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Review Article

Dental Radiography and Radiation Damage to Children Article Review

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Abstract

We live in a world that is constantly exposed to natural radiation. Medical and dental radiographs are also added to these espousers, so we should be cautious when ordering radiography. Evidence suggests that organs in the body are more vulnerable to radiation consequences. These organs should be covered as much as possible.

In this matter, children are no exception. They are more sensitive than adults, so the risk of cancer per unit dose of X-rays for children is higher than that of adults. Children's dental radiography is in the category of less invasive methods. Digital signals are the newest and safest way to take pictures of kid's teeth. During radiography, the least radiation that has the least side effects is used, so, there is no concern, and parents can accelerate the treatment process with the help of radiographs of the child's teeth.

Radiation from single-dental radiographs is less than that of other, but because of the high use of this device, its risks are significant, and it is necessary to observe protective measures when using radiation generating devices. Therefore, it is highly recommended that patients who try to take radiographs, they have to use protective eyeglasses, thyroid shields and lead apron (vest) to avoid being exposed to radiation.

Keywords: *Radiation; Dental Radiography; Digital Signals; Protective Eyeglasses; Thyroid Shields; Lead Apron*

Introduction

The discovery of X-rays by Roentgen in 1895 [1] was one of the greatest achievements in the field of diagnosis of dentistry. Dental radiographic images are necessary for the treatment of children. Evidence suggests that primary teeth get loose earlier than normal time, except when their caries are detected early. Early diagnosis of caries in children will keep away the child from bitter experiences of a toothache, tooth extraction, and emotional stress [2-4]. in addition, dental radiography can quickly detect dental problems and reduces the need for a long-term orthodontic treatment [5-9]. Some restorative procedures also require detailed information such as indication of dental caries, which can only be done by Bite Wing radiography [10,11]. Radiographs are an essential part of most clinical dental examinations and diagnoses [12-14].

The effective dose for common dental radiography varies for intraoral radiographs and panoramic radiography. Consequently, particular attention should be paid to children because children and adolescents are particularly vulnerable to radiation [15,16].

The radiation that is used in dentistry, especially for children, is negligible. As science progresses, these rays are reduced in devices and are not harmful to the body. Regardless of whether the patient is a child or an adult, the dental radiography can be safely taken of the inside and outside of the mouth. Parents can be sure of the child's condition by regular check-ups. Meanwhile, selected radiographs are used for the child depending on the program which the dentist is considering.

Choosing the right dental radiography for children

Selecting an appropriate dental radiography is depending on the age of the child, the size of the oral cavity and the degree of cooperation of the patient. These are determined by the patient's precise assessment and examination before taking the radiography [12-14]. Clinical examinations indicate the need for radiography and some of the type that is needed. The child should be exposed to minimal radiation [17].

As far as possible, the number of radiographs should be reduced, and the radiation time minimized, at the same time, radiographic images should allow full dental examination and their retaining structures. The child's collaboration is also important in choosing the radiographic technique and can be effective in reducing the exposure to excess radiation [17].

Radiographic Selection Criteria

The decision to perform radiography is taken on the basis of complete evaluation and examination of the patient [17]. Dental radiography is done when there is either a suspicion of a disease; or a left untreated disease that threatens the health of the teeth. Hence, the decision to use radiography should be based on professional judgment. Selection criteria include symptoms that allow the dentist to determine who can benefit from radiography. Two criteria are important when deciding on radiography to be:

- The dental evolution stage
- The risk of dental caries

Common dental radiography in children

They are divided into two groups:

1. Intraoral that includes BW, PA and occlusal.
2. Extraoral contains the following: OPG, Digital radiography, Cephalometric and CBCT.

Effective dose

The effective dose for common dental radiography varies ranging from around 1.5μSv for intraoral radiographs to between 2.7 to 24μSv for panoramic radiography [18]. Particular attention should be paid to children because they are more susceptible to radiation risk than adults [19,20]. There are some specific criteria and guidelines to aid the dentist in determining the need for dental radiographs [21-23]. Needless to say, special attention should be applied for pediatric patients due to their markedly higher radiation sensitivity.

