rays. Wilhelm Conrad Roentgen, a bavarian physicist discovered X-ray on Nov 8, 1895. To quote KH Thomas, "radiographic examination is useful to discover, to confirm, to classify, to define and localize a lesion [2].

Intraoral Radiography

Intraoral radiographic examinations are the backbone of dental radiography. There are three categories of intraoral radiographs: periapical, bitewing and occlusal projections [3]. lntraoral radiographs have limited role in edentulous patients. They can be used in locating any localized abnormalityorthe examination of tuberosities [4]. Radiographs are important aids in the evaluation of sub-mucosal conditions in patients seeking prosthodontic care. The presence of abnormalities in edentulous jaws may be unsuspected because of absence of any clinical signs or symptoms they show the relative thickness of alveolar ridge and the muco periosteum, the quality of the bone [5]. lt is of great diagnostic value for removable partial

Extraoral Radiography

These techniques imply that the film is placed outside the oral cavity, against the side of the face to be radiographed and the X-ray beam is directed towards it. Extraoral radiographs in complete denture can provide survey of the patient's denture foundation and surrounding structures, evaluate the status of impacted teeth, trauma, temporomandibular joint area [6].

Panoramic Radiography

Panoramic imaging is a technique for producing a single tomographic image of the facial structures that includes both the maxillary and mandibular dental arches and their supporting structures [7]. Panoramic Radiography is of special value in the diagnosis and treatment planning for the complete denture patient. It provides a view of entire maxillomandibular region on a single film without inconveniencing the patient and with minimal time expenditure. The radiographs were evaluated for the presence of retained root fragments, impacted teeth, radiolucencies, radiopacities and foreign bodies, location of the mental foramina at or near the crest of the residual alveolar ridge. Maxillary sinus proximity to the crest of the residual alveolar ridge [8]. It is used for the longitudinal assessment of the success of the implant. Panoramic images provide a broader visualization of the jaws and adjoining anatomic structures. These are widely available and can be used as screening radiograph. They are also used to assess the crestal alveolar bone and cortical boundaries of the mandibular canal, maxillary sinus and nasal fossa [9].

Computed Tomography

Tomography is a process by which an image layer of the body is produced, while the images of the structures above and below that layer are made invisible by blurring [6].

Tomography may be classified into three types:

a. Conventional tomography
b. Computed tomography
c. Emission tomography

CT can make an important contribution to the non-invasive quantification of individual muscles. Additional studies are being undertaken to examine the time course of changes in cross-sectional area due to tooth loss and to establish the contribution of successful prosthetic appliances in maintaining adequate muscle function. Preliminary studies have indicated that the retention of a small number of teeth used as over denture abutments appears to play a significant role in the maintenance of oral function [10]. CT was first applied successfully in implantology in the 1980s. In CT implant imaging, multiple thin axial slices are obtained through jaws and then the data are reformatted with special software packages to produce cross-sectional and panoramic views. CT has become popularin implant and temporomandibular joint [9].

Magnetic Resonance Imaging (MRI)

This technique relies on the phenomenon of nuclear magnetic resonance to produce a signal that can be used to construct an image. It uses the nonionizing radiation from the radiofrequency (RE) band of the electromagnetic spectrum. MRI is capable of providing excellent soft-tissue contrast and has the potential for providing excellent positional information with submillimeter accuracy; it can be used for guiding biopsies and stereotactic surgery [6]. MRI techniques are currently being used in dentistry for diagnosis of temporomandibular joint diseases which may lead to a degeneration of the discs, inflammatory conditions of the facial skeleton, and in examination of the salivary glands, maxillary sinuses, masseter muscles, in the detection of early bone changes such as tumors, fractures, inflammatory conditions and hematoma. The growth of the facial skeleton can also be monitored by MRI with the help of control points.12First described in 1946, its application in implantology is however of recent origin. MRI is used in implant imaging as a secondary imaging technique when primary imaging techniques fail. Oriented MRI imaging of the posterior mandible is dimensionally quantitative and enables spatial differentiation between critical structures and the proposed implant site. MRI is not useful in characterizing bone mineralization or a high-yield technique for identifying bone or dental disease [9]. MRI has found application in the implant dentistry by providing more precise information regarding the bone height, bone density and contour [11]

Cone-Beam Computed Tomography

Cone-beam computed tomography (CBCT) is a recent technology initially developed for angiography in 1982 and subsequently applied to maxillofacial imaging. It uses adivergentor "cone" -shaped source of ionizing radiation and a two-dimensional area detector fixed on a rotating gantry to acquire multiple sequential projection images in one complete scan around the area of interest [7]. In this new method for the fabrication of complete dentures using a Dental 3D CBCT System was used to digitize the dentures. In this scanning method, only refined dentures that maintain the maximal intercuspal position are scanned quickly. Therefore, not only the 3D morphological data of the denture space but also the jaw registration are obtained without exposing the human body to radiation [12]. CBCT provides cross-sectional images of the alveolar bone height, width, and angulations and accurately depicts vital structures such as the inferior alveolar dental nerve canal in the mandible or the sinus in the maxilla. ln many instances a diagnostic stent is made with radiographic markers and inserted at the time of the scan .This provides a precise reference of the location of the proposed implants or teeth. CBCT also provides adequate visualization of the TMJ [7].

Digital Radiography

The term digital radiography refers to a method of capturing a radiographic image using a sensor, breaking it into electronic pieces and presenting and storing the image using a computer. This system is not limited to intraoral images; panoramic and cephalometric images may also be obtained [6]. Image enhancement and the digital measuring techniques, can help the surgeon in establishing the optimum depth and orientation of the implants [13].The image can be manipulated to change the density and contrast and to measure the bone density at specific sites [9].

Specialized Radiographic Techniques

Scanographs produce images with higher contrast and greater detail and this is a better image quality than a standard transmission radiograph. Arthrography of the TM joint is basically a method that will supply information on soft tissue state of the

TM joint [6]. Arthroscopy of the TM joint is a procedure where direct visualization of the internal joint structure can be done. This aids in doing surgical procedures and biopsy procedures, which may be performed under visual control. Dentascan Imaging provides programmed reformation, organization and display of the imaging study. The limitations of the dentascan is that the image may not be of the true size and requires compensation for magnification, it has a limited range of diagnostic gray scale, determination of the bone quality requires other aids. A diagnostic template used for implant imaging is very useful [6].

Conclusion

Radiographic interpretation is an essential part of diagnostic process. The ability to recognize what is revealed by aradiograph enables a dental professional to play a vital rolein the detection of diseases, lesions and condition of the jaw that cannot be identified clinically [6]. Intra oral periapical radiography is an important diagnostic aid and routinely used for investigating the periapical and periodontal diseases [1]. Emphasizing the need for a radiographic examination of the edentulous patients before constructing complete dentures is of great benefit because the normal appearance of the dental ridges may conceal problem underneath [4]. The development and rapid commercialization of CBCT technology dedicated to imaging the maxillofacial region will undoubtedly increase dental practitioner access to 3D radiographic assessments in clinical dental practice [14]. lntraoral, panoramic and cephalometric radiography may be used best during initial phase of patient evaluation. Once the decision for implant placement has been made, the proposed site must be further evaluated using conventional tomography or CT. MRI is not commonly used for implant imaging because bony detail cannot be readily appreciated [9].

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