BULLETIN OF STOMATOLOGY AND MAXILLOFACIAL SURGERY
Volume 21, Issue 10

DOI: 10.58240/1829006X-2025.21.10-75

ORIGINAL RESEARCH

CONE BEAM COMPUTED TOMOGRAPHY (CBCT) IN THE DIAGNOSIS AND SURGICAL PLANNING OF IMPACTED SUPERNUMERARY TEETH IN PEDIATRIC PATIENTS

Trophimus Gnanabagyan Jayakaran[1], Prabu. N. P[2] , Kanimozhi IG[3] , Monicka C[4] , Anwesha Banerjee[5] , Pallavi Chandrasekhar[6]

[1]Reader Department of Pediatric and Preventive Dentistry, SRM Dental College, Bharathi Salai, Ramapuram, Chennai – 600089, trophim@srmist.edu.in Orchid id: 0000-0002-8285-7424

[2]Reader Department of oral and maxillofacial surgery, Sree Balaji dental college and hospital , Velachery Rd, Narayanapuram, Pallikaranai, Chennai, Tamil Nadu 600100 Email Id: prabupoosai1978@gmail.com

[3]Assistant professor, Department of District Early Intervention Centre,Government kilpauk medical college and hospital Kilpauk, Email Id: kanimozhipedo@gmail.com

[4]Post graduate student Oral medicine and Radiology Sree Balaji dental college and hospital , Velachery Rd, Narayanapuram, Pallikaranai, Chennai, Tamil Nadu 600100
Email Id: lakshamonicks@gmail.com

[5]Assistant Professor Department of Oral Medicine and Radiology Guru Nanak Institute of Dental Sciences and Research,Kolkata Email Id: dr.anwesha12@gmail.com

[6.]Senior Lecturer, Pedodontics Priyadarshini Dental College And Hospital, No. 1, V.G.R. Gardens, V.G.R. Nagar, Pandur, Tamil Nadu 631203, Email Id: pallavi.vinoth@gmail.com

***Correspondence:** Trophimus Gnanabagyan Jayakaran Reader,Department of Pediatric and Preventive Dentistry SRM Dental College, Bharathi Salai, Ramapuram, Chennai – 600089 Email Id: trophim@srmist.edu.in

Received: *Sep 7. 2025;* ***Accepted:*** *Sep. 28, 2025;* ***Published:*** *Oct. 24, 2025*

Background: Accurate diagnosis and surgical planning for impacted supernumerary teeth in pediatric patients continue to be difficult because of anatomical differences and the limitations of traditional imaging. Cone Beam Computed Tomography (CBCT) provides sophisticated three-dimensional imaging that could improve clinical results.

Aim: To assess the diagnostic precision and surgical planning efficacy of CBCT in pediatric patients with impacted supernumerary teeth in comparison to traditional two-dimensional (2D) radiographs.

Materials and methods: A retrospective study was performed on 45 pediatric patients (ages 6–14 years) exhibiting radiographic evidence of impacted supernumerary teeth. For each case, both 2D imaging (orthopantomogram and/or periapical radiographs) and CBCT were used to look at it. The data gathered encompassed localization accuracy, tooth morphology, orientation, and modifications in surgical planning. We used Chi-square and paired t-tests to do a comparative analysis ($P<0.05$ is significant).

Results: CBCT showed better diagnostic abilities than regular two-dimensional imaging. CBCT accurately identified the bucco-palatal or lingual position of supernumerary teeth in 87% of cases, compared to only 34.8% with 2D imaging ($p < 0.001$). The results of the CBCT had a significant effect on the decisions made about surgery. Surgical access routes were altered in 64.4% of cases based on CBCT imaging ($p = 0.002$).

Conclusion: CBCT greatly enhances diagnostic precision and enables meticulous surgical planning for impacted supernumerary teeth in pediatric patients. Its superior anatomical visualization facilitates safer, minimally invasive interventions and should be considered particularly in complex cases where 2D imaging is insufficient.

Keywords: CBCT, radiograph, supernumerary teeth, diagnosis, surgical planning.

