

Imaging Services: Cone Beam Computed Tomography

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[Instructions for Use](#)

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Related Clinical Guideline

- [Cardiology and Radiology Imaging Guidelines](#)

Coverage Rationale

Cone beam computed tomography (CBCT) is unproven and not medically necessary for routine dental diagnosis due to insufficient evidence of efficacy.

CBCT should not replace traditional dental radiographs as a preliminary diagnostic tool, or for routine dental procedures such as restorations, but be used as an adjunct when the level of detail CBCT is needed to safely render treatment for complex clinical conditions (e.g., oral surgery, implant placement and endodontics). These procedures may have a higher risk of complications without the level of detail CBCT imaging provides. CBCT imaging used for these reasons should be read and interpreted by an appropriately trained professional.

Applicable Codes

The following list(s) of procedure and/or diagnosis codes is provided for reference purposes only and may not be all inclusive. Listing of a code in this policy does not imply that the service described by the code is a covered or non-covered health service. Benefit coverage for health services is determined by the member specific benefit plan document and applicable laws that may require coverage for a specific service. The inclusion of a code does not imply any right to reimbursement or guarantee claim payment. Other Policies and Guidelines may apply.

CDT Code	Description
D0364	Cone beam CT capture and interpretation with limited field of view - less than one whole jaw
D0365	Cone beam CT capture and interpretation with field of view of one full dental arch - mandible
D0366	Cone beam CT capture and interpretation with field of view of one full dental arch - maxilla, with or without cranium
D0367	Cone beam CT capture and interpretation with field of view of both jaws; with or without cranium
D0368	Cone beam CT capture and interpretation for TMJ series including two or more exposures
D0380	Cone beam CT image capture with limited field of view - less than one whole jaw
D0381	Cone beam CT image capture with field of view of one full dental arch - mandible
D0382	Cone beam CT image capture with field of view of one full dental arch - maxilla, with or without cranium

CDT Code	Description
D0383	Cone beam CT image capture with field of view of both jaws; with or without cranium
D0384	Cone beam CT image capture for TMJ series including two or more exposures
D0391	Interpretation of diagnostic image by a practitioner not associated with capture of the image, including report
D0393	Treatment simulation using 3D image volume
D0394	Digital subtraction of two or more images or image volumes of the same modality
D0395	Fusion of two or more 3D image volumes of one or more modalities

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CPT Code	Description
70486*	Computed tomography, maxillofacial area; without contrast material
70487*	Computed tomography, maxillofacial area; with contrast material(s)
70488*	Computed tomography, maxillofacial area; without contrast material, followed by contrast material(s) and further sections
76376*	3D rendering with interpretation and reporting of computed tomography, magnetic resonance imaging, ultrasound, or other tomographic modality with image postprocessing under concurrent supervision; not requiring image postprocessing on an independent workstation
76377*	3D rendering with interpretation and reporting of computed tomography, magnetic resonance imaging, ultrasound, or other tomographic modality with image postprocessing under concurrent supervision; requiring image postprocessing on an independent workstation

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* Coding Clarification: Dentists submitting claims for cone beam computed tomography using the above CPT codes will be subject to medical guidelines and procedures. See the following for additional information: [Cardiology and Radiology Imaging Guidelines](#).

Description of Services

Cone-beam computed tomography (CBCT) is a variation of traditional computed tomography (CT). The CBCT systems used by dental professionals rotate around the patient, capturing data using a cone-shaped X-ray beam. These data are used to reconstruct a three-dimensional (3D) image of the patient's oral and maxillofacial region. Dental CBCT are increasingly used by radiologists and dental professionals for various clinical applications including dental implant planning, visualization of abnormal teeth, endodontic (root canal) diagnosis, and diagnosis of dental trauma. Although the radiation doses from dental CBCT exams are generally lower than other CT exams, dental CBCT exams typically deliver more radiation than conventional dental X-ray exams. Concerns about radiation exposure are greater for younger patients because they are more sensitive to radiation (i.e., estimates of their lifetime risk for cancer incidence and mortality per unit dose of ionizing radiation are higher) and they have a longer lifetime for ill effects to develop. See the following website for additional information: <http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/MedicalImaging/MedicalX-Rays/ucm315011.htm>. (Accessed May 12, 2020)

Clinical Evidence

Endodontics

Aminoshariae et al. (2018) conducted a systematic review that compared and quantified endodontic outcomes using cone-beam computed tomographic (CBCT) imaging with intraoral periapical radiography. Six articles met the inclusion criteria with low to moderate risk of bias. The odds of the CBCT imaging locating a lesion are twice as good as the odds of traditional radiography locating the same lesion. This may not be of concern for an obvious lesion, but when clinically challenged with a difficult diagnosis and/or decision making, CBCT imaging might provide a greater amount of information needed to establish an accurate diagnosis. Although CBCT imaging can overcome several limitations of 2-dimensional radiography, there are other issues to consider such as radiation, high levels of scatter and noise, variations in dose distribution within a volume of interest,

and cost. For these reasons, CBCT imaging should be used when the history and clinical examination clearly show that the benefits outweigh the potential risks. In other words, not every patient should be unnecessarily exposed to unwarranted radiation and as always, the ALARA (As Low As Reasonably Achievable) principle should be used. The authors identified a limitation of a subgroup analyses not being included since the studies were somewhat consistent because of the overall low heterogeneity among the studies. Although intraoral radiographs are the imaging modality of choice, when 2-dimensional intraoral radiography is inconclusive, the authors found CBCT imaging was reported to have twice the odds of detecting a periapical lesion than traditional periapical radiography in endodontic outcome studies.

