

# Use of Cone-Beam Computed Tomography in Early Detection of Implant Failure



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## KEYWORDS

- Cone-beam computed tomography (CBCT)
- Postimplant assessment
- Implant failure assessment

## KEY POINTS

- Cone-beam computed tomography (CBCT) has become a helpful tool in assessing the stability of the dental implant site.
- Little is known about the ability of CBCT to evaluate peri-implant bone wall morphology or about its performance compared with conventional radiographic modalities, such as periapical radiography.
- For patients with postoperative complications, diagnostic imaging, including CBCT, may be indicated as a supplement to the clinical examination, although in most cases conventional radiographs will provide the necessary information.
- More studies are needed to determine the actual role of CBCT in detecting early implant failure.

## INTRODUCTION

Radiological examination is crucial in planning and assessing dental implants. In 1998, cone-beam computed tomography (CBCT) was introduced to dentistry. Depending on the specific machine, CBCT enables clinicians to obtain 3-dimensional (3D) images with a low dose of radiation.<sup>1</sup> Standard 2-dimensional images do not provide detailed discrimination of the areas suitable for dental implants or of the areas close to an implant. CBCT is widely used in implant dentistry for several indications, including pre-implant assessment of anatomy, implant placement, visualization of important anatomic structures, assessment of bone mineral density, and, recently, early

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assessment of implant failure. CBCT is helpful in assessing the stability of the implant site. However, little is known about the utility and validity of CBCT in evaluating peri-implant bone wall morphology, particularly after bone augmentation procedures performed to improve the implant site.

One potential limitation of CBCT in evaluating implant placement is the presence of metal in the area to be scanned; in these cases, CBCT images are susceptible to artifact, some of which are caused by a phenomenon called *beam hardening*. When an x-ray beam travels through an object, more low-energy photons are absorbed than high-energy photons; this difference produces beam-hardening artifacts that limit the image quality.<sup>2</sup> Although certain techniques can be used to decrease the number of these artifacts, such as changing the exposure conditions, decreasing the field of view, or changing the patient's position, the use of CBCT for early detection of implant failure is still limited.<sup>3,4</sup> This article presents a summary of current knowledge about the use of CBCT in implant dentistry, evaluates the potential use of CBCT in detecting early implant failures, compares the performance of CBCT with that of other traditional imaging techniques, and examines the limitations of CBCT.

### INDICATIONS FOR CONE-BEAM COMPUTED TOMOGRAPHY IN IMPLANT DENTISTRY

Selection of the potential implant site is crucial to the success or failure of the implant. The potential implant site must be evaluated to determine the quantity and quality of available bone, the angulation of the alveolar process, the relationship of the site to anatomic structures, and the possible problems in the area.<sup>5</sup> Radiologic techniques can provide information crucial to an assessment of all of these factors. CBCT allows cross-sectional evaluation of the dental arch for a determination of the width, height, and quality of bone at the potential implant site. CBCT technology provides the clinician with the ability to fully assess the potential implant site using a relatively low radiation dose (compared with traditional computed tomography [CT]), and at a reasonable cost to the patient. Considering the quality of the images, the low radiation dose, and the favorable cost, CBCT is currently one of the most recommended imaging modalities for assessing potential implant sites. The use of 3D information in diagnosis and treatment planning has been enhanced by the availability of CBCT. **Box 1** shows the main indications of CBCT in implant dentistry.

#### *Use in Measuring Bone Mineral Density*

The most frequently reported indications for the use of CBCT in implant planning are to measure the alveolar ridge and map the bone morphology of potential implant sites (**Figs. 1–3**). CBCT images have been found to provide information for the clinician beyond linear measurements, such as measurement of bone mineral density.<sup>6</sup> Several

#### **Box 1**

##### **Main indications of CBCT in implant dentistry**

- Evaluation of the quality, height, and width of available bone
- Three-dimensional assessment of alveolar ridge topography
- Identification of vital anatomic structures
- Identification of potential problems
- Fabrication of CBCT-derived surgical guides
- Patient education

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