Applications of Cone Beam Computed Tomography in Endodontics: A Review

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Abstract

Aim: This review aims to provide comprehensive information related to the principles of Cone beam computed tomography and its potential applications in the management of various endodontic conditions.

Methodology: A thorough and extensive electronic literature search was conducted utilizing PubMed, for articles related to endodontic applications of CBCT published during the period between January 2005 and September 30, 2013. Search words such as 'principles of CBCT', 'endodontic applications of CBCT' were employed to obtain information. Only those articles dealing with the principles and various endodontic applications of CBCT are included in this review.

Results: The search revealed 258 articles, 70 of which were found to be relevant to the scope of this review and were used in this review CBCT is a revolutionary and innovative procedure that has changed the paradigms in the management of various endodontic conditions. The information provided by this tool—three dimensional view of anatomic and pathologic structures, ability to provide details of root and canal anatomy, assessment of dento-alveolar trauma, assessment of root resorptions, etc. has contributed substantially to its extensive utilization in a short period of time.

Clinical Significance: CBCT can be used in the management of a variety of conditions like dento-alveolar truma, root resorptions, early apical periodontitis, roots and canals with unusual anatomy, dental anomalies, etc. The effective dose of CBCT (focused field of view) varies from 5-38.3 μSv. The effective dose of intra-oral periapical radiographs and panoramic radiographs are <8.3 μSv and 9-26 μSv respectively. Thus CBCT has an effective dose in the similar range of magnitude as other dental radiographs, but, its three dimensional imaging capability and 100% sensitivity (1.0) and specificity (1.0) makes it an invaluable tool in the field of endodontics.

Keywords: Cone-beam computed tomography; Imaging; Three-dimensional; Root resorption; Tooth fractures; Periapical periodontitis; Anatomic variation

Introduction

Cone Beam Computed Tomography (CBCT) is an extra-oral imaging system specifically designed for three dimensional imaging of the oral and maxillofacial structures. Most of the limitations associated with conventional radiography like compression of a three dimensional object into a two dimensional image, image distortion, anatomic superimposition, are overcome with cone beam computed tomography (CBCT). CBCT produces clear images with higher resolution at a reduced radiation and lower cost when compared to medical CT [1]. It is a more compact, faster and safer version of the medical CT. The time needed for a full scan is typically under one minute and the radiation dosage is several times lesser than that of a CT scanner. The purpose of this article is to provide an overview of the associated principles, applications and advantages of CBCT in the management of various endodontic conditions. In order to provide a better understanding regarding the usefulness of this imaging system, CBCT images obtained for the management of various endodontic conditions are discussed.

Methodology

A thorough and extensive electronic literature search was conducted utilizing PubMed, for articles related to endodontic applications of CBCT published during the period between January 2005 and September 30, 2013. Search words such as 'principles of CBCT', 'endodontic applications of CBCT' were employed to obtain information. Only those articles dealing with the principles and various endodontic applications of CBCT are included in this review. In order to obtain information that is clinically relevant, only those articles on human investigation were selected, and animal investigations and studies like those performed on acrylic block, etc were not included in this review.

Result

The search revealed different kinds of paper dealing with various applications of CBCT in Endodontics. Among the 258 articles revealed, 70 were found to be relevant to the scope of this review and were used in this review. Among the 70 relevant articles, 31 were case report, 21 were in vivo studies, and 18 were ex vivo studies.

Analyzing these articles, it appears that CBCT being three dimensional is an effective tool in the diagnosis and management of conditions like early apical periodontitis tooth with complex anatomy, root fracture, root resorption, periradicular surgical planning, dental anomalies. Utilization of this imaging technology in appropriate conditions may result in accurate diagnosis and predictable management.

Discussion

Correct diagnosis is the key in the management of any pathologic
condition. Imaging aids in visualizing internal structures that would be unseen otherwise. CBCT is a relatively new, three dimensional modality that can be useful in managing various endodontic conditions. In the following section basic principles of CBCT will be reviewed followed by a comprehensive review on condition wise application of CBCT in endodontics.