Al-Salehi and Horner (2016) evaluated the impact of limited volume CBCT upon diagnosis as part of endodontic management of posterior teeth. Eligible patients were all adults aged 18 years or over who were referred to a specialist endodontic unit. Inclusion criteria were cases that were either re-treatment or de novo root canal treatment where the anatomy was judged to be complex. Exclusion criteria included vulnerable groups and de novo endodontic treatment with uncomplicated root canal anatomy. For each patient, a full history and clinical examination was performed, a high-quality color photographic intraoral image, two paralleling technique periapical radiographs and limited volume CBCT examination were carried out. CBCT is being increasingly used in field of endodontics. The benefits gained from the use of CBCT must be carefully balanced against the increased radiation dosage. It was concluded that the routine use of CBCT could not be justified.

Rosen et al. (2015) evaluated the diagnostic efficacy of cone-beam computed tomographic (CBCT) imaging in endodontics based on a systematic search and analysis of the literature using an efficacy model. A systematic literature search identified 58 articles that met the inclusion criteria. 90% of the articles evaluated technical characteristics or the accuracy of CBCT imaging, which was defined in this model as low levels of efficacy. The author's identified only 6 articles that supported the practitioner's decision making, treatment planning and treatment outcome which was defined as higher levels of efficacy. The expected ultimate benefit of CBCT imaging to the endodontic patient as evaluated by its level of diagnostic efficacy is unclear and is mainly limited to its technical and diagnostic accuracy efficacies. The author's concluded that even for these low levels of efficacy, current knowledge is limited and therefore, a cautious and rational approach is advised when considering CBCT imaging for endodontic purposes.

Long et al. (2014) conducted a meta-analysis to determine the diagnostic accuracy of cone-beam computed tomography (CBCT) for tooth fractures in vivo. A total of 12 studies were included in the meta-analysis. The pooled sensitivity, specificity, positive likelihood ratio, negative likelihood ratio and summary receiver operating characteristic were 0.92, 0.85, 5.68, 0.13 and 0.94, respectively. The pooled prevalence of tooth fractures in patients with clinically-suspected but periapical-radiography-undetected tooth fractures was 91%. Positive and negative predictive values were 0.98 and 0.43. The authors concluded that CBCT has a high diagnostic accuracy for tooth fractures and could be used in clinical settings. The authors stated that they were very confident with positive test results but negative test results should be interpreted cautiously, especially for endodontically treated teeth. The limitations of this meta-analysis were small sample sizes in some studies, no applying reference standard test for all patients in some studies, and unavailability of data for subgroup analysis for horizontal and oblique tooth fractures. Moreover, CBCT devices and exposure protocols differed among included studies. According to the authors, since image quality may vary among different CBCT devices and exposure protocols, the results in this meta-analysis should be interpreted with caution and may not be applied to all CBCT devices.

Petersson et al. (2012) completed a systematic review that evaluated the diagnostic accuracy of radiographic methods employed to indicate presence/absence and changes over time of periapical bone lesions. Twenty-six studies fulfilled criteria set for inclusion. None was of high quality; 11 were of moderate quality. According to the authors, there is insufficient evidence that the digital intraoral radiographic technique is diagnostically as accurate as the conventional film technique. The same applies to CBCT. The authors stated that no conclusions can be drawn regarding the accuracy of radiological examination in identifying various forms of periapical bone tissue changes or about the pulpal condition.

Implant Dentistry

In a retrospective study, Özalp et al. (2018) studied and evaluated the correlations between measurements made using panoramic radiography and cone-beam computed tomography (CBCT) based on certain anatomical landmarks of the jaws with the goal of preventing complications due to inaccurate measurements in the pre-surgical planning phase of dental implant placement. 56 patients (30 male, 26 female) underwent panoramic radiography and a CBCT evaluation before dental implant surgery. Measurements were performed to identify the shortest vertical distance between the alveolar crest and neighboring anatomical structures, including the maxillary sinus, nasal floor, mandibular canal, and foramen mentale. The differences between the measurements on panoramic radiography and CBCT images were statistically analyzed. The statistically significant

differences were observed between the measurements on panoramic radiography and CBCT for all anatomical structures. The author's conclusions supported the idea that panoramic radiography might provide sufficient information on bone height for preoperative implant planning in routine cases or when CBCT is unavailable. However, an additional CBCT evaluation might be helpful in cases where a safety margin cannot be respected due to insufficient bone height.

