LOCALIZATION TECHNIQUE BY CBCT SCAN:FOR DETECTION OF IMPACTED UPPER CANINE IN ORTHODONTIC TREATED PATIENTS

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Abstract

Background: The dental radiograph is a two dimensional view for a three dimensional object present in the jaws , sometimes various objects like supernumery tooth, impacted tooth or foreign bodies present inside the jaws and are hidden from eyes causing problem to patient in the form of pain, swelling and vestibular obliteration. Object localization is a method used to locate the position of tooth or foreign object present inside the jaws. It is a small review on various techniques used in object localization and its use in dentistry.**Materials and methods**: about 33 patients with impacted upper canines in Baghdad smile clinics with the total of 45 cases using cone beam computerized tomography **(CBCT)** scan. used **NewTom CBCT** device in our research.so in the screen of the CBCT device we should select anatomical region of interest , and Select default position of the device.as well as to obtain high quality imaging we should plce the patient in correct position , the patient should be asked to place his/her incisor in the groove of the device , once the positioning parameters set we press on the exposure button until the device complete its 360 rotation aroud the head of the patient. **Results:** current study found that prevalence of impacted upper canine was much more in females than males 75.7% versus 24.3%; so the majority of patients were youthful compared to old patients. Palatally impacted canine was much more common than buccally impacted canine. Also the artifacts in our CBCT scanning like beam hardening, noise, blurry images, aliasing. **Conclusion:** CBCT scanning is easy and convenient method of localization to obtain accurate 3D images for impacted canines. also the patient seems more cooperative and more comfortable with CBCT device , It has less artifacts than conventional methods , But unfortunately it has more radiation dose than conventional methods.

Keywords: Localization Technique ; CBCT Scan ;Upper Canine; Orthodontic Treated Patients

INTRODUCTION

In order for us to understand what an impacted tooth is and whether and when it should be detected and treated, we must first define our perception of normal development of the dentition as a whole and the time-frame within which it operates.

The development of a child has many components. In assessing the developmental age of a child, it is necessary to consider and correlate these components and there is a hypothetical mean for each, though the overall development rate rarely falls exactly on this mean. A child's growth and development rate may also be different for each of the developmental components.

Somatic age: A child may be tall for his or her age, so that his or her somatic age may be considered to be advanced.so the Skeletal age: By studying radiographs of the progress of association of the epiphyseal cartilages of the bones in the hands of a young patient (the carpal index) and comparing this with average data values for

children of his or her age, we are in a position to assess the child's skeletal age. Sexual maturation age: The sexual age of a child is related to the appearance of primary and secondary sexual features. Mental age: This is assessed by intelligence quotient (IQ) tests. Behavioral age: This is an assessment of a child's behavior and his or her self-concept.These are among the indices complementing the chronological age,which is calculated directly from the date registered on the child's birth certificate. All these parameters are essential in the comprehensive assessment of a child's developmental progress.

Based on the principles set out by Grøn, it has been widely accepted that, under normal circumstances, a tooth erupts with a developing root and with approximately three-quarters of its final root length. Typically, when they erupt the mandibular central incisors and first molars will have marginally less root development, whereas the mandibular canines and second molars will demonstrate slightly more root development. This is now generally accepted as a diagnostic baseline from which to evaluate the eruption of teeth in general. Angle's class II malocclusion is to be found in 20–25% of the child population in most countries of the Western world, However, this is not reflected in an orthodontic practitioner's office, where one finds that up to 75% of patients are being treated for this malocclusion. The reason for this incongruity in seeking treatment is entirely facial appearance, since the visible manifestation of the condition causes the patient's appearance to be adversely affected to a much greater extent than by most other conditions. In other words, appearance plays an extremely large part in the initiative and motivation of the parent to seek treatment forthe child and for the child to be ready to be treated.

The impacted canines with localization technique either right angle or tube shift or CBCT scan resulting in 3D images , in our research we will do it in CBCT scan. plain film radiography cannot provide reliable information in the bucco-lingual plane. Accordingly, incisor root resorption that may have occurred will likely remain undiagnosed until it is well advanced. Additionally, the bucco-lingual distance that separates the impacted tooth from its neighbor is very difficult to assess from these films.