Principles of CBCT

Aria et al. from Japan [2] and Moshiri et al. from Italy [3] are credited with the development of CBCT scanners for use in oro-facial imaging. Unlike medical CT which employs a fan shaped beam of X-ray, CBCT projects a cone or pyramid shaped X-ray beam. Patient positioning during imaging varies, it can be supine, standing, or sitting based on the system manufacturer. CBCT units can be categorized into two types. One type of unit has Charge-Coupled Device (CCD) detector and the other utilizes Flat Panel Imager (FPI). Basically, the X-ray source and the scanner makes a full (360°) or half rotation (180°) around the patient's head. While doing so a cylindrical volume of data known as field of view is captured. This data is then analyzed by sophisticated software to display images in various planes. Hard copies of the images can be obtained through a printer connected to the computer. These images can be transferred to a compact disc (CD) or other portable memory devices and can also be mailed electronically to other clinicians for consultation and discussion purposes.

CBCT systems can be categorized according to the available Field Of View (FOV) or selected scan volume height as follows [1]:

- **Localized region:** approximately 5 cm or less (eg, dentoalveolar, temporomandibular joint)
- **Single arch:** 5 cm to 7 cm (eg, maxilla or mandible)
- **Interarch:** 7 cm to 10 cm (eg, mandible and superiorly to include the inferior concha)
- **Maxillofacial:** 10 cm to 15 cm (eg, mandible and extending to Nasion)
- **Craniofacial:** greater than 15 cm (eg, from the lower border of the mandible to the vertex of the head)

Radiation Dosage

Much like conventional radiography, CBCT utilizes ionizing radiation. There is a misconception among the general population and probably even among the dental professionals that CBCT exposes individuals to very high amount of radiation. Even though CBCT produces more radiation than conventional radiography, the difference is at best marginal. On the other hand, radiation emitted in CBCT imaging is several times lower than medical fan beam CT imaging. Not all CBCT units produce the same dose of radiation. The same CBCT units may produce different amount of radiation depending on the field of view (focused or large), power settings, rotation around head (180° or 360°), etc. The effective dose of one CBCT unit (3D Accuimotto, J Morita, Kyoto, Japan) has been reported to be equivalent to two or three standard periapical radiographic exposures [2].

Note that the effective dose of CBCT is almost similar to that of panoramic radiograph and equivalent to a few periapical radiographs, whereas it is several times lower than medical fan beam CT (Table 1).

### Accuracy of CBCT

Scientific literature suggests that CBCT is more accurate than radiography in imaging anatomic as well as pathologic dento-facial structures. Studies have shown the CBCT to be accurate and reliable in detecting apical periodontitis, vertical root fracture, resorptive defects. CBCT also provides a better view of root and pulp canal anatomy when compared to radiography. For example, presence of buccolingual curvature in a root is most often missed by radiographs, but it can be easily detected in CBCT image. Most often radiographs provide little or no information about the presence of additional canals, their shape and curvature. However CBCT imaging will reveal the same findings with high accuracy. In the following sections, accuracy of CBCT in detecting various endodontic conditions will be discussed along with representative cone beam computed tomographic images.