In a systematic review, Bornstein et al. (2014) reviewed, analyzed, and summarized the available evidence on the use of cross-sectional imaging, specifically maxillofacial cone beam computed tomography (CBCT) in pre- and postoperative dental implant therapy. According to the authors, on the basis of the data found in the literature, the following can be concluded:

- Most published national and international guidelines on implant dentistry do not offer evidence based action statements developed from a rigorous systematic review approach.
- Most publications on guidelines for CBCT use in implant dentistry provide recommendations that are consensus-based or derived from a limited methodological approach with only partial retrieval and/or analysis of the literature or contain even generalized or non-case-specific statements.
- Indications or contraindications reported for CBCT use in implant dentistry are based on nonrandomized clinical trials, either cohort or case-controlled studies.
- The reported indications for CBCT use in implant dentistry vary from preoperative analysis regarding specific anatomic considerations, site development using grafts, and computer-assisted treatment planning to postoperative evaluation focusing on complications due to damage of neurovascular structures.
- It will be difficult to prove a clear and statistically significant benefit of cross-sectional imaging (with special emphasis on CBCT) over conventional two dimensional imaging such as panoramic radiography with respect to damage of the IAN or other vital neurovascular structures in the arches resulting in dysesthesia or pain in comparative prospective studies due to the high number of cases needed for such an evaluation (power).

Shelley et al. (2014) completed a systematic review to determine if the pre-operative availability of cross-sectional imaging, such as cone beam CT, has a diagnostic impact, therapeutic impact or impact on patients' outcome when placing two dental implants in the anterior mandible to support an overdenture. Studies were considered eligible for inclusion if they compared the impact of conventional and cross-sectional imaging when placing dental implants in sites including the anterior mandible. An adapted quality assessment tool was used for the assessment of the risk of bias in included studies. Pooled quantitative analysis was not possible and, therefore, synthesis was qualitative. Of 2374 potentially eligible papers, 5 studies were included. The authors stated that little could be determined from a synthesis of these studies because of their small number, clinical diversity and high risks of bias. The authors concluded that there is no evidence to support any specific imaging modality when planning dental implant placement in any region of the mouth. Therefore, those who argue that cross-sectional imaging should be used for the assessment of all dental implant sites are unsupported by evidence.

Oral Surgery

In a randomized controlled multicenter trial Guerrero et al. (2014) compared the postoperative complications following surgical removal of impacted third molars using panoramic radiography (PAN) images- and cone-beam computed tomography (CBCT)-based surgeries for "moderate-risk" cases of impacted third mandibular molars. The secondary objective of the study was to compare the reliability of CBCT with that of PAN in preoperative radiographic determination of the position of the third molar, number of roots, and apical divergence. The sample consisted of impacted third molars from 256 patients with a close relation to the inferior alveolar nerve (IAN). Patients were divided into two groups: the CBCT group (n=126) and the PAN group (n=130). The incidences of IAN sensory disturbance and other postoperative complications were recorded for each group at 7 days after surgery. Statistical analysis was used to compare the diagnoses of five trained dentomaxillofacial radiologists and to relate radiologic diagnoses to perioperative findings. Logistic regression was used to determine whether the imaging modality influenced occurrence of postoperative complications. Two extractions (1.5%) in the CBCT group and five (3.8%) in the PAN group resulted in IAN sensory disturbance. Logistic regression models did not show that CBCT modality decreased postoperative complications following surgical removal of impacted third molars. Yet, CBCT revealed the number of roots and apical divergence of the roots more reliably than panoramic radiographs however, the authors concluded that CBCT was not better than panoramic radiography in predicting postoperative complications for moderate-risk cases of impacted third mandibular molars.

Matzen et al. (2013a) assessed the influence of cone beam CT (CBCT) on treatment planning before surgical intervention of mandibular third molars and identified radiographic factors with an impact on deciding on coronectomy. A total of 186 mandibular third molars with an indication for surgical intervention underwent a radiographic examination with two methods: (1) panoramic imaging in combination with stereo-scanography and (2) CBCT. After the radiographic examination a treatment plan

(TP) was established: either surgical removal (Sr) or coronectomy (Co). The first TP was based on the panoramic image and stereo-scanogram, while the second TP was established after CBCT was available. Logistic regression analyses were used to identify factors predisposing for Co after CBCT. Treatment was performed according to the second TP. Agreement between the first and second TP was seen in 164 cases (88%), while the TP changed for 22 teeth (12%) after CBCT. Direct contact between the third molar and the mandibular canal had the highest impact on deciding on Co. Direct contact was not a sufficient factor, however; thus, lumen narrowing of the canal and canal positioned in a bending or a groove in the root complex were additional canal-related factors for deciding on Co. The authors concluded that CBCT influenced the treatment plan for 12%. Direct contact in combination with narrowing of the canal lumen and canal positioned in a bending or a groove in the root complex observed in CBCT images were significant factors for deciding on coronectomy. The study did not confirm the utility of such findings in improving care and outcome of patients.