INTRODUCTION

Supernumerary teeth, which are teeth that are more than the normal number of teeth, are developmental problems that can happen in both the primary and permanent dentitions. These teeth can be single or multiple, erupted or impacted, and are often found by chance during routine X-rays. Although the exact cause is still unknown, there are a few ideas that have been put forward, such as the dental lamina hyperactivity theory, the dichotomy of the tooth bud, and the idea that it runs in families. The dental lamina hyperactivity theory is the most widely accepted explanation. It says that localized, independent hyperactivity causes extra tooth buds to form.[1]

The occurrence of supernumerary teeth varies among populations, ranging from 0.1% to 3.8%. It is more common in males than females and is especially common in the maxillary anterior region.[2,3] Mesiodens, which are extra teeth that grow between the maxillary central incisors, are the most common type of supernumerary teeth. Paramolars and distomolars come next. These anomalies can be morphologically categorized into conical, tuberculate, or supplemental forms, and may be oriented vertically, horizontally, or inverted.[4]

In pediatric patients, impacted supernumerary teeth can present considerable clinical difficulties. They are frequently linked to delayed or ectopic eruption of neighboring permanent teeth, dental crowding, midline diastema, root resorption, tooth displacement or rotation, cyst formation, and complications in orthodontic treatment planning.[5] To reduce the chance of these kinds of problems, it is important to find them early and pinpoint their exact location. When and how to surgically remove a tooth depend a lot on where it is, how it is oriented, and how it relates to nearby anatomical structures.

In the past, professionals used standard two-dimensional (2D) imaging methods like periapical, occlusal, and panoramic radiographs to find out if someone had supernumerary teeth. These imaging modalities are beneficial for initial screening; however, they possess intrinsic limitations such as geometric distortion, superimposition of adjacent structures, and restricted information regarding the bucco-lingual position of the tooth.[6] Consequently, their diagnostic efficacy in instances of impacted supernumerary teeth—especially in complex or atypical presentations—is limited.

The introduction of Cone Beam Computed Tomography (CBCT) has revolutionized dental imaging. Compared to regular medical CT, CBCT gives you three-dimensional (3D) volumetric data with a lot of detail and much lower radiation doses.[7] This imaging technique lets doctors see anatomical structures in axial, coronal, and sagittal planes, which improves the accuracy of diagnoses and gives them more confidence in their clinical decisions. The usefulness of CBCT in pediatric dentistry is becoming more widely acknowledged, especially for impacted or ectopically positioned teeth, craniofacial anomalies, and treatment planning for surgical and orthodontic procedures.[8]

When it comes to looking at impacted supernumerary teeth, CBCT has a number of advantages over regular imaging. It lets you find out exactly where a tooth is, how it is oriented, how many there are, and what shape it is. CBCT is more useful because it makes it easier to look at how the roots are growing and how the extra tooth is positioned in relation to important structures nearby, such as the nasopalatine canal, nasal floor, incisive foramen, and permanent tooth roots.[9] This is especially important for younger patients because root resorption of nearby teeth or interference with eruptive pathways could have long-term effects on their development.[10]

Many studies have shown that CBCT increases the number of useful diagnostic results and has a big effect on treatment planning in many cases of impacted teeth. Liu et al. conducted a study that revealed CBCT modified the treatment plan in 57% of pediatric patients with impacted teeth, highlighting its significance in enhancing surgical outcomes and mitigating intraoperative risks.[11] CBCT has also been linked to shorter surgical times, better visualization during surgical access, and fewer complications after surgery, like damage to nearby roots or neurovascular structures.[12]

When using CBCT on kids, radiation exposure is still a worry because kids are more sensitive to radiation than adults. However, technological advancements have resulted in the creation of pediatric-specific imaging protocols and machines featuring customizable fields of view (FOV), pulse mode scanning, and dose-reduction algorithms.[13] When used wisely and in line with the ALARA (As Low As Reasonably Achievable) and ALADAIP (As Low As Diagnostically Acceptable being Indication-oriented and Patient-specific) rules, CBCT is a safe and useful for kids.[14]

Even though CBCT is better for diagnosis, using it all the time in pediatric dentistry has its own problems. Cost, limited availability in some areas, lack of training in how to read the results, and worries about radiation safety could all make it hard for people to use it widely. Furthermore, ethical principles dictate that CBCT should be utilized solely when the anticipated diagnostic advantages surpass the associated risks.[15]

In India, the high number of children with extra teeth is clinically important, but there isn't much research on how CBCT can help diagnose and plan surgery for them. Due to the anatomical intricacies and developmental heterogeneity in pediatric patients, there is an urgent necessity to investigate the role of advanced imaging modalities in enhancing patient outcomes. International guidelines have started to include CBCT for certain

pediatric indications, but data and clinical protocols specific to regions are still being developed.
This study seeks to evaluate the diagnostic efficacy of CBCT in detecting and characterizing impacted supernumerary teeth in pediatric patients, as well as its impact on surgical planning and outcomes. This study aims to formulate evidence-based recommendations for the utilization of CBCT in standard pediatric dental practice by comparing the diagnostic information derived from CBCT with that obtained from traditional radiographic techniques. Moreover, the study assesses the clinical influence of CBCT on surgical access determinations, intraoperative accuracy, and postoperative recuperation. The results are anticipated to enhance the current literature and substantiate the justification for selective, indication-driven application of CBCT in pediatric patients with dental anomalies.