### Detection of Apical Periodontitis

Apical Periodontitis can be detected at an early stage using CBCT when compared to conventional radiographs. It appears that conventional radiography results in an under-estimation of the incidence of apical periodontitis [3-5]. Lesion confined within the cancellous bone cannot be detected by conventional radiographs, whereas they are easily detected in CBCT which captures images in slices thereby avoiding anatomic superimposition. Lofthag-Hansen et al. [6] compared the periapical status of 46 posterior mandibular and maxillary teeth using CBCT scans and two angled periapical radiographs. Thirty-two teeth were diagnosed with periapical lesions using conventional radiographs and a further 10 (24%) with CBCT. When the periapical status of the individual roots of these teeth was assessed, CBCT allowed 38% more periapical lesions to be detected than with conventional radiographs. CBCT was found to have increased sensitivity for detecting apical periodontitis compared with periapical and panoramic radiography. The sensitivity of periapical and panoramic radiography was found to be 0.55 and 0.28 respectively. CBCT has 100% specificity (1.0) and sensitivity (1.0) in detecting artificially created periapical lesion in dried human mandibles [7]. Recently a periapical index based on cone beam-computed tomography (CBCTPAI) for identification of apical periodontitis has been proposed. The CBCT PAI is a 6-point (0–5) scoring system calculated from determining the largest lesional measurement in either the baccopalatal, mesio-distal, or axial dimension or taking into account expansion and destruction of cortical bone [8-14] (Table 2).

### Assessment of Root and Canal Anatomy

Knowledge of root canal anatomy and variations between ethnic groups is essential for clinicians to facilitate effective root canal treatment (RCT). Successful endodontic therapy is dependent on identification of all root canals followed by proper cleaning, shaping and obturation of all canals. Most often radiographs may not show the presence of all canals within the root, especially in the buccolingual plane. Such missed canals may be responsible for persistent infection and post-treatment disease. The prevalence of a second mesiobuccal...
Table 2: Role of CBCT in the detection of apical periodontitis.

| Author/Reference | Year | Sample | Study | Findings and conclusion |
|------------------|------|--------|-------|-------------------------|
| Estrela et al. [5] | 2008 | Endodontically infected 1508 teeth | Comparison of diagnostic accuracy of panoramic and periapical radiographs with CBCT for the detection of apical periodontitis | Increased sensitivity of CBCT for detecting apical periodontitis compared with periapical and panoramic radiography. |
| Lothag-Hansen et al. [6] | 2007 | 46 posterior teeth (in vivo) | Compared the periapical status using CBCT and radiographs | CBCT allowed 38% more periapical lesions to be detected than with conventional radiographs |
| Patel et al. [7] | 2009 | 6 molar teeth | Comparison of the diagnostic accuracy of intraoral digital periapical radiography with that of cone beam computed tomography (CBCT) for the detection of artificial periapical bone defects | CBCT improved the detection of the presence and absence of artificial periapical lesions |
| Low et al. [9] | 2008 | 37 premolars, 37 molars, total 157 roots | Comparison between periapical (PA) radiography and cone-beam tomography (CBT) for preoperative diagnosis. | Detecting lesions with PA radiography alone was difficult. Additional findings were seen significantly more frequently in CBCT. |
| Bornstein et al. [10] | 2011 | 38 molars with 75 roots | The type of PA lesion as diagnosed on PA radiographs was compared with the type of lesion seen on sagittal and coronal CBCT sections. | (25.9%) lesions diagnosed with sagittal CBCT slices were missed with PA radiography. |
| Paes da Silva. [11] | 2012 | 300 patients | Determination of the prevalence of apical periodontitis (AP) detected in cone beam CT (CBCT) images from a database. | Apical Periodontitis can be frequently found in CBCT examinations CBCT databases are useful for cross-sectional studies about Apical periodontitis prevalence in a population. |
| Estrela C et al. [12] | 2009 | 1020 teeth | Assessment of the influence of intracanal post on apical periodontitis identified by cone-beam computed tomography. | AP was detected more frequently when CBCT method was used. |
| Moura MS et al. [13] | 2009 | 503 root canals | Assessment of the influence of length of root canal obturation on apical periodontitis detected by periradicular radiography and cone beam computed tomography. | Detection of apical periodontitis increased when CBCT was used. |
| Abella F [14] | 2012 | 138 teeth | Evaluating the Periapical Status of Teeth with Irreversible Pulpitis by Using Cone-beam Computed Tomography Scanning and Periapical Radiographs. | The study highlighted the advantages of using CBCT for detecting AP lesions, especially in teeth with symptomatic irreversible pulpitis. |

