

## *Review Article*

### **Different Techniques of Dental Radiography for Paediatric Patients: A Review**

Aniyo R<sup>1</sup>, Kaur G<sup>2</sup>, Neha<sup>3</sup>

<sup>1</sup> Postgraduate Student, <sup>2</sup> Professor and HOD, <sup>3</sup> Reader

Department of Pedodontics and Preventive Dentistry, Maharaja Ganga Singh Dental College and Research Centre, Sriganaganagar.

#### **ABSTRACT**

Radiography has been a very important part for proper treatment planning in dentistry and they are very important and valuable aids in the oral health care of the children. It is also considered as one of the very important diagnostic tool for detecting oral diseases like dental caries, periodonatal diseases, different kind of oral pathology etc. When the paediatric patient comes to the clinic or department for the first time, radiography has been done in most of the case for diagnosis. Radiography has been acceptable and painless method and confidence can be achieved. So this review aims to give a brief information and guideline about the specialized technique and different modification of dental radiography which can be used in infants, young, gag reflex, mentally challenge and handicapped children.

**Key words:** Dental radiography, Handicapped children, Pediatric patients.

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**Corresponding author:** Dr. Aniyo R, Postgraduate Student, Department of Pedodontics and Preventive Dentistry, Maharaja Ganga Singh Dental College and Research Centre, Sriganaganagar

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#### **Introduction**

The initial radiographic examination should not be based on patient's age should be based on child's circumstances. Because each patient is different and unique. After thorough medical and dental history and completing clinical examination, and assessing the patient's response to the environmental factors that affect the oral health.<sup>1</sup> The main reasons for taking radiographs of teeth and supporting tissue in pediatric dentistry are:

1. Detection of caries
2. Dental injuries
3. Disturbances in tooth development
4. Examination of pathological conditions other than caries.<sup>2</sup>

However, there are associated risk with radiography which should not be neglected especially among children. There are certain guidelines in dental radiology to avoid unnecessary exposure to X-radiation and to identify those individuals who may benefit from a radiographic examination.<sup>3</sup>

#### **RADIOGRAPHIC METHODS**

Radiographs can be classified mainly into the conventional and advanced techniques. Bitewing and intraoral periapical conventional radiograph are mostly used for the detection of caries, there can be overlapping of teeth due to faulty angulations and may also miss the initial lesion. In primary dentition, most susceptible surface is occlusal surface where caries frequently attack, but after the eruption of first permanent molars, the proximal lesions greatly increases. In such situation, bitewing radiographs are absolutely required to detect proximal caries in primary molars. Digital radiography and Xeroradiography are some of the advance technique with very little of the radiation to which the patient has been exposed, and avoids the need for developing films.<sup>4</sup>

#### **Modification of Different Projection Techniques**

Radiographs considered as the valuable tool that are essential to diagnose oral diseases and to evaluate the development of dentofacial structures and the results of

the post treatment outcomes. Because each patient is different and unique, firstly a proper medical and dental history with proper clinical examination is needed for determining the need for dental radiograph and assessing the patient's response and vulnerability to the environmental factors that affect oral health. There are certain modifications which are required for taking radiographs, in infants, young, gag reflex, mentally challenge and handicapped children.<sup>1</sup> Several different radiographic techniques may be used to take the radiographs of these patients. Like, intraoral radiographs may be taken with the presence of parent or guardian who can hold the films in place. Some of the film holding devices such as bite blocks or a hemostat can be used through a rubber stopper to hold the film in the oral cavity. Otherwise a film can be also placed with the help of patient's occlusion, thus making it not dependent on digital fixation.<sup>5</sup>

#### **For Infants**

It is always recommended to use size 0 intraoral periapical films for the exposures for an infant below 3 years of age. Some times, it becomes very difficult for a young child to manage and hold the films that have been placed for molar projections. Similarly, the mandibular molar films and the bitewing radiographs cause impinge on the sublingual tissues and causing discomfort and irritation of the tissues. Young children usually faces difficulty while taking a radiograph. In those cases, it becomes necessary to take parental help where the parent is asked to hold the film or both the child as well as the film. Both child and parent are directed in the same direction, and the child head is supported with the parents shoulder and the radiograph is being taken. If the adult attending is pregnant, then someone else should be with child.<sup>6</sup>

