



A REVIEW ON DIFFERENT DIAGNOSTIC IMAGING TECHNIQUES THAT CAN BE USED IN IMPLANTS DENTISTRY.

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Abstract:

In today's world, dental implants are becoming the most commonly used treatment modality in the replacement of the missing tooth or the teeth in the dental arch. The field of dentistry has been totally revolutionized with the usage of dental implants. Dental implants have become the part of the modern dentistry. Dental implants are alloplastic materials, that are implanted into the alveolar bone to support the fixed prosthesis as well as removable dental prosthesis. For the purpose of proper diagnosis and treatment planning, imaging of the surrounding structure is very much required for the proper outcome of the treatment. Along with the imaging of the surrounding structure, systemic conditions, should also be evaluated, which include any systemic disease, that might hamper the final outcome for the implant. Pre surgical treatment planning is utmost important for the success of the implant.

Keywords: Imaging techniques, implants, fixed prosthesis, removable prosthesis, intra oral peri apical radiography, cone beam computed tomography, computed tomography, OPG, digital radiography.

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Introduction : -

Dental implants are one of the most common treatment option for replacing single tooth or for replacing multiple teeth. Dental implants has gained much acceptance and popularity because they are permanent restoration which do not interfere with the normal oral functioning and results in building up the self esteem of the patient. Success of the dental implants is dependent on the accurate diagnosis and treatment planning. Radiographic examination of the implant site plays an important role in the success of the dental implant treatment. Earlier only conventional radiographic techniques were considered as the gold standard views for the diagnostic purpose, which includes, intra oral peri apical radiography, cephalometric views, panoramic views. But with the advancement in the radiographic techniques from two dimensional view to three dimensional view results in the accurate diagnosis and treatment, which ultimately results in the long term success of the dental implant prosthesis.

The main objective of the dental imaging is to confirm, whether the implant treatment is good and appropriate for the patient or not. Dental imaging helps in the identification of vital structure present beneath the bone, for e.g. in mandible to check the inferior alveolar canal, in maxilla to check and confirm the distance from the maxillary sinus. To check the availability of the bone height for the confirmation of the implant length to be placed in the alveolar bone, to confirm the presence of any bony undercut, to confirm any bony protrusion, to confirm for any pathology if present underneath the bone, for the purpose of estimation of length and width of the implant to be placed in the alveolar bone , according to the availability of the bone. The success of the dental implant depends on osseointegration, which is known as the contact between the implant and the alveolar bone at the microscopic level. Dental imaging techniques can be utilized in three phases, i.e. pre surgical, surgical, and prosthetic²⁻⁹.

i) Pre surgical phase : -

the prime objective of this phase is to collect the radiographic information regarding the quality of the bone, regarding the quantity of the bone, radiographic bone height, radiographic bone width, any bone projections, bony concavities, distance from the vital structures like inferior alveolar nerve, canal, maxillary sinus, so as to prevent any damage to the underlying vital

structure and to check for any pathology present at the surgical site of the implant .

ii) Surgical and intra operative implant loading phase : -

The main objective of this phase is to check the surgical site , during the time of the surgery and immediately after the completion of the surgery . In this phase, healing of the surgical site along with the integration phase is evaluated , to ensure the position of the abutments for the correct positioning of the prosthesis in the mouth.

iii) Post prosthetic implant loading phase : -

This phase started just after the final cementation of the prosthesis over the implant abutments till the implant remains in the alveolar bone . The main objective of this phase is to evaluate the long term maintenance of the implant in the oral cavity. This phase also helps in evaluating the crestal bone loss around each implant and also evaluate the normal functioning of the implant along with present status and prognosis of the dental implant. It also helps in assessing the normal level of the bone surrounding the dental implant to evaluate any change in the mineralization of the bone surrounding the implant as well as to evaluate the any change regarding the volume of the bone¹⁻¹¹.

The main objectives of the imaging are as follows : -

- To determine the height of the alveolar bone available for the placement of the dental implant.
- To determine the available width of the alveolar bone for the placement of the dental implant.
- To evaluate the quality of the alveolar bone .
- To evaluate the morphology of the alveolar bone , to check for any bony protrusions or bony undercuts present in the alveolar bone .
- To evaluate the internal anatomy of the alveolar bone , to check for any pathology .
- To establish the boundary of the alveolar bone .

Different imaging technologies which can be used in the dental imaging are as follows : -

Intra oral peri apical radiography, OPG, cephalograms, occlusal radiography, conventional tomography, computed tomography, interactive computed tomography, cone beam computed tomography, magnetic resonance imaging, ultrasonography .

Peri apical radiography: -

It is one of the most commonly used radiographic technique , not only used in implant cases but also commonly used in the diagnosis of caries , extent of caries , peri apical infection surrounding the

tooth, confirmation for the need of endodontic treatment, Used to check for any peri apical pathology, used to evaluate the amount of bone available for the placement of the implant, used to evaluate post implant level of the bone surrounding the implant, used to evaluate any surrounding or peri apical pathology around the implant, use to evaluate the bony trabecular pattern. However taking peri apical radiograph is difficult in cases of edentulous or severely resorbed ridge cases, because this technique can be difficult as adequate support for positioning of the instrument is not available⁹⁻¹².

Digital radiography : -

This digital radiography utilizes computer for its functioning. In this digital radiography, the information which is received from the rvg sensor is interpreted by a special software and is projected over the computer screen. This resulting image can be modified in terms of brightness, contrast and inversion. accurate measurements can be achieved with this digital radiography as one can do measurement calibration on the computer screen. The major advantage of the digital radiography is its speed of capturing the image as well as projecting the image over the computer screen with good magnification . the main disadvantage of the digital radiography is the size of the sensor, some times the size of the sensor make it difficult in positioning in the areas which are having undercuts or near the mandibular tori²⁻⁷.