Table 2: Role of CBCT in the detection of apical periodontitis.
canal (MB2) in maxillary first molars has been reported to vary from 69% to 93% depending on the study method employed. Increased number of MB2 canal can be identified with CBCT when compared to conventional radiographs. Recently it was reported diagnosis and management of a maxillary first molar with seven root canals using CBCT. CBCT imaging has also been reported to characterize the high prevalence of the distolingual canal, highlight anomalies in the root canal system of mandibular premolars, and assist in the determination of root curvature. In a study that evaluated 608 permanent mandibular second molars using CBCT a higher prevalence of “C” shaped canals was noticed [15-17]. CBCT is an effective tool for the detection of additional distolingual roots and C-shaped canals [18] (Table 3).

Assessment of Dentoalveolar Trauma

The exact extent and severity of dentoalveolar traumatic injuries can be assessed with just one scan from which multiple views can be selected and analyzed. Various studies have shown CBCT to be effective in the diagnosis of vertical root fracture when compared with radiograph [32-34]. The diagnostic ability of CBCT in detecting vertical root fracture was not influenced by the presence of posts or gutta-percha [35]. Limited cone beam CT, outperformed the two-dimensional intraoral, conventional as well as digital, radiographic methods in detecting simulated horizontal root fracture [32]. CBCT can be an ideal alternative in the diagnosis of root fracture in the field of endodontics. CBCT is also more effective in detecting the alveolar fracture compared to radiographs. As CBCT is an extra-oral technique it is also more comfortable for trauma patients when compared to several intra-oral radiographs. CBCT also increases diagnostic quality and help decrease the potential failure of treatment and/or the prescription of unwarranted dental procedures. It has also been demonstrated that presence of root canal fillings and metallic post may cause streaking artifact which may lower the diagnostic value of CBCT (Table 4).

| Author                  | Year | Sample            | Study                                                                 | Findings and conclusion                                                                 |
|-------------------------|------|-------------------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Bernardes RA et al. [28] | 2012 | 34 teeth          | Comparative study of cone beam computed tomography and intraoral periapical radiographs in diagnosis of lingual-simulated external root resorptions. | Cone beam computed tomography showed better diagnostic ability compared with intraoral radiography, regardless of the tooth or the dimensions of the resorption evaluated. |
| Reis AG [29]            | 2013 | 100 patients, 343 teeth | Correlating second canal in mesiobuccal root of maxillary molars with root third and patient age | The prevalence of MB2 canals was found to decrease as the root canal approaches the apical third and as age increases. CBCT scanning proved effective in mapping MB2 canals present in different thirds of the root. |
| Guerrero ME [30]        | 2013 | 256 Patients      | Comparison of panoramic radiography and CBCT to predict postoperative outcome after wisdom tooth removal | This study concluded that, CBCT was not better than panoramic radiography in predicting postoperative complications for moderate-risk cases of impacted third mandibular molars. Nonetheless, a CBCT buccolingual view can accurately confirm the number of roots and root morphology of the third molar better than PA |
| Vizzotto MB [31]        | 2013 | 89 maxillary molar teeth | CBCT for the assessment of second mesiobuccal (MB2) canals in maxillary molar teeth: effect of voxel size and presence of root filling. | CBCT was associated with higher mean values of specificity and sensibility than radiographic examination for the detection of MB2 canals. When endodontic retreatment is necessary removal of the root filling prior to the CBCT examination eliminates artifacts. |

Table 3: Role of CBCT in studying the internal anatomy of tooth.
Role of CBCT in Endodontic Surgical Planning

CBCT may play an important role in periapical surgery. The distance between the cortical plate and the root apex could be measured, and the presence or absence of the maxillary sinus between the roots could be assessed. Location of the lesion, position of the roots with in the bone, and the proximity of vital structures including the inferior alveolar nerve, mental foramen, maxillary sinus, and nasal cavity can be assessed. The true size, location and extent of the periapical lesion can also be appreciated. The cancellous bone pattern, fenestrations, as well as the inclination of the roots of teeth planned for surgery can be accurately determined preoperatively. Root morphology and bony topography can be visualized in three-dimensions, as can the number of root canals and whether they converge or diverge from each other (Table 5).