#### **Handicapped children**

Many of the mentally challenge and handicapped children will not allow and reluctant to place an intraoral film in their mouths. Usually intraoral radiographs of these children are done by parent holding the film in position. A holding device can be more effective as it fixes the film in position while the patient occludes than trying to hold the film by digital placement. Extraoral radiographs like panoramic, lateral jaw or 45° projections are also can be used in such cases<sup>5</sup>. Rinn Snap-A-Ray is used instead of using the conventional holders where intra oral holders are difficult to place in the oral cavity. With this modified technique it becomes easier to place the film in mentally and handicapped children.<sup>7</sup>

#### **Mentally Challenged Children**

For mentally challenge and limited ability, to retain the film placement, an intraoral film with bitewing tabs is being used for all bitewing and periapical radiographs. An hole is made in the tab where 18-inch length of floss is attached in the tab (for retrieval of the film). The patient are made to wear a lead apron with a thyroid

shield, and person who is holding the patients and films or sensor should wear lead - lined apron and gloves.<sup>8</sup>

#### **Children Having Gag Reflex**

Children usually experience gag reflex during while taking radiographs. At times gagging has been considered as an effort made by the child to defend themselves consciously. For this reason, it is necessary to aware the patient thoroughly with the radiographic taking before the procedure. Distraction has been one of the most effective methods for reducing gag reflex. The child is asked to concentrate and focus intensely on something till the procedure gets over. The given task may be to raise one leg, and his toes, make a fist or hold his breath for sometime. It is always advisable to perform the examination in the morning when the individual is well rested, rather than in the afternoon or evening. It is also observed that there is reduced chances of gagging when the stomach is empty or half filled. Sedative and topical anesthetic are the pharmacological techniques that are used for managing gag reflex. There are some few agents that have been recommended and shown for decreasing the gag reflex which includes phenothiazine derivatives, antihistamines, barbiturates, and nitrous oxide. Use of local anesthetics such as xylocaine or dyclone in topical or rinse form are used for temporary relieving. General anesthesia is usually not recommended for taking radiographs.<sup>9</sup> Positioning and placement of film may also be varied to according to the child who gags during radiography. Certain factors need to be kept in mind while taking radiography such as children have smaller jaws, shallow lingual vestibule, which requires the use of smaller films. Sometimes posterior film can be kept toward the front of the mouth initially and allow the child itself to move the film posteriorly into position by themselves which can be also one of the technique to distract the patient.

#### **Radiography Alternative to Intraoral Periapical Radiographs**

Extraoral techniques is another alternative to intra oral radiograph when it is practically difficult and not possible due to many factors, e.g. handicapped children, young patients or patient with a gag reflex. Lateral jaw or lateral oblique and the panoramic films are some of the frequent substitute which are used.<sup>10</sup>

#### **Modified Techniques Of Film Packets and Holder**

Film packets can be modified in many ways to reduce patients anxiety level, to minimize the discomfort and gag reflex while placing the film in the oral cavity. Bending of the film (occlusal), using the small size film or either bending of the corners of the film to decrease the irritation especially in the sublingual area of the oral cavity are some of the modification.<sup>11,12,13</sup> Lewis *et al.* suggested the maintaining of plane of the film by using cotton rolls, which are taped with the packet of the film<sup>14</sup>. "Reverse"Bitewing is a technique where the film is placed in the buccal vestibule, and the beam is directed

through the jaws from the opposite side of patient's head.<sup>14</sup>

### **Modification Of Management Techniques**

The different management techniques are used for different age group. Below child <3 years includes "desensitization" i.e. the child is explained about the procedure in simple language and what dentist wants to do. Tell, show and do technique is used to explain the taking of a photograph of the tooth with the help of a camera. It helps not only in reducing the patient's anxiety but also helps in achieving the confidence of the child. Least difficult radiographs has to be taken initially. A positioning device (Snap-A-Ray) can be used for securing and stabilizing the film those who faces problems for stabilizing the film.<sup>15</sup> Many of the older children may also become uncooperative sometimes due to exaggerated gag reflex, small jaw size difficult to place the radiograph or a fear of engulfing the film. Different techniques being used to overcome these difficulties. Smallest size radiograph or rolling the film so as to accommodate in the jaw should be used and so that it does not irritate the soft tissues especially for the detection of proximal caries. The only disadvantage with this technique is that, the image can be distorted. Patient's cooperation can be achieved by using desensitization techniques and proper use can be effective. A child should be exposed slowly to new stimulus to gain confidence. This technique can be accurately described by "Lollipop radiography: In this technique child is asked to lick a sugarless lollipop." After some few licks, a radiographic film is attached over the lollipop with orthodontic rubber band and the film with lollipop is given back to the child and asked to lick it again. After this, the patient is asked to stabilize properly this in the mouth, and then radiograph is taken.<sup>15</sup>