Radiation Rate in Dental Radiography for Children

Oral and dental radiographs may be worrisome for some parents. According to scientific data, the maximum virtual ray that one person can receive per year is 5,000 μSv [24]. So, if a person falls below this limit, there is nothing to worry. Ordinary dental radiography only radiates about five millimeters in the mouth and jaw. Therefore, if more than 1,000 radiographs of this type are taken, there is a risk of complications. Each person naturally absorbs approximately 350 μSv of radiation from the surrounding environment annually [24]. Therefore, taking into account the environmental rays, each person can even take radiographs up to 70 times a year from all teeth.

Radiation doses to ordinary people from various sources are 2.5 μSv/year, out of which, 15 percent of the radiation contribution is from radiation sources of medicine. Also, about 20 percent of medical radiation is due to unnecessary resources [25,26]. Although dental radiography has low doses and a low risk, however, because of the large volume of patients referred, the effects of this small amount can be important [26-29].

According to estimates from the United States, 25% of the radiographs were dental radiographs in 1993 [30].

The amount of radiation received in various dental imaging techniques is as follows [31]:

- A dental radiograph (PA or BW) provided with a circular collimator and a PSP or F-speed film: .008 mSv
- Panoramic (OPG): .01mSv
- CBCT (with ideal device): between .04 to .08 mSv depending on the size of the exposed area.
- Radiation from dental radiographs is quite minimal and very safe for healthy patients to be exposed to. For radiation safety of the patients, a radiographic source between 60 kVp and 70 kVp is used [31].

Dental X-Ray radiation comparison

Radiation Sources	Dosage msv
Full mouth series f-speed film*	0.171000
Full mouth series digital	0.090000
Cross-country flight (New York to Los Angeles)	0.040000
4 bitewings f-speed film*	0.038000
4 bitewings digital	0.020000
Panoramic film	0.0142 - 0.0243
Panoramic digital	0.0074 - 0.0149
1 periapical f-speed film*	0.009500
1 periapical digital	0.005000

Table 1: *Resource: www.todaysrdh.com/wp, Dental X-ray radiation comparison chart.*

Table 2 shows the effective dose rate in various radiology techniques and whether each of these imaging methods is equivalent to a few days of background radiation. For example, providing a panoramic image with an ideal digital device, only impose equivalent to 1-3 days of radiation to the patient.

Examination	Effective Dose (p.Sv)	Equivalent Background Exposure (days)
Intraoral		
Rectangular collimation		
Posterior bitewings: PSP or F-speed film	5	0.6
Fulkncuth: psi) or F-speed film	35	4
Full-mouth: CCD sensor (estimated)	17	2
Round collimation		
Full-mouth: D-speed film	388	46
Fulkncuth: psi. 01 F-speed film	171	20
Fulknctrth: CCD sensor (estimated)	85	10
Extraoral		
Panoramic	9-24	1-3
Cephalometric	2-6	0.3-0.7

Cone-beam CV		
Large field of view	68-1073	8-126
Medium field of view	45-860	5-101
Small field of view	19-652	2-77
Multislice CT		
Head: Conventional cnotocor	860-1500	101-177
Head: Low-dose protocol'i	180-534	21-63
Abdornent	5300	624
Chest	5800	682
Plain films		
Skull	70	8
Chest	20	2
Barium enema	7200	847

Table 2: *Resource: White SC, Pharoah MJ: Oral Radiology - E-Book: Principles and Interpretation: Elsevier Health Sciences; 2014.*

Parental concerns

Parents are worried about this because children are more sensitive to radiation than adults. Also, their question is that could the dental radiography be harmful to their child? In order to have assurances to parents, it should be reminded radiation levels in children's radiography are safe for children.

As noted, children are more sensitive than adults [32], so carcinogens can be caused by high doses of radiation. X-rays do not lead to cancer, in fact, the total amount of radiation that occurs in a cumulative manner and in the course of life which leads to the disease. The lower the child's age, the greater is the impact of this radiation on his lifespan.

One thing to note is that if it is a digital radiography, it has fewer beams than conventional ones. E-film is used that is more sensitive to light than other types. Hence, much less radiation is needed for the film to develop.