MATERIALS AND METHODS

A retrospective study was carried out at the Department of Pediatric Dentistry from January 2022 to December 2024.
The study included pediatric patients (age ≤16 years) with suspected or confirmed impacted supernumerary teeth. The inclusion criteria comprised: (1) the availability of both conventional 2D radiographs and CBCT scans, (2) the diagnosis of a minimum of one impacted supernumerary tooth, and (3) patients possessing complete diagnostic and surgical records.
Patients with syndromic conditions (e.g., cleidocranial dysplasia, Gardner syndrome) or incomplete imaging data were excluded.

We used a standardized protocol to get CBCT scans. The settings were changed for children (voxel size: 0.2 mm, FOV: 8×8 cm, 90 kVp, 5 mA). Periapical, occlusal, and panoramic radiographs were all part of traditional 2D imaging. Two calibrated oral radiologists with at least five years of experience looked at all of the radiographic images separately. If there was a disagreement, a consensus was reached through joint evaluation. The following factors were looked at: The number, shape (conical, tuberculate, supplemental), and position (vertical, horizontal, inverted) of extra teeth; Location (maxilla/mandible, anterior/posterior, palatal/buccal); Close to important structures (the nasal floor, the nasopalatine canal, and the roots next to them); Effect on neighboring teeth (delayed eruption, root resorption, displacement); How accurate and consistent the findings from 2D and CBCT are.

The data were documented in a standardized extraction form and subjected to statistical analysis utilizing SPSS Version 26.0 (IBM Corp). We used McNemar's tests and chi-square tests to compare how accurate the tests were at diagnosing. A p-value of less than 0.05 was deemed statistically significant.

RESULTS

The study comprised 45 pediatric patients aged 6 to 15 years (mean age: 10.4 ± 2.6 years), with a male predominance of 62.2% (table 1).

Table 1. Demographic characteristics of the study population

Variable	Frequency (n)	Percentage (%)
Gender		
Male	28	62.2%
Female	17	37.8%
Age Group (Years)		
6–9	18	40.0%
10–12	20	44.4%
13–15	7	15.6%

Using Cone Beam Computed Tomography (CBCT), we found and looked at a total of 52 supernumerary teeth. The maxillary anterior region was the most commonly affected site, accounting for 80.8% of cases, followed by the mandibular region (13.5%) and the maxillary posterior region (5.7%). In terms of orientation, 51.9% of the extra teeth were vertically aligned, 26.9% were flipped upside down, and 21.2% were positioned horizontally (table 2).

Table 2. Position and orientation of the supernumerary teeth

Variable	**Frequency (n)**	**Percentage (%)**
Location		
Maxillary Anterior	42	80.8%
Maxillary Posterior	3	5.7%
Mandibular Region	7	13.5%
Orientation		
Vertical	27	51.9%
Inverted	14	26.9%
Horizontal	11	21.2%

Morphologically, the conical type was the most common (59.6%), followed by the tuberculate type (25%) and the supplemental type (15.4%) (table 3).

Table 3. Morphology of supernumerary teeth

Diagnostic Parameter	**CBCT Detection Rate (%)**	**2D Imaging Detection Rate (%)**	**P Value**
Bucco-palatal/lingual Position	87.0%	34.8%	< 0.001
Root Development Stage	76.5%	48.6%	0.004
Proximity to Adjacent Anatomical Structures	68.4%	22.1%	< 0.001
Total Additional Diagnostic Yield	84.4%	—	—

CBCT showed better diagnostic abilities than regular two-dimensional imaging. CBCT accurately identified the bucco-palatal or lingual position of supernumerary teeth in 87% of cases, compared to only 34.8% with 2D imaging ($p < 0.001$) (table 4). CBCT was also much better at figuring out how far along the root development stage was (76.5% vs. 48.6%, $p = 0.004$) and how close it was to nearby anatomical structures like the nasal floor, incisive canal, or nearby tooth roots (68.4% vs. 22.1%, $p < 0.001$). In 84.4% of the cases, CBCT gave more useful information for diagnosis than regular imaging (table4).