The film is placed on the buccal surface of the tooth, i.e., between the tooth and the cheek in the patient having an exaggerated gag reflex which is practically difficult. Buccal surface of the teeth is in contact with the film side of the packet. Cone is placed under the angle of the ramus while the X-ray head placement is towards the opposite side. Radiation is pass through the tongue over the tooth structure and onto the film. A 2 times more exposure is required for such image to form as the beam has to travel more longer distance as compared with the conventional techniques.<sup>15</sup>

### **Other Radiographic Techniques**

#### **Xeroradiography**

Xeroradiography is one of the most accurate electrostatic imaging technique that uses a modified xerographic copying process to record images which are produced by diagnostic X-rays. In 1937, the xerographic process was invented and first used.<sup>16</sup> The most commonly it is for mammography in medical field, and also successfully applied to imaging other body parts such as the skull, larynx, respiratory tract, TMJ, mandible, paranasal soft tissues, and dental structures. In 1955, for the first time

xeroradiography was used for alveolar structures took place and it was a lateral oblique view of the mandible.<sup>17</sup> The most important advantage of xeroradiography includes simultaneous evaluation of multiple tissues i.e. tissues with different thickness and densities can be easily viewed under one film accurately. Another advantage is that accidental film exposure is impossible. It has excellent characteristics of the forces around the electrostatic charges, which form the latent image i.e. it provides a high-resolution images which makes it easier to assess. Furthermore, dark room requirements are not necessary, and the entire xeroradiographic process may be completed within 60 sec. The process also allows multiple copies simultaneously and it is the most cost effective method when compared to either automatic processing or manual processing.<sup>18</sup> Periapical xeroradiographs were made from a smaller plate when compared with the plate size of conventional X-ray film. Xeroradiograph shows accurately a well-defined and a sharp delineated bone details as well as soft tissue imaging on the same picture. These features offer advantage orthognathic surgery and in cephalometrics tracing especially in children.<sup>19</sup>

#### **Magnetic Resonance Imaging (MRI)**

An MRI is a technique that uses magnetism, radio waves, and a computer to produce images of body structures. It uses non-ionizing radiation from radio frequency band of electromagnetic spectrum (10<sup>9</sup>-10<sup>11</sup> nm of wavelength). It is a kind of non-invasive imaging modality and uses electrical signals to be generated from response of hydrogen nuclei to strong magnetic field and radio wave/radiofrequency pulses which produce an image to allow specialists to explore inner working of human body, to detect and define the difference between healing and diseased tissue without the use of X-ray.<sup>20</sup> Main advantage of MRI scan is an extremely accurate method of disease detection throughout the body and it is mainly indicated for assessing intracranial lesions, with involving posterior cranial fossa, the pituitary, and the spinal cord and trauma to the brain can be seen as bleeding or swelling in the head. It is also used in detecting the staging of tumor i.e. evaluating the size, site and extent of all soft tissue tumors and tumor like lesion which involves all areas, including salivary gland, pharynx, larynx, and orbit. For tongue, mainly for lingual tumor for the definition of boundaries and degree of vascularity. To know the extent of soft tissue tumors and tumor like lesions like, salivary gland, the pharynx, and the larynx.<sup>21</sup> MRI also helps in 3D visualization of the carious lesion with determining its relationship with the adjacent surrounding tooth structures.<sup>11</sup>