Radiographs provide a two-dimensional view of a three-dimensional situation. Because the radiographic image fails to reveal the three-dimensional structure, bony defects overlapped by higher bony walls may be hidden. The use of CBCT scan to produce a precise 3D images. the advantage of simplicity of technique and provides both the orthodontist and the surgeon with important information regarding positioning.

The detailed workings of a CBCT machine are beyond the scope of this research and will only be discussed here insofar as they relate directly to the context of impacted teeth. For a comprehensive description of the manner in which CB CT works [10].A majority of dental CBCT software will have some kind of 3D volume rendering module, which is a very valuable tool for the accurate positional diagnosis and treatment planning of impacted teeth.

Aims of current study: The methods offered have two main aims.

The first relates to the furnishing of qualitative information regarding normal and abnormal conditions that may be associated with unerupted teeth. Thus, we will discuss and compare the different ways of radiologically displaying and recognizing pathological entities, including supernumerary teeth, enlarged eruption follicles, odontomes and root resorption, and second aim is to describe the various radiological techniques that the clinician may find helpful in accurately pinpointing the position of a

clinically invisible, unerupted tooth in the three planes of space. The relative merits of these techniques are discussed and indications for their use are suggested in relation to the different groups of teeth concerned.

Objectives: Correct method for application of CBCT localization technique, and accurately determine the position of impacted upper canines.

MATERIALS AND METHODS

Materials:

CBCT scanning device, in current study used NewTom Go 2D/3D CEPH Integrated imaging device with NNT Software , the CBCT radiographs in Baghdad smile clinics on 33 patients in total with confirmed impacted upper canine cases during the period between October 2022 and January 2023.

The inclusion criteria of the patients were as follows: presence of impacted upper left and right canines buccally/palatally and patient at the age between 10-60 years, whilst exclusion criteria was the presence any pathological condition that could effect on the measurement of the area of interest.so patients data regarding age, gender, all dimensions of impacted upper canines were obtained from the patients.

Methods:

1. first the NewTom GO CBCT device should be connected to NNT software installed on the laptop/PC
2. launch NNT program by clicking on the desktop icon
3. before the examination of the patient we should make new profile for the patient.
4. accessing the 3D section, there is a screen attached to the CBCT device, and determine the center of volumetric reconstruction by selecting the anatomical region of interest, in current case we choose complete child/adult superior arch and the default position for the device.
5. once the default position of device reached we should place the support element before positioning the patient.
6. the patient should not wear any metal metal object around the neck and head.
7. in order to obtain high diagnostic quality imaging is to place the patient in correct positioning as follows:
    a) the first operation adjust the height of the device this done by on board keypad , by adjusting the height of the device we should ask the patient to place his/her incisors are in the groove so his/her incisors interpoximal space is aligned with the bite's midline..
    b) the insure maximum positioning acurrancy , laser is projected on the patient's face, looking at the mirror and watching vertical sagittal trace facial symmetrical position can be improved.
    c) the adjust head tilt angle and obtaining the correct positioning of Frankfurt plane we use up and down on board keys the adjust the hight of the laser.
8. once the examination parameters are set we press next on the virtual console and switch to the PC for the procedure follow-up.

9. from the NNT software we select the scan protocol and the scanning mod we used regular scanning mod.
10. after the the NNT software will take a pictures which allows the patient to adjust its anterior-posterior position within the field of view .
11. by holding the control key and moving the mouse, the patient position can be accurately adjusted.
12. the next front count imaging is only performed to automatically set the exposure parameters .
13. when the parameters are set and the patient is correctly positioned ,We press next and before we leave the room we ask the patient to close his/her eyes and and swallow
14. now we should press the exposure key and hold it until the device complete its 360 degree rotation around the patient's head.
15. when the scan is competed, a message will appear on the software informing that the button should be released and the scan has been completed.