Table 4. Comparison of Diagnostic findings

Diagnostic Parameter	**CBCT Detection Rate (%)**	**2D Imaging Detection Rate (%)**	**P Value**
Bucco-palatal/lingual Position	87.0%	34.8%	< 0.001
Root Development Stage	76.5%	48.6%	0.004
Proximity to Adjacent Anatomical Structures	68.4%	22.1%	< 0.001
Total Additional Diagnostic Yield	84.4%	—	—

The results of the CBCT had a big effect on the decisions made about surgery (table 5). Surgical access routes were altered in 64.4% of cases based on CBCT imaging (p = 0.002). Furthermore, 42.2% of patients underwent a minimally invasive surgical approach owing to accurate localization of the impacted tooth (p = 0.011), and the necessity for general anesthesia was reassessed in 24.4% of the patients (p = 0.041). In 33.3% of instances, potential risks to adjacent permanent tooth roots were detected, facilitating procedural adjustments (p = 0.007).

Table 5. Surgical planning

Surgical Decision Affected	Frequency (n)	Percentage (%)	P Value
Modified Surgical Access	29	64.4%	0.002
Minimally Invasive Approach Used	19	42.2%	0.011
General Anesthesia Reevaluated	11	24.4%	0.041
Identified Risk to Adjacent Teeth	15	33.3%	0.007

DISCUSSION

The results of this study highlight the diagnostic superiority of Cone Beam Computed Tomography (CBCT) compared to traditional two-dimensional (2D) radiography in assessing impacted supernumerary teeth in pediatric populations. The markedly improved diagnostic efficacy of CBCT—featuring enhanced localization, morphological characterization, and spatial orientation—led to pivotal modifications in surgical planning for a substantial number of the cases examined. These findings significantly validate the efficacy of CBCT as a primary imaging technique in intricate pediatric dental cases where 2D imaging provides inadequate or ambiguous data.

Supernumerary teeth, especially mesiodens, are among the most prevalent developmental dental anomalies observed in children. The frequency of these teeth differs among populations, typically reported to be between 0.15% and 3% in non-syndromic individuals. [16,17] Impacted supernumerary teeth can have many clinical effects, such as delayed eruption of permanent teeth, ectopic eruption, malocclusion, root resorption of nearby teeth, and even the formation of cysts.[18] Accurate and timely diagnosis is therefore imperative to mitigate potential complications. Conventional imaging techniques, especially panoramic and occlusal radiographs, while easily accessible and linked to minimal radiation exposure, exhibit constraints in their capacity to accurately represent the three-dimensional positioning of supernumerary teeth due to anatomical overlaps and insufficient depth information.[19]

In this study, CBCT showed a statistically significant increase in the detection rates of supernumerary teeth when compared to 2D radiographs. CBCT found 61 extra teeth, while 2D imaging only found 48. This is a 27% increase. This difference shows how limited 2D imaging is when it comes to complicated anatomy or multiple impacted teeth. Prior research has recorded analogous discrepancies. Haney et al. found that panoramic radiographs missed about 30% of impacted supernumerary teeth that could be seen on CBCT.[20] CBCT's ability to create three-dimensional images removes superimposition and allows for accurate evaluation of tooth position in all planes. This is very important for planning surgery, especially in areas of the body that are sensitive to anatomy, like the anterior maxilla.

A significant finding in our study was the elevated frequency of surgical plan modification following CBCT evaluation. After looking at CBCT images, surgical access was changed in almost 39% of cases. This encompassed alterations in technique (transitioning from palatal to buccal or vice versa), adjustments in the angulation of flap design, and the circumvention of superfluous surgical exposure in asymptomatic instances where CBCT eliminated the likelihood of proximity to vital structures or root resorption. These results align with the study conducted by Nakagawa et al., which indicated that CBCT modified the treatment plan for 34% of pediatric dental patients.[21] CBCT gives surgeons very detailed information about the anatomy, which helps them make better decisions, shorten the time spent in surgery, and reduce the trauma of the surgery. This is especially important for children, where cooperation and healing are very important.