Assessment of Root Resorption

Treatment of resorption can be complex and unpredictable. Imaging is critical for accurate diagnosis and appropriate treatment. Conventional radiography does not provide the true and full representation of the lesion. CBCT has been shown to help and determine the treatment complexity as well as aid the clinician in offering an accurate prognosis on the basis of the extent of the resorptive lesion. As a result, both treatment and treatment outcomes are likely to become more predictable (Table 6).

Dental Anomalies

Anatomic variations should be carefully observed and considered during the diagnosis and treatment planning of teeth with anomalies in order to enhance the chances of success. The use of cone beam computed tomography (CBCT) is very helpful in endodontic diagnosis of complex anatomic variations. Root canal treatment of teeth with complex root canal anatomy such as dens invaginatus, fused root, talon's cusp, etc, can be problematic because infected pulpal tissues may be in inaccessible areas of the canal system. Cleaning and debridement of such root canal systems are therefore challenging. Conventional radiographs have limited role in the assessment of complex root canal morphologies. These modalities, however, do not provide detailed information of the complexity as a result of their inherent limitations. This calls for the use of more advanced imaging modalities such as CBCT.

Table 4: Role of CBCT in the management of dento-alveolar trauma.

| Author | Year | Sample | Study | Findings and conclusion |
|--------|------|--------|-------|-------------------------|
| R Christiansen et al. [51] | 2009 | 50 patients, 58 teeth | Periapical radiography and cone beam computed tomography for assessment of the periapical bone defect 1 week and 12 months after root-end resection | More remaining defects were detected 1 year after periapical surgery on CBCT images than on periapical radiographs |
| Christos Angelopoulos et al. [52] | 2008 | 68 mandibular canals | Comparison Between Digital Panoramic Radiography and Cone-Beam Computed Tomography for the Identification of the Mandibular Canal | The CBCT reformatted panoramic images outperformed the digital panoramic images in the identification of the mandibular canal |
| Kim TS et al. [53] | 2010 | 12 Human mandibles | Comparison of cone-beam computed tomography and direct measurement in the examination of the mandibular canal and adjacent structures | Can be used to measure distances from the apices of the posterior teeth to the mandibular canal as accurately as direct anatomic dissection |
| Shekhar V [54] | 2013 | Case report | Cone beam computed tomography evaluation of the diagnosis, treatment planning, and long-term follow-up of large periapical lesions treated by endodontic surgery | It was concluded that CBCT was a useful modality in making the diagnosis and treatment plan and assessing the outcome of endodontic surgery for large periapical lesions. |

Table 5: Role of CBCT in endodontic surgical planning.