Occlusal radiograph : -

Occlusal radiography is not commonly used in the dental implant imaging techniques . structures like maxillary sinus, nasal cavity, naso palatine canal can be seen with the help of occlusal radiography. It has also been stated that maxillary occlusal radiographs are more distorted as compared to the mandibular occlusal radiographs. Occlusal radiographs helps in determining the facio lingual dimension of the mandibular alveolar ridge . But some times it is used, as it shows the widest width of the alveolar bone versus the width present at the crest. Which is where the diagnostic information needed the most⁵⁻¹¹.

Panaromic radiography : -

These are rotational tomograms of narrow beams. They utilized predetermined focal trough with two or more centers of rotation, which results in production of the image of the maxillary and the mandibular jaws. In this technique errors in the positioning of the jaws in the sagittal plane can occur easily, so positioning of the patient is very

much crucial in this procedure that too especially in the edentulous patients. This radiographic technique provide us with the positioning of the vital structures, approximate height of the alveolar bone and if any pathological condition present in the surrounding area. The main advantage of the panaromic radiography is , it provides information regarding the opposing land marks, helps in evaluating the bone height, helps in evaluating the boundaries of the jaw, helps in evaluating the gross anatomy of the jaws¹⁻⁵.

Cephalometric radiography : -

It helps in providing the information regarding the thickness , angulation , and helps in providing the vertical bone height in the mid line region, it also helps in revealing skeletal relationship of maxilla and the mandible, and also helps in revealing the soft tissue profile. It also helps in revealing the relationship between the implant site and the vital structures which are present in the surrounding area of the surgical site of implant placement¹⁻⁷ .

Conventional tomography : -

It provides the detail as small as in microns. In conventional tomography, the structure which need to be examined radiographically is in the focal plane, and it results in the visualization of the structures which are present in the focal plane and blurring the adjacent structures. This is achieved by working in different tomographic movement i.e. in straight, elliptical, circular, spiral movement. Spiral and hypocycloidal movements are the most commonly used movements . images achieved by computed tomography are of best quality by enhancement of the contrast, blurring reduction and manipulation of the image . images achieved by computed tomography provides precise information regarding the volume of the alveolar bone or the surrounding bone, density of the bone and helps in simulating the implant surgery⁸⁻¹⁴.

Computed tomography : -

It was introduced in the year of 1972 by Sir Godfrey Hounsfield . it provides images of high density of resolution and also allowing the soft tissue to be visualized. It provides cross sectional tomographic images of the implant site. The only disadvantage of the computed tomography is the limited availability of the CT machine and the high costing of the machine³⁻⁴.

Tuned aperture computed tomography : -

Tuned aperture computed tomography is a method which is based upon optical aperture theory. The information is collected by passing a radiographic

tube that can also be fixed in a close sequence. After the completion of the exposure, the relationship between the source and the object can be utilized to determine the projection of the geometry. Tuned aperture computed tomography map the incrementally collected data in to a single matrix of three dimension. Tuned aperture computed tomography images very efficiently identified the crestal defect around the implant as well as around the natural teeth⁵⁻⁸.

Interactive computed tomography : -

It was developed to filled the gap in transferring of the information from the radiologist to directly to the clinician. By this technique radiologist can transfer the image study to clinician directly and the clinician can view and interact with the file at their own computer. This technique provides three dimensional treatment plan in which the anatomy of the patient can be visualized before the implant surgery by the dentist and the patient for the purpose of the approval or any modification. It also helps in determination of bone quality around the surgical site of the implant²⁻⁵.

Cone beam computed tomography : -

These scanners are designed specially for the purpose of the diagnosis and treatment planning in the implant therapy. In this technique multiple images of the single section which is required for the placement of the implant can be generated with in a single scan. Radiographic markers can be inserted at the time of the scan , this will help in locating the précised location of the proposed implant. With the help of data received by CBCT technique stereo lithographic models can be generated this will guide and help the dentist to place implant in the exact position. Cone beam computed tomography generates high resolution of images of all the anatomical structures, the bony trabeculae, it is a rapid scanning procedure with a low dose of radiation, easy accessible, and easy to study and handle. The main dis advantage of the CBCT is it is having low range of contrast, reduced scan volume⁹⁻¹⁰.

Magnetic resonance imaging : -

It was discovered by lauterbur. It was stated that images created by MRI was not affected by the implants. MRI helps in differentiating the inferior alveolar canal from the adjacent bone , and also visualizes the fate which is present in the trabecular bone, MRI avoids the radiation hazards those are created with the computed tomography. MRI is strictly contraindicated in patients those are having ferrotomagnetic metallic implants in their body¹¹⁻¹⁴.

Zonography : -

It is a modification of the panoramic radiography. It helps in generating cross sectional images of the jaw. It helps in estimating the spatial relationship between the critical structures and the site where the implant is planning to be placed. The main disadvantage of this technique is the blurring of the adjacent structures, superimposition of the image¹⁵⁻¹⁸.

Conclusion : -

There are various imaging techniques utilized in the dental implant treatment. One should be having a thorough knowledge of all the techniques. The success of the implant placement can be enhanced with all the excellent imaging modalities that exist in todays time. Select the imaging modality in accordance to the number of the implants to be placed in the oral cavity.

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