#### **Computed tomography (CT)**

Housefield was the first to develop CT scanner in the field of dentistry, which is also known as CAT scanning (computed axial tomography). The attenuation of an X-ray beam present in the body is used in conventional radiography which project to a shadow onto an image

receptor. These shadowgraphs are used to record a two-dimensional (2D) representation of a three-dimensional (3D) object. Small lesions are usually not accurately identified because of overlapping and underlying anatomy, image distortion also occurs sometimes because of unequal magnification effects and there is low contrast masses which are poorly delineated because the scattering contributes substantially to the image data.<sup>22</sup> It is a kind of radiographic technique that gives the concept of thin layer radiography (tomography) with computer synthesis. CT is a digital and mathematical imaging technique and with a creation of tomographic sections where the tomographic layer is not contaminated by blurred structures from adjacent anatomical structure. It enables differentiation and it is a kind of non-invasive procedure.<sup>17</sup> CT examinations are more reliable, quicker and friendly to the patient. There have been tremendous research and development which are made to give good image quality for diagnostic confidence at the lowest possible X-ray dose. CT is mainly indicated for investigations like intracranial diseases, for implants like assessment of maxillary alveolar bone height and thickness before inserting implants, for suspected intracranial and spinal cord damage and assessment of fractures involving the orbits and nasoethmoidal complex, cranial base and cervical spine fractures, tumor staging-assessment of site, size and extent of benign and malignant tumors, for tumors and tumor-like discrete swelling intrinsic and extrinsic to the salivary glands and for the investigation of the temporomandibular joint disorder (TMJ). It makes it easier as it eliminates superimposition of images of structures which are present outside the area of interest; surfaces which are hidden can be examined in detail. It has the advantage of ability to rotate the images and to add or subtract structural components and helps in relationships to be studied. Structural relationships of hard and soft tissues can be observed and assessed directly.<sup>22</sup> Though there are many advantages, there are certain limitations also for its usage. In CT imaging blurring effect is much more greater than in conventional radiographic systems. The detail of a CT image is not so fine as that can be obtained on other radiographs. Furthermore, artifacts are produced from the metallic objects such as fillings. The equipment is very expensive.<sup>23</sup> Clinical application of CT in children includes diagnosis of neonatal maxilla and its disorders which involves the auditory ossicles and TMJ disorders. It also helps in detailed view of the dental arches and positioning of the supernumerary teeth. The extent of the cyst and tumors can be also identified. In orthodontic cases, both skeletal as well as a dental relationship can be assessed. Proper evaluation and assessment of the trauma involving the face can be also made with the use of CT.<sup>24</sup>

### Cone beam CT (CBCT)

CBCT also called as dental volumetric tomography, cone-beam volumetric tomography, dental CT, and cone beam imaging. It is a recent technology which was initially developed for angiography in 1982 and subsequently

applied to maxillofacial imaging also. It is only since the late 1980s that it has become possible to produce clinical systems that are both inexpensive and also small enough to be used in the dental office. The main principal feature of CBCT is that multiple planar projections can be acquired by rational scan to produce a volumetric dataset from which inter-relational images can be generated.<sup>25</sup> Cone-beam scanners use a 2D digital array which provides an area detector rather than a linear detector as CT does. This is combined with a 3D X-ray beam with circular collimation so that the resultant beam is in the shape of a cone, hence the name "cone beam" has been given. The exposure needs to incorporate the entire region of interest (ROI), only one rotational scan of the entry is necessary to acquire enough data for image reconstruction. As CBCT requires only a single scan for capturing the necessary data, so the time required for CBCT scanning is less (<30 sec) as compared to conventional CT where CBCT data reconstruction and viewing is done on a personal computer. Some manufacturers also provide software which are mainly required for orthodontic analysis and implant placement.<sup>24</sup> CBCT can be also used in pediatric patients for malocclusions and craniofacial anomalies, like cleft lip and palate. Also used for determining the position of the unerupted teeth and to know the resorption of the teeth which helps in proper treatment planning and its outcome.<sup>26</sup> It has certain limitations which are related to the cone beam projection geometry, detector sensitivity, and contrast resolution that produce images with less clarity and utility of conventional CT images.<sup>27</sup>

### Conclusion

Proper use of radiograph and innovative radiographic techniques can get the dentist to obtain good diagnostic radiographs with minimum harm and maximum comfort for the pediatric patient. There are many modifications which are available for both intraoral and extraoral techniques for paediatric patient and its all depends on the type and condition of the patient and also the situation for the use of these modified techniques. All these modifications and different techniques can be a substitute for the conventional radiographic method especially in practically different situation.

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