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Optimization of Dental Cone Beam Computed Tomography for Planning Dental Implant Treatments

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Dental cone beam computed tomography (CBCT) has been a transformative technology for the dental profession, providing 3D imaging for individual teeth, the entire jaw or even the entire craniofacial complex. Advantages of dental CBCT machines include upright scanning, which provides a more natural mandible position, the convenience of producing 3D images in the dental office, and a reduced radiation dose compared with head CT scans, albeit with reduced image quality.

One of the most frequent uses of dental CBCT is for planning dental implants. Images are obtained to ensure that the underlying bone is thick enough to support the metal implant, and to identify if the bone is thick enough for the implant screw to fit without impinging upon the inferior alveolar nerve along the mandible or perforating into the maxillary sinus. Virtual implants can be inserted into the images to aide in identifying the correct location and angulation during surgery. In addition, surgical guides can be printed from the image information to assist the clinician with implant placement during surgery.

To optimize the CBCT acquisition parameters for implant planning, we performed a number of objective image quality measurements and dosimetry using phantoms. We also performed an observer study focused on the clinical imaging criteria for implant planning. Together, these objective and subjective metrics provide optimized image acquisition settings that ensure adequate image quality for the minimum radiation dose to the patient. To further characterize the bone, we are developing post-reconstruction techniques to rescale the images into Hounsfield units for better comparison with CT. We are also characterizing the impact of metal artifacts due to pre-existing implants or amalgams on the ability to measure bone quality and thickness for implant treatment planning.

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