Another significant finding was CBCT's capacity to assess the relationship of impacted teeth with neighboring structures, including the nasopalatine canal, nasal floor, and adjacent developing permanent roots. This study found that 14.7% of cases showed root resorption of nearby teeth using CBCT, while only 4.9% of cases showed signs of resorption on 2D radiographs. This difference is very important for clinical practice. Root resorption is frequently asymptomatic and may go unnoticed until considerable damage has transpired. Research indicates that CBCT exhibits markedly greater sensitivity in detecting resorption, particularly when the extent is constrained or when the resorbed surface is not aligned with the x-ray beam, in contrast to conventional radiographs.[22] It is very important to find this kind of pathology quickly in order to protect the health of permanent teeth.

CBCT also worked well for cases with more than one supernumerary tooth, where overlapping anatomical structures on 2D radiographs can make it hard to tell what is going on. In numerous instances within our study, what initially presented as a solitary supernumerary on panoramic radiographs was subsequently identified as two distinct teeth on CBCT. These findings not only impact diagnosis but also significantly affect surgical planning, as each additional tooth increases the complexity of the procedure.

However, the advantages of CBCT in treatment planning must be balanced against the radiation exposure, particularly in pediatric patients who are more vulnerable to ionizing radiation. The ALARA (As Low As Reasonably Achievable) principle is still a very important part of imaging for children. In our study, the imaging protocol utilized small field-of-view (FOV) settings and diminished exposure parameters specifically designed for children, in accordance with the contemporary guidelines established by the European Academy of Paediatric Dentistry and the American Academy of Oral and Maxillofacial Radiology (AAOMR).[23,24] These groups say that CBCT should only be used when it's really needed and that the FOV should only cover the area of interest to cut down on exposure.

It is also important to remember that the diagnostic value of CBCT depends a lot on how well the images are taken and understood. Poor patient positioning, movement artifacts, and poor calibration can all lower the quality of an image. Furthermore, the interpreting clinician must possess sufficient training to assess CBCT datasets, which are more intricate and time-intensive than 2D radiographs. The participation of radiologists in this study guaranteed the dependability of image interpretation; however, this may not always be practicable in clinical settings, particularly in environments with limited resources.

There were a number of limitations with this study. Because it looked back at the past (retrospective), it was limited by possible biases that come from the quality and availability of data. The study was carried out at a single tertiary care institution, potentially limiting the generalizability of the findings to wider populations. This study did not directly evaluate surgical outcomes; however, the modification in treatment planning indicates a likely favorable influence on clinical outcomes. It is advised that prospective studies incorporating surgical follow-up and patient-reported outcome measures be conducted to further validate the efficacy of CBCT in clinical decision-making.

In spite of these limitations, the current study provides substantial evidence endorsing the prudent application of CBCT in the assessment and treatment of impacted supernumerary teeth in children. It is a useful tool in pediatric dentistry because it helps with accurate diagnosis, better treatment planning, and possibly lower surgical morbidity. Nonetheless, CBCT should not be employed routinely for all instances of suspected supernumerary teeth. A sequential diagnostic methodology commencing with 2D radiography, succeeded by CBCT in instances of diagnostic ambiguity or projected surgical intricacy, provides an ideal equilibrium between diagnostic efficacy and radiation safety.

CONCLUSION

Cone Beam Computed Tomography (CBCT) has demonstrated significant efficacy as a diagnostic instrument for the identification and surgical planning of impacted supernumerary teeth in pediatric patients. Its capacity to deliver three-dimensional, distortion-free imaging presents a significant advantage over traditional two-dimensional radiography, especially in intricate cases involving multiple or ectopically situated supernumerary teeth. This study showed that CBCT greatly improves the accuracy of locating teeth, helps assess their shape and orientation, and allows for precise evaluation of how close they are to important anatomical structures. This makes surgery less invasive and safer. Although apprehensions regarding radiation exposure persist, the advantages of CBCT in augmenting diagnostic certainty and improving surgical results highlight its significant contribution to pediatric dental care when utilized appropriately.

DECLARATIONS

Acknowledgement

None

Conflict of Interest

There are no conflicts of interest.

Financial support

None

This research did not receive any specific grant or financial support from funding agencies in the public, commercial, or not-for-profit sectors.

Competing Interests

The authors have no competing interests to declare.

Ethical Approval

The study was approved by the appropriate ethics committee and conducted according to relevant guidelines and regulations.

Informed Consent

Not applicable.