Matzen et al. (2013b) compared the diagnostic accuracy of panoramic imaging, stereo-scanography and cone beam computed tomography (CBCT) for assessment of mandibular third molars. One hundred and twelve patients (147 third molars) underwent radiographic examination by panoramic imaging, stereo-scanography and CBCT. There were no significant differences between the modalities regarding tooth angulation, root morphology and number of roots. However, CBCT was more accurate than stereo-scanography for determining root bending in the bucco-lingual plane. Moreover, sensitivity for direct contact to the mandibular canal was higher for CBCT than for panoramic images and specificity for no direct contact to the mandibular canal was higher for panoramic images and CBCT than for scanograms. The authors concluded that panoramic imaging, stereo-scanography and CBCT seem equally valuable for examination of tooth angulation and number and morphology of roots of mandibular third molars. However, CBCT was more accurate for assessment of root bending in the bucco-lingual plane and more accurate than panoramic images to identify direct contact to the mandibular canal. There is no evidence from this study that this information will affect patient management.

Guerrero et al. (2012) conducted a randomized controlled trial to measure sensory disturbances of the inferior alveolar nerve (IAN) after removal of impacted mandibular third molars using cone beam computed tomography (CBCT) and dental panoramic radiography (PAN) for preoperative assessment and to measure the efficacy of the observers' prediction of IAN exposure at surgery based on CBCT compared with PAN. The sample consisted of 86 impacted third molars (from 79 consecutive patients) in close relation to the IAN as determined by PAN and judged as showing a "moderate" risk of IAN damage. Postoperative sensory disturbances occurred in 1 patient in the CBCT group and 1 patient in the PAN group. The light-touch sensation test showed no significant differences at the lip and chin levels for CBCT- versus PAN-based surgery. Significant differences in making a correct diagnosis of neurovascular bundle exposure at the extraction of impacted teeth were found between the 2 modalities. The authors concluded that within the limits of the present pilot study, CBCT was not superior to PAN in predicting postoperative sensory disturbances but was superior in predicting IAN exposure during third molar removal in cases judged as having "moderate" risk.

In a systematic review, Guerrero et al. (2011) evaluated the evidence for the diagnostic efficacy of cone beam computed tomography (CBCT) for impacted teeth and associated features. The literature search yielded 96 titles, of which 7 were included in the review. There was only limited evidence for diagnostic efficacy expressed as sensitivity, specificity and predictive values. Only two studies compared CBCT and panoramic radiographs with a valid reference method and presented the results in terms of percentage of correct diagnoses. The authors stated that the review revealed a need for studies that meet methodological standards for diagnostic efficacy of CBCT in the diagnosis of impacted teeth. According to the authors, there is a need for randomized controlled trials where different findings of CBCT examination are analyzed in relation to the treatment outcomes. These studies should measure performance of imaging alternatives (CBCT and conventional radiography) for the purpose of making diagnoses and in their contribution to improved management of patients. Furthermore, additional multicentre studies are required to determine when CBCT imaging is needed.

In a prospective study, Ghaemina et al. (2011) evaluated the role of cone beam computed tomography (CBCT) in the treatment of patients with impacted mandibular third molars at increased risk of inferior alveolar nerve (IAN) injury. Subjects with an increased risk of IAN injury, as diagnosed on panoramic radiographs, were enrolled in this study and underwent additional CBCT imaging. Two oral maxillofacial surgeons independently planned the surgical technique and estimated the risk of IAN injury on panoramic radiographs and on CBCT images. A test of symmetry and the McNemar test were executed to calculate the differences between the two imaging modalities. The study sample comprised 40 patients presenting with 53 mandibular third molars. Risk assessment for IAN injury based on panoramic radiography compared with CBCT imaging differed significantly. After reviewing the CBCT images, significantly more subjects were reclassified to a lower risk for IAN injury compared with the panoramic radiograph assessments. This change in risk assessment also resulted in a significantly different

surgical approach. The results of this study show that CBCT contributes to optimal risk assessment and, as a consequence, to more adequate surgical planning, compared with panoramic radiography. This study is limited by a small study population.

Orthodontics

Signorelli et al. (2016) studied radiation doses of different cone-beam computed tomography (CBCT) scan modes and compared them to conventional orthodontic radiographs (CORs) by means of phantom dosimetry. Thermoluminescent dosimeter (TLD) chips (3 × 1 × 1 mm) were used on adult male tissue-equivalent phantoms to record the distribution of the absorbed radiation dose. Three different scanning modes (i.e., portrait, normal landscape, and fast scan landscape) were compared to conventional orthodontic radiographs. Although one CBCT scan may replace all conventional orthodontic radiographs, one set of CORs still entails 2-4 times less radiation than one CBCT. Depending on the scan mode, the radiation dose of a CBCT is about 3-6 times that of a digital panoramic radiograph, 8-14 times a posteroanterior cephalograms, and 15-26 times a conventional lateral. The authors concluded CBCT should not be recommended for use in all orthodontic patients as a substitute for a conventional set of radiographs.