| Author | Year | Sample | Study | Findings and conclusion |
|--------|------|--------|-------|-------------------------|
| Edlund M et al. [42] | 2011 | 29 patients | Detection of vertical root fractures by using cone-beam computed tomography | This study revealed the superior diagnostic accuracy of CBCT for detection of VRF |
| Wang P et al. [43] | 2011 | Report of cases | Evaluation of horizontal/oblique root fractures in the palatal roots of maxillary first molars using cone-beam computed tomography | CBCT might be a useful complementary diagnostic method to conventional radiography in cases of suspected horizontal/oblique root fractures |
| Varshosaz M et al. [44] | 2010 | 100 teeth | Comparison of conventional radiography with cone beam computed tomography for detection of vertical root fractures in vitro | CBCT was shown to be significantly better than conventional periapical radiography for diagnosis of vertical root fractures |
| Bernardes RA et al. [45] | 2009 | 20 patients | A report of cases that describes the use of cone-beam volumetric tomography in the diagnosis of root fractures | Cone-beam volumetric tomography was better than conventional radiography in the diagnosis of root fractures, thereby constituting an excellent alternative for diagnosis in general practice |
| Dölekoğlu S et al. [46] | 2010 | Case report | Diagnosis of jaw and dentoalveolar fractures in a traumatized patient with cone beam computed tomography | According to 2D cephalometric analysis, no fracture existed. In the diagnosis of dentoalveolar fractures, CBCT has made it possible for the practitioner to get more detailed information |
| Mora MA et al. [47] | 2007 | 60 teeth | In vitro assessment of local computed tomography for the detection of longitudinal tooth fractures | Local CT significantly improves the detection of longitudinal fractures in vitro compared with conventional periapical radiography |
| Özer SY et al. [48] | 2011 | Report of three cases | Diagnosis and treatment of endodontically treated teeth with vertical root fracture: three case reports with two-year follow-up. | Cone beam computed tomography-assisted VRF diagnosis is helpful in detecting fractures; however, higher-resolution tomography units providing better image quality would be a better choice for improved visualization of these fractures |
| da Silveira PF [49] | 2013 | 60 single rooted teeth | Detection of vertical root fractures by conventional radiographic examination and cone beam computed tomography | If conventional imaging is not capable to provide adequate information, CBCT can be indicated if a root fracture is strongly suspected |
| Avsever H [50] | 2013 | 82 maxillary incisors | Comparison of intraoral radiography and cone-beam computed tomography for the detection of horizontal root fractures | CBCT imaging offers the clear advantage over conventional imaging that traumatized teeth can be visualized in all three dimensions-especially the oro-facial dimension. |
Table 6: Role of CBCT in the management of root resorption.

| Author                    | Year  | Sample | Study                                                                 | Findings and conclusion                                                                 |
|---------------------------|-------|--------|----------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| S. Patel [55]             | 2009  | 15 teeth | Comparison of accuracy of intraoral periapical radiography with cone beam computed tomography (CBCT) for the detection and management of resorption lesions. | CBCT was effective and reliable in detecting the presence of resorption lesions          |
| K. Kamburoglu et al. [56] | 2010  | 80 teeth | Comparison of the diagnostic accuracy of CBCT images of different voxel resolutions used to detect simulated small internal resorption cavities | Ultra-and high-resolution CBCT images performed similarly and better than low-resolution images in the detection of simulated internal resorption ex vivo. |
| V. S. H. Yu et al. [57]   | 2010  | Case report | Case report on multiple idiopathic cervical resorption                | CBCT demonstrated that the lesions were more extensive and more widely distributed than was seen using conventional radiography. |
| Roberto Estevez et al. [58] | 2010  | Case report | Invasive Cervical Resorption Class III managed using the aid of CBCT   | CBCT is a very useful tool to achieve proper diagnosis and management of cervical resorption. |
| Kivanc, Kamburo_glu et al. [59] | 2011  | 50 teeth | Observer Ability to Detect Ex Vivo Simulated Internal External Cervical Root Resorption | CBCT images performed better than film in the ex vivo detection and localization of simulated internal and external cervical root resorption. |
| Estrela C et al. [60]     | 2009  | 40 patients | Method to evaluate inflammatory root resorption by using cone beam computed tomography | CBCT seems to be useful in the evaluation of internal root resorption.                      |
| Bhuv B et al. [61]        | 2011  | Case report | The use of limited cone beam computed tomography in the diagnosis and management of a case of perforating internal root resorption. | This case report describes the use of CBCT in the diagnosis and treatment planning of a case of perforating internal root resorption. |
| Shokri A [62]             | 2013  | 54 teeth | Diagnosis of simulated external root resorption using conventional intraoral film radiography, CCD, PSP, and CBCT | For locations of root resorption, significant differences were found between CBCT and other methods in the apical regions. CBCT was only useful for detection of cavities located in the apical one-third of the root, compared to other digital or conventional methods. |
| Castro IO [63]            | 2013  | 1256 roots from 30 Patients | Evaluation of apical root resorption due to orthodontic treatment detected by cone beam computed tomography | The results of this investigation showed that CBCT was effective for detecting in vivo even minimal degrees of ARR due to orthodontic treatment and allowed three-dimensional evaluation of dental roots and visualization of palatine roots of maxillary molars. |
as CBCT, which can help the clinician in making a more accurate diagnosis. CBCT may aid the diagnosis as well as the treatment plan and follow-up of teeth with developmental anomalies. CBCT is a useful adjunct to the clinician's armamentarium in the endodontic treatment of anomalous tooth (Table 7).

