Diagnostic Aids in Orthodontic Practice - an overview

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Abstract

Diagnosis is an essential step that forms an important link between clinical examination and medical or dental treatment. Based on the clinical examination, radiographic interpretation and laboratory results, diagnosis can be further modified. Many advances has been taken place in the field of dentistry since its development. Dental diagnostic records have advanced from study casts and periapical x-rays to cone beam computed tomography, magnetic resonance imaging and ultrasound. Orthodontic diagnosis require a broad overview of the patient's situation & must take into consideration both objective & subjective findings. The essence of the problem oriented approach is the development of a comprehensive database of pertinent information. A review of the diagnostic records in orthodontics is being discussed in this paper.

Introduction

Diagnosis is an essential step that forms an important link between clinical examination and medical or dental treatment. Based on the clinical examination, radiographic interpretation and laboratory results, diagnosis can be further modified[1]. Many advances have been taken place in the field of dentistry since its development. Diagnostic records have advanced from study casts and periapical x-rays to cone beam computed tomography, magnetic resonance imaging and ultrasound[2]. This paper is a review of the diagnostic records in orthodontics.

Digigraph

Kevin H Y Mok and Michael S Cooke[3] described about the use of digigraph in orthodontic diagnosis. It is a sonic digitization technique. This technology helps to register linear distances. They helps to reduce the radiation exposure from lateral cephalometric tracings for patient diagnosis. Mesiodistal width of teeth are recorded after digitization of the plaster cast. Mesiodistal measurements are taken with the help of digitizing hand piece. The tip of the hand piece is positioned on the chosen landmark and while pressing the button on the handpiece.

Digital study models

Stevens R D et al[4] described about digital study models. The digital study models help an orthodontist to send the alginate impression of the patient or the existing plaster model of the patient to dental imaging companies and helps to process the impression or plaster study models into a virtual 3D image in the computer. They can be retrieved any time from the company website.

Intraoral periapical radiographs, panoramic radiographs and cephalograms

Panoramic radiographs and lateral cephalograms are most commonly used in orthodontic practice to know about the teeth, their axial inclination and their maturation status and the surrounding periodontium and alveolar bone. Lateral cephalograms are used in orthodontics to know about the skeletal and dental status of an individual[5].

Radiovisiography

First system introduced in digital radiography. Imaging system used in dentistry with minimal radiation exposure and it has many advantages over conventional radiography. It produced instant images without the need for a dark room[6].

Conventional tomography

Developed by Hounsefield in 1972. Computed tomography generates an image with the help of a computer. By using multiple slices of an image it helps to give 3 dimensional form of an image. But the soft tissue contrast produced by the CT is not that efficient[7].

Tuned aperture computed tomography

RL Webber, RA Horton, D A Tyndall and JB Ludlow[8] described a novel technology for the acquisition of 3 dimensional radiographic data. It is also known as transmission radiography. TACT images are produced from a no of x-ray projections based on a reference point. They are helpful in visualizing hard tissues of the oral cavity. From an arbitrary number of x-ray projection a TACT slice can be produced. Every projection should contain a reference point produced by the fiducial object which is located above the detection plane. For creating TACT slices one x-ray source can be used and it can be moved through several points in space to create multiple x-ray projections. These images are not much of help in the diagnosis of caries periodontal and periapical diseases.

Cone beam computed tomography

CBCT produces a cone shaped beam of radiation and the beam rotates around the patient. The computer reconstruction of the image is obtained by software algorithms. Both the x-ray source and the detector is able move around the patients head and creates a

sequential 2 dimensional image. Using a computer software a 3 dimensional image is created[9]. The radiation exposure depends on the field of view, exposure time, voltage and amperage. It helps in imaging and visualization of impacted tooth, TMJ morphology and diseases associated with it, assessment of upper airway, extent of root resorption, assessment bone morphology, ankyloses of teeth[10].

Microcomputed tomography

Gary Yip, Paul Schneider, and Eugene W. Roberts reported about the usefulness of micro computed tomography in orthodontic diagnosis. It evolved as a successor to routine histological sectioning and bone assessment using microradiographic techniques. Micro CT is a new dental technology to detect subtle changes in bony structures in relation orthodontic implants, dentofacial orthopedics and normal orthodontics. They helps to assess the modelling and remodeling of bone in mineralized tissues. This imaging technology is a major breakthrough in dental imaging as it helps to evaluate the supporting bone around dental implants[11].

Multi detector CT

It is a form computed tomography imaging for diagnostic imaging. It uses two dimensional array of detector elements. Thus it helps to acquire multiple thin slices and forms faster CT image. Special algorithms allow multiplanarreformation of 3 dimensional images and reconstruction of panoramic images. Helps in detailed assessment of pathologic malformations. It has comparatively shorter acquisition time and thus reduces the motion artefacts due to patient movement. Decreased noise and scatter radiation when compared to CBCT and higher soft tissue resolution.. It allows image creation in the axial, coronal, sagittal and oblique or curved image planes[12,13].

Spectrophotogrammetry

Formation and comparison of a sequence of photographic images by making use of the principle of triangulation is the basis of spectrophotogrammetry. Cameras are positioned in the space. A point p is noted in the images which are x and y coordinates for this value it is possible to determine the third coordinate that is the z axis. It is denoted as point b in the triangle knowing the angles and distance between cameras. Two different positions of the cameras to be set to determine the 3D coordinates of the points by drawing virtual lines from the intersection of the cameras to the object and thus helps to define the size and shape of the object. A 3D model is now obtained of the soft tissues in the form of point cloud. A mesh is created from this point cloud ie, face is reconstructed and it consists of tiny polygons. A computer is then used to process the image with the help of photogrammetric software[14].

Stereolithography

Also known as rapid prototyping. It is initially used in engineering science to create replicas of objects before wide range production. It uses the technique of computer assisted designing and computer assisted manufacturing. The CAD data is transferred to stereolithographic apparatus to build the models. The stereolithographic apparatus consists of liquid photosensitive resin in a container, a model building platform and a curing ultraviolet laser. The laser beam is computer controlled and directed to the resin and, on contact, polymerizes the surface layer; when this layer is completed, a mechanical platform moves down 1mm (or less) into the resin bath, carrying and exposing a new layer of resin, and this second layer is then cured and bonded on the previous one, in a sequential fashion. This process is repeated, layer-by-layer, as necessary, until completing the stereolithographic model of the anatomical structures of interest[15].

Oblique lateral transcranial radiography

The oblique lateral transcranial projection visualizes the lateral part of the temporomandibular joint. No measurement of depth is obtained. It is moreaccurate than

lateral tomography, because in lateral tomography there can be a difficulty in identification of landmarks because of displacement of condyle16.Jumean et al. has found that TMJ with oblique transcranial TMJ radiographs are an accurate method of radiographically evaluating the lateral aspect of the temporomandibular joint[17].

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