Review Article

Dentistry Section

The Role Of CT Scan In The Posterior Maxilla: A Boon For Dental Implant Planning

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ABSTRACT

Recent developments in computed tomography (CT scan) have changed diagnostic and radiological assessments, not only in general medicine, but also in implant dentistry. The aim is not only to improve the precision and the predictability of implant placement, but also to change an invasive surgical protocol for sinus grafting and subsequent implant placement in the posterior maxillary region. In compromised situations of rear maxilla with some bone available, the best position of the implant placement is evaluated, and the need for additional surgical interventions such as sinus lift and grafting procedures can be exactly determined. This improves the predictability of the treatment goals, allows for better risk management, and provides more individual information for the patient.

Key Words: Computed tomography, Posterior maxilla, Dental Implantology

INTRODUCTION

The embryological pneumatisation of the maxilla is as much a curse as it is a boon for an implantologist. The demerits lie in the eventuality that the volume of the bone which is available for implantation will significantly be reduced following the loss of the posterior maxillary teeth. The advantage of natural pneumatisation is that the clinician has a potential space to augment, which is relatively free of important anatomical structures which may complicate the sinus grafting procedures.

Lack of sufficient bone height in the posterior maxilla frequently precludes the standard implant placement in this region [1]. Though the implants can be placed in the maxillary tuberosity, multiple units when needed are a problem, unless the deficient posterior maxilla is augmented.

Estimating the bone volume which has to be harvested prior to surgery for maxillary sinus floor bone grafting, might help in selecting the donor site, minimizing complications, following bone harvesting and reducing hospital expenses [2].

Chanavaz M stressed that bone loss in the posterior maxilla has two contributing factors, basal bone loss due to the osteoclastic activity of the sinus membrane and alveolar bone loss due to the disappearance of the marginal bone[3]. Sinus grafting and subsequent implant placement maintains the bone height in the posterior maxilla on the basal bone side by the bone graft and on the alveolar side by the functional implant, thus providing physiological stimulus to the bone.

Several types of bone-graft materials have been used [4]: autogenous bone from the iliac crest or the maxillary tuberosity, frozen bone, freeze-dried bone, demineralized freeze-dried bone, and hydroxyapatite. Hydroxyapatite is a resorbable calcium phosphate material and it acts as a foundation for new bone regeneration. Some authors have found more success when this is mixed with freeze-dried bone [5].

The technique for sinus grafting, either the lateral approach or the crestal osteotome technique, can also be decided with the help of CT scans. .

Krennmair et al suggested that the intraoral sites should be given preference and that extraoral bone harvesting is necessary only in patients with contraindications for intraoral sites, with maxilla with severe bilateral atrophy, or with maxillae for which both external and internal (onlay) grafting are needed [1]. Since they provided nearly as much bone as is required for most augmentations, following this predicament could lead to disasters if the volume of bone available for the intra-oral site falls short, thus necessitating the abandoning of the operation.

CONVENTIONAL DENTAL PANORAMIC TOMOGRAM

The DPT (dental panoramic tomogram) remains the mainstay of the diagnostic review of the maxillary sinuses for Implantology. Whilst it is two-dimensional by nature, it is an invaluable tool and in most situations, is by itself adequate to plan sinus surgery for Implantology.

It provides the following information:

1. residual ridge resorption
2. the amount of bone between the crest of the alveolar ridge and the floor of the sinus
3. Antero-lateral view of the maxillary sinuses.
4. bony septa or compartmentalisation of the maxillary sinus.

Its drawbacks are:

1. it is two dimensional (the bucco-lingual view of the sinus cannot be visualised)
2. it is difficult to calculate the amount of graft material which is required
3. the exact position of the opening of the maxillary sinus into the lateral wall of the nose (hiatus semilunaris) cannot be determined.

CT- SCAN

Computerized tomography is a useful diagnostic tool for sinus surgery, but it is not mandatory. It provides the following information:

1. the three dimensional representation of the maxillary sinus (bucco-lingual dimension of the sinus can be seen)
2. the clear visualisation of the bony septa
3. the presence of any soft or hard tissue pathology
4. the calculation of the amount of bone graft material to be used

5. the elevations and depressions of the sinus floor can be visualised in all dimensions
6. the information on the level of sinus opening into the lateral wall of the nose.
7. the thickness of the lateral wall of the maxillary sinus

The delineating significance of the CT scan as opposed to the DPT, is obviously it's three dimensional nature.

Bony septa are frequently seen in the floor of the sinus. The CT scan can give information about the bucco-lingual extent of the septa and allow the clinician to make pre-operative notes on them. The careful elevation of the sinus lining from the floor and its preservation is a critical part of the sinus grafting procedure.

The presence of most pathologies can be verified by the CT scan as much as the DPT. The CT scan however, can map its location accurately. The most common temporary contraindication, sinusitis, is seen as a thickening of the Schnederian membrane.

One of the most significant aspects of CT scans is the ability to calculate the amount of bone graft material which is required for the sinus grafting of the maxilla. Detailed cross-sectional CT scans allow the calculation of the augmentation volume for various implant lengths and residual ridge heights [1]. In most cases however, a conventional DPT provides adequate information to calculate the augmentation volume.

Uchida and associates reported that the augmentation volume which was required for a 10 mm elevation would be 1.5 ± 0.9 cmm^3 [2]. Further, Krennmair et al found that with an increase of an augmentation height of 5 mm, the augmentation volume increased by 100 %. This appears to be a guideline and not a rule, as the anatomy of the sinuses is variable, however, it needs to be stressed again that such calculations can be more accurately made with the use of a CT-scan and not a DPT.

The sinus lift procedure which was developed in the mid 1970s has been refined and is now frequently performed [6]-[9]. Krennmair et al opined that the contours of the sinus lift will not always follow the straight lines which are drawn on CT scans. This may not always be practically significant, as sinus floor grafting is not micro-surgery and small miscalculations can be made during clinical surgery.

The anatomical position of the maxillary sinus opening into the lateral wall of the nose can be seen with the help of CT scans. It is important to restrict the level of bone grafting to below the opening of the osteum; otherwise the graft material may extrude into the nasal cavity. Further drainage of the sinus into the lateral wall of the nose will be impeded or blocked.

Lateral wall thickness can be measured on the CT scan. This gives the clinician a good feel of the surgery. Reduced thickness means a closer proximity of the sinus lining, which requires that the clinician should be extremely careful while preparing the osteotomy from the outset. Thicker lateral walls allow the clinician to make more definitive bur cuts to outline the osteotomy before approaching the infracturing of the sinus wall.

While Uchida and associates used axial CT scans without calculating the residual ridge heights, Krennmair et al showed that cross-sectional CT scans which define the width and height of the residual ridge, allow for an exact calculation of the height and volume of bone augmentation. The latter would be more appropriate, as sinus grafting is a function of both the residual ridge bone height as well as the anatomical depths of the maxillary sinus.

CONCLUSION

The utilization of CT scans in implant dentistry, especially in the posterior maxilla, is a safe option in treatment planning and in the better control of the prospective implant axis with respect to the prosthetic tooth position. This contributes to a higher predictability of the ultimate treatment outcome, with subsequent better patient information about the implant prosthodontic treatment.

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