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The role of CT and MRI scans in maxillary sinus augmentation surgery

Bharani Krishna.T[1], Mohammad Naffizuddin[2], M.Sirisha[1], Ch.Ram Sunil[3], K.Tilak Vardhan Reddy[4], K.Bhavya Sri Sai[5]

1 *Assistant Professor, Department of Oral Medicine and Radiology, Dr. N.T.R. University of Health Sciences, Vijayawada, Andhra Pradesh, India*

2 *Assistant Professor, Department of Oral & Maxillofacial Surgery, Care Dental College, Dr. N.T.R. University of Health Sciences, Vijayawada, Andhra Pradesh, India*

3 *Professor, Department of Conservative Dentistry and Endodontics, Sibar Institute of Dental Sciences (SIDS), Dr. N.T.R. University of Health Sciences, Vijayawada, Andhra Pradesh, India*

4 *Consultant Prosthodontist, Dr. N.T.R. University of Health Sciences, Vijayawada, Andhrapradesh, India*

5 *Dental Surgeon, Dr. N.T.R. University of Health Sciences, Vijayawada, Andhrapradesh, India*

Abstract

Diagnostic imaging has a primary role in presurgical planning. Computerized tomography has become a standard for assessing the feasibility of implant surgery. Three- dimensional diagnostic assessments have a decisive value in presurgical treatment planning, especially in situations in which the alveolar process has pronounced resorption, and therefore insufficient bone volume for placing endosseous implants. These situations, which once limited the placement of implants in the posterior maxilla, can now be overcome via maxillary sinus augmentation procedures. In these cases, diagnostic imaging, in particular using CT scans, plays a vital role in providing reliable and necessary information. MR imaging reveals to be ideal imaging in diagnosing maxillary sinus augmentation.

Keywords: Risk factors, Diabetes mellitus, Hyperglycemia, Periodontal disease, Periodontitis.

***Corresponding author:**
Dr. Bharani Krishna.T
Assistant Professor, Department of Oral Medicine and Radiology, Dr. N.T.R. University of Health Sciences, Vijayawada, Andhra Pradesh, India
Email:
bharanikrishna3@gmail.com

INTRODUCTION

CT undoubtedly offers considerable advantages compared with traditional diagnostics (Orthopantography, intraoral X-rays), overcoming the limit of two-dimensionality and ensuring 3D information on the implant site.

Information on the bone densitometry on cortical bone walls and on bone resorption in the alveolar processes is important for the correct planning of prosthetic treatment, either from a functional or an esthetic point of view [1].

Information on associated orosinus pathologies is also important. In complex dental operations, CT must be considered as an essential presurgical diagnostic method [2].

Limits that are still impossible to overcome are the items linked to the presence of metal restoration that causes a scatter effect, which interferes with diagnostic imaging [3].

CT in sinus augmentation planning

CT allows accurate calculations of the recipient site and possibly also the donor site volume in the event of maxillary sinus lifting or augmentation of the mandibular alveolar ridge.

Three-dimensional reconstructions are an accurate and reliable method for calculating the amount of bone tissue needed to obtain an adequate reconstruction of the alveolar process in order to permit the placement of dental implants [4]. In cases where bone graft is taken from an intraoral site, CT allows calculation of the amount of tissue that can be removed without running into anatomical problems caused by inadequate bone availability. The need for bone from distant sites such as the iliac crest or the tibia can also be assessed if insufficient intraoral bone is available for harvesting.

One important advantage of spiral CT over other methods is the possibility of reconstructing images in multiple projections from just one acquisition, with an undoubted reduction in the dose absorbed by the patient.

Three-dimensional reconstructions using volume rendering images have today reached much higher diagnostic levels than early 3D reconstructions. In particular cases such as analysis of maxillary sinus lumen morphology, it may be useful to use virtual endoscopy, which can simulate and help the planning of sinoscopy operations [5].

Study Technique

When planning sinus elevations, collimation of 1mm or less is preferred in the maxillary sinus in an axial projection, proportional to the more limited region involved. This is due to the undeniable advantage of better precision in locoregional evaluations and the possibility of 1:1 scale monitoring.

Post operational controls

A CT scan, especially if it can be compared with a pre-surgical investigation, provides an effective confirmation of correct grafting of the maxillary sinus.

Densitometry evaluation provides information on graft mineralization. Monitoring of the position of implants and any sinus complications is also possible [6]. It must be remembered; however, that information on dental implant osseointegration cannot be obtained except via the histological analysis of a biopsy sample.

New diagnostic prospects: magnetic resonance [MR]

The possibility of using an imaging method that is less harmful biologically and does not use ionizing radiation has aroused interest in its use for implantology. Magnetic resonance is based on electromagnetic fields and radio frequencies.

Using MR in dental Surgery is not new. It is now an essential method in studying temporomandibular joints, especially in evaluating joint meniscus [7].

MR in the study of maxillary sinuses

Magnetic resonance has been found to have greater sensitivity than CT when identifying the presence of inflammatory pathologies in the maxillary sinuses, which is important when planning sinus augmentation surgery.

Magnetic resonance offers the advantage of identifying the presence of acute, ongoing inflammation immediately, showing a hyperintense signal of mucosa thickening in the maxillary sinus [8].

The importance of this method, however, lies in its capacity to make a differential diagnosis between the stagnation of mucus and the presence of polyps or cystic retention in the maxillary sinuses.

MR in implantology

Currently, MR allows sequences according to favourable scanning levels for the study of the maxilla and mandible: oblique, parallel to horizontal branches, coronal and perpendicular.

Reconstructions can be carried out using dental programs with 3D acquisitions in weighted T1 sequences, although practically speaking, results show a lower spatial resolution than a CT scan [9].

Limits to the potential use of this method are that it cannot be used for patients with pacemakers, Endocranial surgical clips and all iron magnetic prostheses in the sequence field or surrounding area. Dental therapy using ferrous materials may create artefacts in the acquired images [10].

CONCLUSION

MR has a promising role in imaging diagnostics, although currently, Denta scan reconstructions have a lower spatial resolution than CT. At present, this equipment is mainly limited to neuro and osteoarticular investigations. The development of MR will be an interesting test for dental Surgery in the near future, especially using dedicated coils and low-intensity magnetic field equipment used for both plannings and for the follow up of complex procedures.

Conflict of Interest

The authors have no conflict of interest.

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