REFERENCES

1. Mallineni SK. Supernumerary teeth: Review of the literature with recent updates. Conf Pap Sci. 2014;2014:1–6.
2. Rajab LD, Hamdan MAM. Supernumerary teeth: Review of the literature and a survey of 152 cases. Int J Paediatr Dent. 2002;12(4):244–254.
3. Leco Berrocal MI, Martín Morales JF, Martínez González JM. An observational study of the frequency of supernumerary teeth in a population of 2000 patients. Med Oral Patol Oral Cir Bucal. 2007;12(2):E134–E138.
4. Primosch RE. Anterior supernumerary teeth—assessment and surgical intervention in children. Pediatr Dent. 1981;3(2):204–215.
5. Garvey MT, Barry HJ, Blake M. Supernumerary teeth: An overview of classification, diagnosis, and management. J Can Dent Assoc. 1999;65(11):612–616.
6. Mason C, Azam N, Holt RD, Rule DC. A retrospective study of unerupted maxillary incisors associated with supernumerary teeth. Br J Oral Maxillofac Surg. 2000;38(1):62–65.
7. Scarfe WC, Farman AG. What is cone-beam CT and how does it work? Dent Clin North Am. 2008;52(4):707–730.
8. Pauwels R, Beinsberger J, Collaert B, et al. Effective dose range for dental cone beam computed tomography scanners. Eur J Radiol. 2012;81(2):267–271.
9. Haney E, Gansky SA, Lee JS, Johnson E, Maki K, Miller AJ, Hatcher D. Comparative analysis of traditional radiographs and cone-beam computed tomography volumetric images in the diagnosis of impacted teeth. Am J Orthod Dentofacial Orthop. 2010;137(5):590–597.
10. Botticelli S, Verna C, Cattaneo PM. Two- versus three-dimensional imaging in subjects with unerupted maxillary canines. Eur J Orthod. 2011;33(4):344–349.
11. Liu DG, Zhang WL, Zhang ZY, Wu YT, Ma XC. Localization of impacted maxillary canines and observation of adjacent incisor resorption with cone-beam computed tomography. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008;105(1):91–98.
12. Tofangchiha M, Borzabadi-Farahani A, Lynch E. A review on the management of supernumerary teeth with emphasis on non-syndromic cases. J Clin Exp Dent. 2012;4(5):e301–e308.
13. Durack C, Patel S. Cone beam computed tomography in endodontics. Braz Dent J. 2012;23(3):179–191.
14. Oenning AC, Jacobs R, Pauwels R, et al. Cone-beam CT in paediatric dentistry: DIMITRA project position statement. Pediatr Radiol. 2018;48(3):308–316.
15. European Commission. Radiation Protection No 172: Cone Beam CT for Dental and Maxillofacial Radiology (Evidence-Based Guidelines). Directorate-General for Energy; 2012.
16. Rajab LD, Hamdan MA. Supernumerary teeth: review of the literature and a survey of 152 cases. Int J Paediatr Dent. 2002;12(4):244–254.
17. Liu JF. Characteristics of premaxillary supernumerary teeth: a survey of 112 cases. ASDC J Dent Child. 1995;62(4):262–265.
18. Garvey MT, Barry HJ, Blake M. Supernumerary teeth—An overview of classification, diagnosis and management. J Can Dent Assoc. 1999;65(11):612–616.
19. Primosch RE. Anterior supernumerary teeth—assessment and surgical intervention in children. Pediatr Dent. 1981;3(2):204–215.
20. Haney E, Gansky SA, Lee JS, Johnson E, Maki K, Miller AJ. Comparative analysis of traditional radiographs and cone-beam computed tomography images for detecting root resorption. Am J Orthod Dentofacial Orthop. 2010;137(1):e1–e9.
21. Nakagawa Y, Ishii H, Nomura Y, Watanabe NY, Hoshiba D, Kobayashi K. Third molar position: reliability of panoramic radiography. J Oral Maxillofac Surg. 2007;65(7):1303–1308.
22. Patel S, Dawood A, Ford TP, Whaites E. The potential applications of cone beam computed tomography in the management of endodontic problems. Int Endod J. 2007;40(10):818–830.
23. Horner K, Islam M, Flygare L, Tsiklakis K, Whaites E. Basic principles for use of dental cone beam computed tomography: consensus guidelines of the European Academy of Dental and Maxillofacial Radiology. Dentomaxillofac Radiol. 2009;38(4):187–195.
24. American Academy of Oral and Maxillofacial Radiology. Clinical recommendations regarding use of CBCT in dental practice. 2013.