RESULTS

In our research we examined 33 patients with an impacted upper canine conditions and the results will be as following:

Table 1: Patient's statistics in our study

Patient No.	Gender	Age	Case report after radiograph examination.	Angle of impaction
1	Male	32	Palatally impacted left and right canines	Left:76 Right:42
2	Male	29	Palatally impacted right canine	30
3	Male	29	Palatally impacted right canine	52
4	Male	17	Palatally impacted left canine	37
5	Male	13	Palatally impacted left canine	77
6	Male	13	Palatally impacted right canine	45
7	Male	12	Buccally impacted right canine	66
8	Male	10	Buccally impacted right and left canines	Left:79 Right:75
9	Female	10	Buccally impacted right and left canines with horizontally tilted right central incisor	Left:63 Right:64
10	Female	27	Palatally impacted right canine	32
11	Female	21	Palatally impacted right and left canines	Left:55 Right:50
12	Female	58	Palatally impacted right canine	46
13	Female	38	Palatally impacted right canine	56
14	Female	38	Palatally impacted left canine	22
15	Female	29	Palatally impacted right canine	50
16	Female	28	Palatally impacted left canine	34
17	Female	27	Palatally impacted left canine	57
18	Female	27	Palatally impacted right canine	54
19	Female	26	Buccally impacted right and left canines	Left:61 Right:84
20	female	24	Palatally impacted left canine	39
21	Female	21	Palatally impacted left and right canines	Left:79 Right:85
22	Female	21	Palatally impacted left and right canines	Left :70 Right:78
23	Female	20	Buccally impacted right canine	47
24	Female	20	Buccally impacted left canine	65
25	Female	19	Palatally impacted right canine and buccally impacted left canine	Left :22 Right:36

26	Female	19	Palatally impacted left canine	23
27	Female	18	Palatally impacted left and right canine	Left : Right:
28	Female	17	Palatally impacted left canine	28
29	Female	16	Palatally impacted right canine	49
30	Female	13	Buccally impacted right and left canine	Left :66 Right:
31	Female	12	Buccally impacted left canine	
32	Female	10	Buccally impacted right canine	
33	Female	25	Palatally impacted left and right canine	Left : Right:

CBCT radiographs we performed for the 33 patients: (for skip move to Table 2)