In the case of dental caries, a cavity detector can also be used instead of radiography [33]. This method is associated with some kind of error, but it is suitable for reducing parental concerns rather than radiography of the tooth.

Creation of confidence in the child for taking radiography

Dental radiography equipment can cause a child's fear or a child's curiosity. It's better to let the child touch the radiographs equipment and get to know the camera. The patient can take one of the films in his hands, and the dentist can show him where it will be placed.

Showing and telling is an easy way to get the child to be involved [34]. The description of the actions that will be carried out can also make the child be more cooperative. Many of the children who are initially ready to cooperate, after knowing how many films will be taken starting to be fussy and uncooperative. Radiography of easier areas at first can increase radiographic success in other areas.

If placing a film causes nausea, or child makes an objection to the film's insertion, local anesthetics can be used. The dentist should be very patient when taking radiographs. It may be necessary to place a film a few times before the radiation is given. If the child does not cooperate, voice control [35], acting seriously, reinforcements [36], non verbal communication [35] and caring for the child are usually effective. Noteworthy, taking a dental radiography of children with sensory, mental and physical disabilities requires specific methods.

Safety against radiation of the device

One of the characteristics of X-rays is that it provides some of its energy to the material that passes through it. If this material is living tissue, it can cause biological damage. There is a lot of information available about the damage and the consequences of radiation at the high levels. X-ray effects at low levels (such as diagnostic radiology), on biological systems, are still unknown.

Our assumptions about injuries are obtained by generalizing the information from radiation at high doses to doses of conventional dentistry. Dentists should be concerned about the dangers of radiography for patients. This concern is due to three biological effects that are: 1- Carcinogenicity, 2- Teratogenicity (deformity), 3- Mutagenicity [37,38].

Children protections against radiation

During their growing years the immature and rapidly dividing cells are more prone to suffer DNA damage. This kind of exposure impacts the body in a number of ways. Notably, they are known to compromise cell membrane function, calcium and antioxidant balance, DNA, and blood-brain barrier permeability [39].

The destructive effects of excessive radiation on the organs of the child's body are clear. These sensitive organs which can be affected include skin, red bone marrow, gonads, eyes, thyroid, and breast [40].

Dentists and his staffs can directly protect the patient or indirectly preserve themselves from unnecessary exposure to radiation through the use of correct techniques. The easiest way is to protect the child by covering the areas of the body that do not need to be exposed. This is done by using a collar and a lead apron. The apron keeps the gonads and chest from the initial beam and scattered rays while the collar covers the thyroid gland.

This method does not provide the complete protection, especially for the thyroid, but it is effective in reducing the exposure. The apron used in radiography has a front and back part because the radiation source is on the sides or back of the patient.

Faster films help reduce the amount of radiation in the patient. Nowadays, it uses radiographs that reduce radiation time. Recently, the use of devices that can focus the beams in one spot has increased.

In recent decades, many findings have been achieved to reduce the dose received by patients and personnel in radiology centers. These findings are presented in the form of recommendations for radiation protection in the instructions issued by the protection agencies. [41,42].

In other words, such recommendations include the use of high-speed radiographs, the use of a long distance between the members and the source of radiation, the quality control of equipment and the use of protective devices for the sensitive body's organs [40-42].

Conclusion

In dentistry, as in other disciplines, radiography is used to diagnose diseases or oral and dental injuries. In fact, with a simple radiography, a dentist is able to diagnose a tooth abscess, jaw bone damage due to jaw and teeth fractures, or tooth decay, and so on. The amount of radiation received by the body during dental imaging is far below the annual limit. Therefore, there is not much concern about the radiation caused by dental radiographs. Of course, all efforts should be based on minimizing the dose received in humans, since it has been proven that the dose received by the person is as low as possible, but can have negative effects.

Since the X-ray and other radiographic sources of the teeth are designed to reduce radiation, these processes are safe and have minimal exposure. In fact, many offices currently use digital X-ray rays that reduce most of the rays. However, the American Dental Association (ADA), the oral health, recommends that patients have more protection when wearing a lead vest to cover the abdominal area, and also a lead collar to protect the thyroid.

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