In a prospective study, Algerban et al. (2013) compared the impact of using two-dimensional (2D) panoramic radiographs and three-dimensional (3D) cone beam CT for the surgical treatment planning of impacted maxillary canines. The study included of 32 subjects (19 females, 13 males) with a mean age of 25 years, referred for surgical intervention of 39 maxillary impacted canines. Initial 2D panoramic radiography was available, and 3D cone beam CT imaging was obtained upon clinical indication. Both 2D and 3D pre-operative radiographic diagnostic sets were subsequently analyzed by six observers. Perioperative evaluations were conducted by the treating surgeon. McNemar tests, hierarchical logistic regression and linear mixed models were used to explore the differences in evaluations between imaging modalities. Significantly higher confidence levels were observed for 3D image-based treatment plans than for 2D image-based plans. The evaluations of canine crown position, contact relationship and lateral incisor root resorption were significantly different between the 2D and 3D images. By contrast, pre- and perioperative evaluations were not significantly different between the two image modalities. The authors concluded that surgical treatment planning of impacted maxillary canines was not significantly different between panoramic and cone beam CT images.

Van Vlijmen et al. (2012) conducted a systematic review of (CBCT) applications in orthodontics and evaluated the level of evidence to determine whether the use of CBCT is justified in orthodontics. The authors identified 550 articles, and 50 met the inclusion criteria. The authors found no high-quality evidence regarding the benefits of CBCT use in orthodontics. Limited evidence shows that CBCT offers better diagnostic potential, leads to better treatment planning or results in better treatment outcome than do conventional imaging modalities. Only the results of studies on airway diagnostics provided sound scientific data suggesting that CBCT use has added value. The additional radiation exposure should be weighed against possible benefits of CBCT, which have not been supported in the literature. The authors suggested that future studies should evaluate the effects of CBCT on treatment procedures, progression and outcome quantitatively.

Rossini et al. (2012) analyzed the literature focused on cone- beam computed tomography (CBCT) diagnostic accuracy and efficacy in detecting impacted maxillary canines, and evaluated the possible advantages in using CBCT technique compared with traditional radiographs. The literature search yielded 94 titles, of which 5 were included in the review. Three studies used CBCT technique to 3D localize maxillary impacted canines and assess root resorption of adjacent teeth. The other two publications compared traditional radiographs with CBCT images in the diagnosis of maxillary impacted canines. Only three studies presented the results using statistical analysis. The authors concluded that CBCT has a potential diagnostic effect and may influence the outcome of treatment when compared with traditional panoramic radiography for the assessment of impacted maxillary canines. According to the authors, there is a need of future studies performed according with high level methodological standards, investigating diagnostic accuracy and effectiveness of CBCT in the diagnosis of maxillary impacted teeth. The authors stated that the methodological differences among selected studies (i.e., study sample, materials and methods) revealed the lack of studies performed using methodological standards for diagnostic accuracy and effectiveness of CBCT in the diagnosis of maxillary impacted teeth.

Botticelli et al. (2011) evaluated whether there is any difference in the diagnostic information provided by conventional two-dimensional (2D) images or by three-dimensional (3D) cone beam computed tomography (CBCT) in subjects with unerupted maxillary canines. Twenty-seven patients (17 females and 10 males, mean age 11.8 years) undergoing orthodontic treatment with 39 impacted or retained maxillary canines were included. For each canine, two different digital image sets were obtained: (1) A 2D image set including a panoramic radiograph, a lateral cephalogram, and the available periapical radiographs with different projections and (2) A 3D image set obtained with CBCT. Both sets of images were submitted, in a single-blind

randomized order, to eight dentists. A questionnaire was used to assess the position of the canine, the presence of root resorption, the difficulty of the case, treatment choice options, and the quality of the images. Data analysis was performed using the McNemar-Bowker test for paired data, Kappa statistics, and paired t-tests. The findings demonstrated a difference in the localization of the impacted canines between the two techniques, which can be explained by factors affecting the conventional 2D radiographs such as distortion, magnification, and superimposition of anatomical structures situated in different planes of space. According to the authors, the increased precision in the localization of the canines and the improved estimation of the space conditions in the arch obtained with CBCT resulted in a difference in diagnosis and treatment planning towards a more clinically orientated approach. The study did not confirm the utility of such findings in improving care and outcome of patients.

Periodontics

Yang et al. (2019) evaluated the performance of cone-beam computed tomography (CBCT) in assessment of periodontal bone loss. If effective, CBCT could potentially be a more comfortable and accurate way to evaluate this disease. One hundred and eighty tooth sites from 13 patients were included. Clinical attachment level (CAL) was measured, CBCT images were then acquired prior to periodontal surgery. The distance between the cemento-enamel junction and alveolar bone crest at the mesio-buccal, mid-buccal, distobuccal, mesio-lingual/palatal, mid-lingual/palatal, and disto-lingual/palatal sites were all measured and comparisons of the measurements were made by three methods. Statistically significant differences were found between CBCT and CAL + 2.04 mm, as well as intra-surgical evaluation. All sites showed differences in CBCT versus intra-surgical measurement and versus CAL + 2.04 comparisons, except the buccal sites. The authors found the results of CBCT do not agree with results of intra-surgical measurement and therefore CBCT should be used with caution and only when necessary, to avoid radiation hazards.