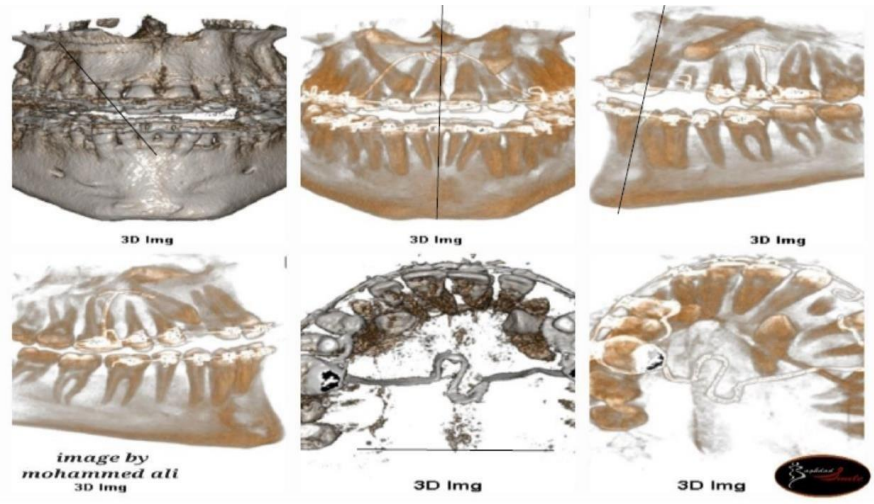

Fig 1: Case1-2 /palatally impacted both canines / 32years old male

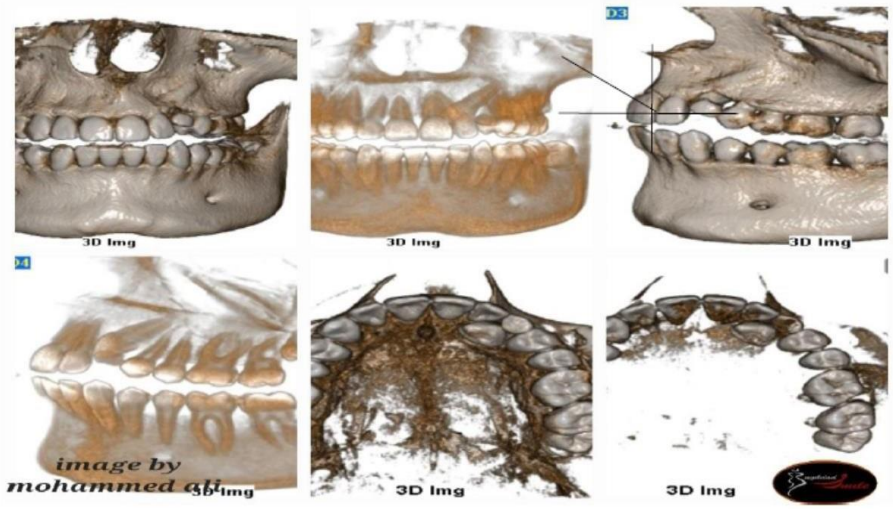

Fig 2: Case3/palatally impacted right canine/29 years old male

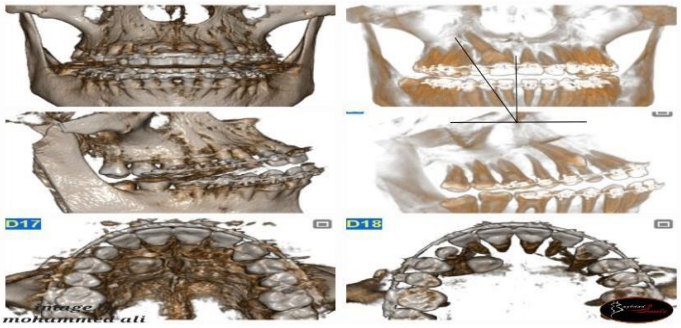

Fig 3: Case4/palatally impacted right canine /29 years old male

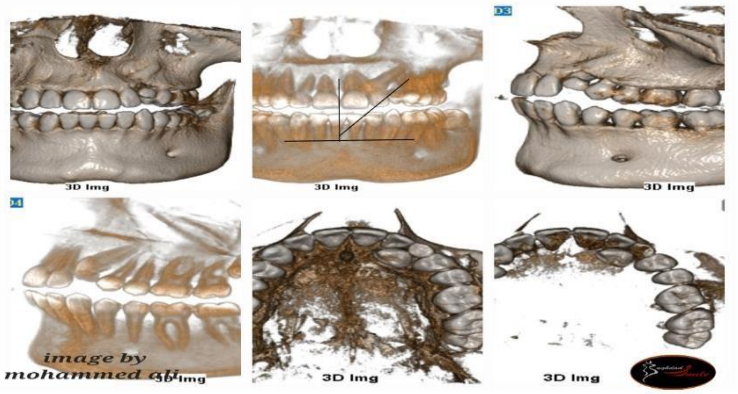

Fig 4: Case 5/palatally impacted left canine/17 years old male

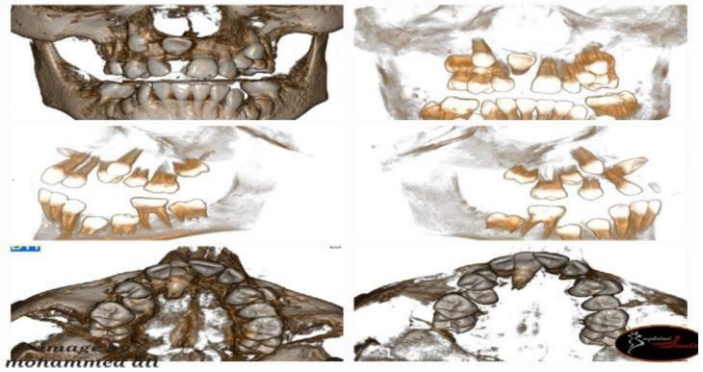

Fig 5: Case 9-10 / buccally impcted left and right canines/10 years old male

Fig 6: Case11-12/ buccally impcted left and right canine /10years old female

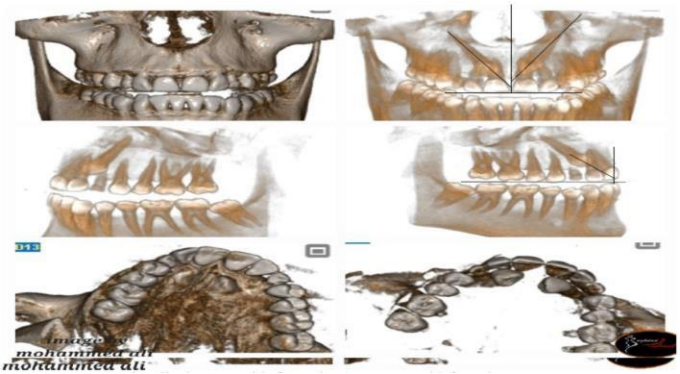

Fig 7: Case13/ palatally impacted left canine/27 years old female

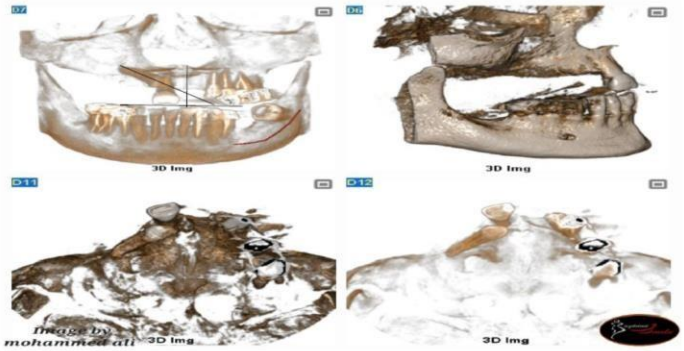

Fig 8: Case14-15/ palatally impacted left and right canine /21 years old female

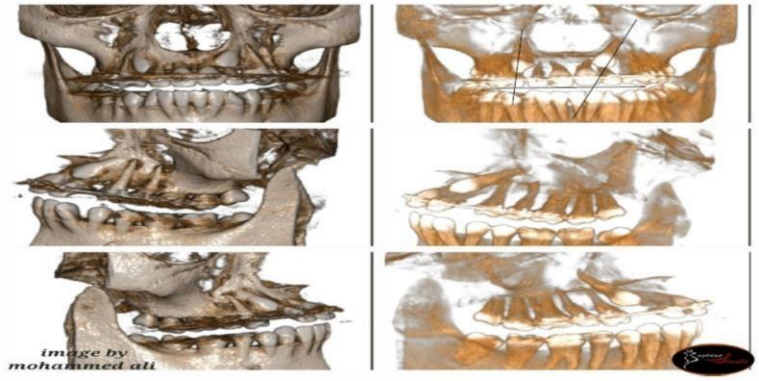

Fig 9: Case24-25/buccally impcted left and right canine /26years old female

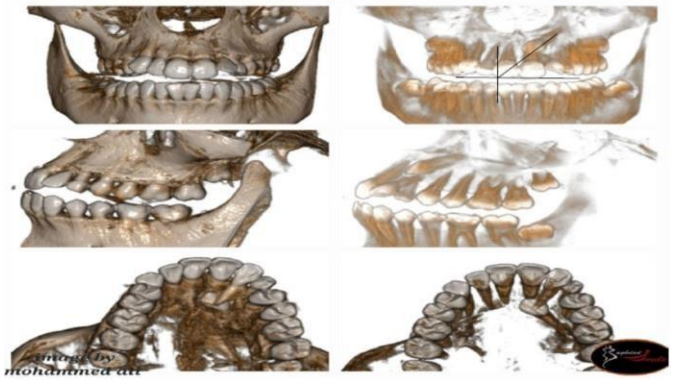

Fig 10: Case26/ palatally impacted left canine /24years old female

Table 2: Impacted Canine Prevalence Between Genders

Total No. of patients	No. Males	No. Females	Age variation
33	8	25	10-58 Years old.

Based on our study we found that the prevalence of impacted canine cases in females are much more common than males it counts for 24.3% for males versus 75.7% for females, As for the age: the majority of the patients were youthful 16-30 years and minority were the old people (above 30 years old).

The pediatric children (up to 15 years) counted for 24.2%, so youthful patients between (16-30 years) counted for 63.6% also old patients 30-58(highest age recorded)counted for 12.2%.

Table 3: Impacted canine position prevalence in mouth among our patients

Total No. of patients	Total No. of cases	Palatally impacted canines	Buccally impacted canines
33	45	30	15

Based on our study we found that palatally impacted canines are more common among the patients it counts for 66.67% versus 33.3% for buccally impacted.

Table 4: Artifacts during CBCT Scanning process

Artifacts	Tube hardening	Patient motion (blurry image)	Noise	Aliasing
No patients	28	5	21	10

Note: we only found artifacts in mutiplanar reconstruction images.

Based on our statistics we found that tube hardening (due to height density materials like amalgam filling or PFM crowns or orthodontic appliances) is the most common artifact in CBCT scanning.