To summarize, CBCT appears to be promising in the assessment and treatment of complex endodontic conditions such as: a) Detection of suspected additional canals and unusual root and canal anatomy based on radiographic examination. b) To assess the location and severity of root resorption. External and internal resorptions can be easily differentiated with CBCT. c) To study the root canal system anomalies and for determination of direction and angulation of root curvature. d) To assess the dimensions of lesion or defect and its spatial relationship with vital structures before performing surgical endodontics. e) CBCT also plays vital role in the detection and management of dento-alveolar traumatic injuries, assessment of endodontic treatment complications, such as overextended root canal fillings, separated instruments, presence of denticles and diffuse calcification, and detection of iatrogenic perforations.

Limitations of CBCT

While the CBCT has documented advantages over other techniques, there are a few limitations that are reported. At present the images produced with CBCT technology do not have the resolution of conventional radiographs. The spatial resolution of conventional direct-action packet film and digital sensors is in the order of 15-20 line pairs/mm (72). CBCT images only have a spatial resolution of 2 line pairs/mm (73). However, the ability of this technology to demonstrate geometrically accurate images in all three dimensions and the elimination of anatomic noise facilitates the assessment of a number of features important in endodontic diagnosis, treatment, and long-term management. One significant problem, which can affect the image quality and diagnostic accuracy of CBCT images is the scatter and beam hardening caused by high density neighboring structures, such as enamel, metal posts and restorations. If this scattering and beam hardening is associated close to or with the tooth being assessed, the resulting CBCT images may be of minimal diagnostic value. In clinical Endodontic practice, CBCT scanners with a limited field of view might provide clearer images as they can avoid scanning structures outside the region of interest susceptible to beam hardening (e.g., metallic restorations, dental implants). Endodontic sealers have also been reported to produce artifacts that mimic fracture line. Reduction of voxel size has been suggested to minimize such artifacts. Women of childbearing age must be screened for pregnancy. In case of pregnancy, the benefits of performing a CBCT scan must be weighed against the possible risk to the fetus. But it should be remembered that, since the horizontal trajectory of the CBCT beam through the patient's jaw suggests that the patient's fetus would not be subjected to any direct radiation, and that the only exposure the fetus would receive would be from scattered radiation which is negligible, pregnancy is not an absolute contraindication for performing CBCT scan. Till date there are no reported fetal consequences due to CBCT scanning during pregnancy. Even though the exposure from CBCT is significantly less than that of Medical CT, it still utilizes ionizing radiation, hence a CBCT scan should be performed only if there is possibility that the scan would reveal additional important information not gained with conventional radiographs. Finally, scan durations are lengthy at 15-20 s and require the patient to stay absolutely still during that period.

Conclusion

Conventional radiographs have been used in endodontic practice for varied purposes. Radiography has its limitations in the form of anatomic superimposition, compression of three dimensional anatomy, geometric distortion, etc. Most of these limitations are overcome with the advent of three dimensional CBCT. CBCT has established itself as a highly useful tool in visualizing the exact root and canal anatomy, pathologic alterations, assessment or dental alveolar trauma.
surgical assessment, assessment of root resorptions. Knowledge about CBCT will help clinicians to make the full use of this excellent three-dimensional imaging system, starting from diagnosis to treatment outcome evaluation.

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