In this systematic review and meta-analysis, Haas et al. (2018) evaluated the diagnostic validity of cone beam computed tomography (CBCT) in measuring periodontal bone defects. Four databases were searched and the studies were selected by two independent reviewers. The methodology of selected studies was assessed using the 14-item Quality Assessment Tool for Diagnostic Accuracy Studies. Using a selection process in two phases, 16 studies were identified and meta-analysis was performed in seven articles. The results from these meta-analyses showed that no difference between the measurements of CBCT and in situ for alveolar bone loss, and demonstrated a concordance of 82.82% between CBCT and in situ for the classification of the degree of furcation involvement. The main limitations identified by the authors were the heterogeneity between the examiners of the studies and the protocols for the acquisition of the 3D images. The authors concluded based on a moderate level of evidence, CBCT could be useful for furcation involvement periodontal cases, but it should only be used in cases where clinical evaluation and conventional radiographic imaging do not provide the information necessary for an adequate diagnosis and proper periodontal treatment planning.

Leonardi et al. (2016) conducted a systematic review and meta-analysis assessed the diagnostic accuracy of conventional radiography and cone-beam computed tomographic (CBCT) imaging on the discrimination of apical periodontitis (AP) from no lesion. A meta-analysis was conducted on 6 of the 9 articles. All the articles studied artificial AP with induced bone defects. Periapical radiographs (digital and conventional) reported good diagnostic accuracy on the discrimination of artificial AP from no lesions, whereas CBCT imaging showed excellent accuracy values.

Walter et al. (2009) investigated the use of cone beam computed tomography (CBCT) in assessing furcation involvement (FI) and concomitant treatment decisions in maxillary molars. Twelve patients with generalized chronic periodontitis were consecutively recruited and CBCT was performed in maxillary molars (n=22) with clinical FI and increased probing pocket depths. CBCT images were analyzed and FI, root length supported by bone and anatomical features were evaluated. FI and treatment recommendations based on clinical examinations and periapical radiographs were compared with data derived from CBCT images. The estimated degree of FI based on clinical findings was confirmed in 27% of the sites, while 29% were overestimated and 44% revealed an underestimation according to CBCT analyses. Among degree I FI, 25% were underestimated, among degree II and II-III, the underestimation was as high as 75%, while all sites with degree III FI were confirmed in the CBCT. Discrepancies between clinically and CBCT-based therapeutic treatment approaches were found in 59-82% of the teeth, depending on whether the less invasive or the most invasive treatment recommendation was selected for comparison. The authors concluded that CBCT images of maxillary molars may provide detailed information of FI and a reliable basis for treatment decision. There is no evidence from this study that this information will affect patient management.

Grimard et al. (2009) compared the measurements from digital intraoral radiograph (IR) and cone-beam volumetric tomography (CBVT) images to direct surgical measurements for the evaluation of regenerative treatment outcomes. Digital IR and CBVT images were taken prior to initial bone grafting and at the 6-month reentry surgery for 35 intrabony defects. After defect

debridement, direct bony defect measurements were made with a periodontal probe. These same measurements were made on the IR and CBVT images and then compared to the direct surgical values. CBVT correlated strongly with surgical measurements, whereas IRs correlated less favorably. IR measurements were significantly less accurate compared to CBVT for all parameters investigated and underestimated surgical measurements from 0.6 +/- 2.3 mm to 1.5 +/- 2.3 mm. No significant difference for the distance from the cemento-enamel junction (CEJ) to the alveolar crest, defect fill, or defect resolution was seen between CBVT and surgical measurements; however, there was a significant difference for the distance from the CEJ to the base of the defect, with CBVT measurements underestimating the surgical measurements by 0.5 +/- 1.1 mm for reentry and 0.9 +/- 0.8 mm for the initial measurement. The authors concluded that compared to direct surgical measurement, CBVT was significantly more precise and accurate than IRs. The study did not confirm the utility of such findings in improving care and outcome of patients.

Professional Societies

American Association of Endodontists (AAE) and American Academy of Oral and Maxillofacial Radiography (AAOMR)

A position statement for the use of cone-beam-computed tomography in endodontics was prepared by the AAE Special Committee on Cone-Beam-Computed Tomography in conjunction with members of the AAOMR (AAE and AAOMR, 2016).

Diagnosis

- Recommendation 1: Intraoral radiographs should be considered the imaging modality of choice in the evaluation of the endodontic patient.
- Recommendation 2: Limited FOV CBCT should be considered the imaging modality of choice for diagnosis in patients who present with contradictory or nonspecific clinical signs and symptoms associated with untreated or previously endodontically treated teeth.

Initial Treatment

Preoperative

- Recommendation 3: Limited FOV CBCT should be considered the imaging modality of choice for initial treatment of teeth with the potential for extra canals and suspected complex morphology, such as mandibular anterior teeth, and maxillary and mandibular premolars and molars, and dental anomalies.