DISCUSSION

Cone beam computerized tomography (CBCT): gives accurate information of position of the impacted teeth. CBCT imaging is a precise technique in determining not only the labial/lingual relationship of teeth, but also provides details about the exact angulation of the impacted canine(s) which is the most commonly used in most dental clinics in Iraq which is why we did our research using this localization method due its ease of use and we can obtain good cooperation from the patient unlike the tube shift and right angle technique.

As for our research about the 33 impacted upper canines patients we found that our statistics is matches the global studies about those cases:

-the prevalence of impacted canine cases are much higher among the females than males which is corresponds to National library of medicine.

in this research, the position of impacted upper was more palatally (66.67%) than buccally (33.3%) 1:2 ratio which is corresponds to European journal of orthodontics. At the end our research was completely compatible with global research about impacted upper canines as we mentioned above.

CONCLUSIONS

For the detection of impacted upper canines we used localization technique using CBCT scan, we obtained accurate 3D modules and we found it was the most accurate technique in comparison to other conventional techniques and it was easier to the patient and the dentist. Although CBCT is a great tool that provides 3D images, it does not replace standard dental radiographic images and should be utilized as a complementary tool for specific cases, and not for routine cases. CBCT studies with small field of view and small voxel size will provide improved spatial resolution, especially for endodontic purposes. The advantages of CBCT over panoramic radiographs are 3D analysis, no superimposition or distortion, and the ability to create cross-sectional images. The disadvantages over panoramic imaging are increased radiation dose, acquisition artifacts, and cost.

The advantages of the CBCT over conventional technique are faster scan time with less potential for movement artifact, less cost, and less radiation exposure to the patient. A major disadvantage is poor soft tissue contrast, which prevents soft tissue assessment. National Council on Radiation Protection and Measurements (NCRP) has recently published Report No.177 in 2019 - Radiation Protection in Dentistry and Oral & Maxillofacial Imaging. Because CBCT units are markedly more sophisticated than any of the other dental imaging devices, appropriate education and proper trainingfor practitioners and operators are critical in the safe and effective use of this modality.

References

1. Ericson S, Kurol J. CT diagnosis of ectopically erupting maxillary canines – a case report. Eur J Orthod 1988; 10: 115–120.
2. Ericson S, Kurol J. Resorption of maxillary lateral incisors caused by ectopic eruption of canines. Am J Orthod Dentofacial Orthop 1988; 94: 503–513.
3. Ericson S, Kurol J. Radiographic examination of ectopically erupting maxillary canines. *Am J Orthod Dentofacial Orthop* 1987; 91: 483–492.
4. Odegaard J. The treatment of a Class I malocclusion with two horizontally impacted maxillary canines. *Am J Orthod Dentofacial Orthop* 1997; 111: 357–365.Becker A. Comment about making outcome of treatment more predictable. *Am J Orthod Dentofacial Orthop* 1997; 112: 17A–19A.
5. Ericson S, Kurol PJ. Resorption of incisors after ectopic eruption ofmaxillary canines: a CT study. *Angle Orthod* 2000; 70: 415–423.
6. Bodner L, Bar Ziv J, Becker A. Image accuracy of plain film radiography and computerized tomography in assessing morphological abnormality of impacted teeth. *Am J Orthod Dentofacial Orthop* 2001; 120: 623–628.
7. Dula K, Mini R, van der Stelt PF et al. Hypothetical mortality risk associated with spiral computed tomography of the maxilla and mandible. *Eur J Oral Sci* 1996; 104: 503–510.
8. Dula K, Mini R, van der Stelt PF, Buser D. The radiographic assessment of implant patients: decision-making criteria. *Int J Oral Maxillofac Implants* 2001; 16: 80–89.
9. Scarfe WC, Azevedo B, Toghyani S, Farman AG. Cone beam computedtomographic imaging in orthodontics. *Aust Dent J* 2017; 62 (1Suppl): 33–50.
10. Health Protection Agency. Ionising radiation exposure of the UK population: review. Ref: HPA-RPD-001. Chilton: Radiation ProtectionDivision, 2005.
11. Barish RJ. In-flight radiation exposure during pregnancy. *Obstet Gynecol* 2004; 103: 1326–1330.
12. Alara. Code of Federal Regulations (10 CFR 20.2003). United States Nuclear Regulatory Commission.