Intraoperative

- Recommendation 4: If a preoperative CBCT has not been taken, limited FOV CBCT should be considered as the imaging modality of choice for intra-appointment identification and localization of calcified canals.

Postoperative

- Recommendation 5: Intraoral radiographs should be considered the imaging modality of choice for immediate postoperative imaging.

Non-Surgical Retreatment

- Recommendation 6: Limited FOV CBCT should be considered the imaging modality of choice if clinical examination and 2-D intraoral radiography are inconclusive in the detection of vertical root fracture.
- Recommendation 7: Limited FOV CBCT should be the imaging modality of choice when evaluating the nonhealing of previous endodontic treatment to help determine the need for further treatment, such as non-surgical, surgical or extraction.
- Recommendation 8: Limited FOV CBCT should be the imaging modality of choice for non-surgical retreatment to assess endodontic treatment complications, such as overextended root canal obturation material, separated endodontic instruments, and localization of perforations.

Surgical Retreatment

- Recommendation 9: Limited FOV CBCT should be considered as the imaging modality of choice for presurgical treatment planning to localize root apex/apices and to evaluate the proximity to adjacent anatomical structures.

Special Conditions

Implant Placement

- Recommendation 10: Limited FOV CBCT should be considered as the imaging modality of choice for surgical placement of implants.

Traumatic Injuries

- Recommendation 11: Limited FOV CBCT should be considered the imaging modality of choice for diagnosis and management of limited dento-alveolar trauma, root fractures, luxation, and/or displacement of teeth and localized alveolar fractures, in the absence of other maxillofacial or soft tissue injury that may require other advanced imaging modalities.

Resorptive Defects

- Recommendation 12: Limited FOV CBCT is the imaging modality of choice in the localization and differentiation of external and internal resorptive defects and the determination of appropriate treatment and prognosis.

Outcome Assessment

- Recommendation 13: In the absence of clinical signs or symptoms, intraoral radiographs should be considered the imaging modality of choice for the evaluation of healing following nonsurgical and surgical endodontic treatment.
- Recommendation 14: In the absence of signs and symptoms, if limited FOV CBCT was the imaging modality of choice at the time of evaluation and treatment, it may be the modality of choice for follow-up evaluation. In the presence of signs and symptoms, refer to Recommendation #7.

See the following for additional information: <https://www.aae.org/specialty/clinical-resources/cone-beam-computed-tomography/>. (Accessed April 21,2020)

American Academy of Oral and Maxillofacial Radiology (AAOMR)

A position statement developed by consensus agreement by a panel convened by the AAOMR summarized the potential benefits and risks of maxillofacial cone beam computed tomography (CBCT) use in orthodontic diagnosis, treatment and outcomes. The panel reviewed literature on the clinical efficacy of and radiation dose concepts associated with CBCT in all aspects of orthodontic practice and concluded that the use of CBCT in orthodontic treatment should be justified on an individual basis, based on clinical presentation. Despite the number of publications on the use of CBCT for specific orthodontic applications, most are observational studies of diagnostic performance and efficacy with wide ranging methodological soundness. According to the panel, few authors have presented higher levels of evidence and measured the impact of CBCT on orthodontic diagnosis and treatment planning decisions (AAOMR, 2013).

A Position Paper Subcommittee of the AAOMR reviewed the literature on selection criteria for radiology in dental implantology (Tyndall, 2012). All current planar modalities, including intraoral, panoramic, and cephalometric, as well as cone beam computed tomography (CBCT) are discussed, along with radiation dosimetry and anatomy considerations. The AAOMR made the following recommendations:

- Do not use cross-sectional imaging, including CBCT, as an initial diagnostic imaging examination.
- CBCT should be considered as the imaging modality of choice for preoperative cross-sectional imaging of potential implant sites.
- CBCT should be considered when clinical conditions indicate a need for augmentation procedures or site development before placement of dental implants: (1) sinus augmentation, (2) block or particulate bone grafting, (3) ramus or symphysis grafting, (4) assessment of impacted teeth in the field of interest, and (5) evaluation of prior traumatic injury.
- CBCT imaging should be considered if bone reconstruction and augmentation procedures (e.g., ridge preservation or bone grafting) have been performed to treat bone volume deficiencies before implant placement.
- Use cross-sectional imaging (particularly CBCT) immediately postoperatively only if the patient presents with implant mobility or altered sensation, especially if the fixture is in the posterior mandible.
- Do not use CBCT imaging for periodic review of clinically asymptomatic implants.
- Cross-sectional imaging, optimally CBCT, should be considered if implant retrieval is anticipated.

American Association of Oral and Maxillofacial Surgeons (AAOMS)

The AAOMS appointed a task force to study the indications, safety, and clinical practice patterns of cone-beam computed tomography (CBCT) in oral and maxillofacial surgery (OMS). Carter et al. (2016) reviewed published information of CBCT in OMS, identified current positions of academic leaders in the field, and researched the adoption and usage of the technology at the clinical practitioner level. The report summarizes published applications of CBCT that have been vetted by the academic and practicing OMS community to define current indications. The AAOMS and the ADA, and many other groups, are members of Image Gently, the Alliance for Radiation Safety in Pediatric Imaging in which all promote that CBCT should be used only when necessary. The current literature does not support the idea that CBCT is considered standard of care for any procedure. CBCT should not be used as a screening tool. If the necessary information can be obtained through routine radiographic studies, then those should be used first.

American College of Prosthodontists (ACP)

Several types of imaging are available, ranging from conventional intraoral periapical radiographs to panoramic tomography to cross-sectional imaging, which involves multi-detector computed tomography (MDCT) and cone beam computed tomography (CBCT). The ACP position statement makes recommendations based on current literature and existing guidelines on the role of diagnostic imaging, especially cross-sectional CBCT imaging in pre- and post-implant imaging and assessment. It is the position of the ACP that:

- Conventional panoramic and/or intraoral periapical imaging is recommended for initial diagnostic evaluation. CBCT is not recommended for routine initial examination.
- Cross-sectional imaging (CBCT is preferable over CT due to its significantly lower radiation dose) is recommended for preoperative implant assessment.
- The rationale for CBCT imaging must be justified based on clinical evaluation.
- CBCT imaging should be used for the esthetic zone, pre- and post-bone grafting, sinus augmentation, pterygoid plate, and zygomatic implants.
- The region of interest (ROI) should be imaged using a field of view (FOV) no larger than necessary.
- CBCT is recommended to be used for the evaluation of postoperative complications such as postoperative neurosensory impairment, acute rhino-sinusitis, and implant mobility.

American Dental Association Council on Scientific Affairs (ADACSA)

In an advisory statement for the use of cone-beam computed tomography (CBCT) in dentistry, the ADACSA recommends that no radiographic examinations, including CBCT, should be performed for screening purposes and that CBCT should only be considered as an adjunct to standard oral imaging modalities. The ADACSA states that the clinician should prescribe traditional dental radiographs and CBCT scans only when he or she expects that the diagnostic yield will benefit patient care, enhance patient safety, and significantly improve clinical outcomes or all of these. The ADACSA also states that CBCT should be considered as an adjunct to standard oral imaging modalities and may supplement or replace conventional (two-dimensional or panoramic) dental radiography for the diagnosis, monitoring and treatment of oral disease or the management of oral conditions when, in the clinician's decision-making process, he or she determines that oral anatomical structures of interest may not be captured adequately by means of conventional radiography (ADACSA, 2012).

U.S. Food and Drug Administration (FDA)

This section is to be used for informational purposes only. FDA approval alone is not a basis for coverage.

Devices used for computed tomography are classified under the following product codes:

- JAK (system, X-ray tomography, computed)
- MUH (system, X-ray, extraoral source, digital)
- OAS (X-ray, tomography, computed, dental)

There are many 510(k) approvals for these codes, not all of which are for cone-beam computed tomography devices or for devices used for craniofacial imaging. For information on a specific device or manufacturer, search the Center for Devices and Radiological Health (CDRH) 510(k) database by product and/or manufacturer name then check for the appropriate indication in the Summary section of the results: <http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfPMN/pmn.cfm>. (Accessed April 21, 2020)

In a document for radiation-emitting products: dental cone-beam computed tomography, the FDA states that dental CBCT should be performed only when necessary to provide clinical information that cannot be provided using other imaging modalities. See the following for more information: <http://www.fda.gov/Radiation-EmittingProducts/RadiationEmittingProductsandProcedures/MedicalImaging/MedicalX-Rays/ucm315011.htm>. (Accessed April 20, 2020)

Additional Products

CBCT scanners specifically designed for orofacial imaging are available from several manufacturers, including but not limited to Hitachi (CB MercuRay™), Imaging Sciences International (i-Cat®), AFP Imaging (NewTom Systems), Soredex (Scanora® 3D), and Xoran Technologies (MiniCAT™).

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Policy History/Revision Information

Date	Summary of Changes
03/15/2021	<ul style="list-style-type: none"> Updated dental entity brand logo
01/01/2021	Template Update <ul style="list-style-type: none"> Reformatted policy; transferred content to new template
07/01/2020	Supporting Information <ul style="list-style-type: none"> Updated <i>Clinical Evidence</i> and <i>References</i> sections to reflect the most current information Archived previous policy version DCP044.01

Instructions for Use

This Dental Clinical Policy provides assistance in interpreting UnitedHealthcare standard dental benefit plans. When deciding coverage, the member specific benefit plan document must be referenced as the terms of the member specific benefit plan may differ from the standard dental plan. In the event of a conflict, the member specific benefit plan document governs. Before using this policy, please check the member specific benefit plan document and any applicable federal or state mandates. UnitedHealthcare reserves the right to modify its Policies and Guidelines as necessary. This Dental Clinical Policy is provided for informational purposes. It does not constitute medical advice.