The Role of Radiography in Detecting Endodontic Treatment Failures

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ABSTRACT

Background : *Endodontics focuses on diagnosing and treating pulp and periapical tissue diseases. Its goal is to restore teeth to a state where they are symptom-free, fully functional, and show no signs of pathology. Radiological images are essential for comprehensive assessment throughout the treatment process.*

Methode : *The rapid review referred to the PRISMA analysis guidelines, using the PICO strategy through PubMed, Sciences Direct, and Google Scholar databases with inclusion criteria in English language discussing The Role of Radiography in Detecting Endodontic Treatment Failures. Articles were selected based on duplication, title and abstract, and the overall content of the article.*

Result : *Endodontic treatment plays a vital role in conserving teeth by treating the internal structures to prolong their presence in the oral cavity. Radiography serves as an essential adjunct to endodontic procedures, providing crucial support throughout the treatment process. Alongside clinical assessments, radiological evaluations are indispensable for assessing the condition of the teeth and surrounding tissues, including the root tips.*

Conclusion: *Radiography plays a pivotal role in detecting and monitoring the success of endodontic treatment. The use of radiographs allows for the evaluation of periapical status, identification of healing processes, and detection of any new diseases that may arise.*

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INTRODUCE

1.1 Background

Endodontics is a part of dentistry that concerns the diagnosis and treatment of diseases or injuries to the pulp and periapical tissues. The goal of endodontic treatment is to restore the diseased tooth so that it can be biologically accepted by the surrounding tissue. This means that the tooth is without symptoms, can function and there are no other pathological signs.

Endodontic treatment is part of the conservation of teeth, which is the treatment of the inside of the teeth which aims to maintain the teeth as long as possible in the oral cavity.

As long as endodontic treatment is carried out, it cannot be separated from supporting care, namely radiological photos. In addition to clinical assessments, radiological assessments need to be carried out to see the condition around the teeth and at the root tips. In addition, radiological photos were taken when filling the root canals with gutta-percha.

At the final evaluation of endodontic treatment, radiological photographs still need to be done to see the final result whether there is an error or not.

1.2. Writing purpose

The aim of this paper is to investigate the role of dental radiography in detecting failures in endodontic treatment.

LITERATURE REVIEW

Radiography as a discipline in dentistry has an increasingly important role in line with the development and advancement of technology. The radiography unit is a very important diagnostic tool in dentistry and is one of the keys to determining the success of diagnosis. Based on research and surveys conducted on dentist practices in India, only 10.8% reported that they did not have a radiographic unit and the rest had used radiographs to support the examination performed. This proves that the role of radiography is very important in dental practice

Technological advances have contributed significantly to improving the level of oral health. The cathode rays discovered by professor Wilhelm Conrad Roentgen in November 1895 and applied in dentistry by Dr. Otto Walkoff (1899) now plays an important role when performing endodontic treatment such as in determining the length of work. Determination of working length can be done by several methods, including visual methods through periapical radiographs using an endoruller, mathematical methods with measurements using the Bregman formula (measurement of the length of an endodontic device with tactile sensation through insertion of a miller needle or file No. 10 into the root canal with a roof. open pulp, tactile sensation indicates the tool has reached the apical,

Root canal filling is an important step in endodontic treatment. There are many factors

which can affect the quality of endodontic treatment one of the most important being the quality of the root canal filling material and also the determination of the length of action. Conventionally, this length of action is assessed and verified on intra-oral radiographs. There is substantial evidence that the quality of root canal treatment techniques has a significant effect on the outcome of endodontic therapy. Efforts that must be made to improve the quality of the obturation technique and material can be seen through radiographs. Radiographs that can be used to see the quality of the technique and obturation of the root canals are periapical radiographs using both parallel and bisecting techniques.

Endodontics is one of the treatments available in the field of dentistry which is supported by the routine use of periapical radiographs. This is a basic initial investigation, during and after endodontic treatment. Periapical radiographs are assessed to determine various factors that support the success of endodontic treatment such as length of work, number of root canals, determining the level of difficulty, and determining the prognosis of treatment.[5,6] Dependence on radiography is so great that radiography becomes an inevitable necessity.

Radiographic diagnosis or so-called "visual specialization" continues to depend on the ability of the observer to interpret the radiographic images. A healthy human eye has a wide dynamic range for light intensity as a result of light adaptation which is controlled by the ability of the pupil to adjust to the intensity of light reaching the retina and the human eye can distinguish about 60 shades of gray at one time without the use of assistance. Radiographic images are the result of different contrasts created by complex three-dimensional structures with different radiological densities. This variant with contrast can promote several optical phenomena, such as the contrast effect which can cause misinterpretation so that in dentist practice there is a failure to diagnose.

Radiographic diagnosis in the endodontic specialty is very challenging in everyday dental practice, because dentists must be able to distinguish images of different radiographic opacities, apical anatomical tissue, root canal filling or resorption caused by inflammatory processes. Often radiographs are assessed using individual image display devices without any calibration and in clinical settings with bright lighting conditions

Apart from the limitations of the image examination and the individual's visual perception, the radiation dose can also be a limiting factor for the determination of the diagnosis, because high-resolution imaging as tomography cannot be recommended for standard endodontic treatment. Thus, radiographic diagnosis using two-dimensional images and three-dimensional structures continues to depend on the ability of the observer to interpret them. In the field of dentistry, there is little knowledge and controversy about how the observer's

performance of certain diagnoses is affected by the type of image display device and the room lighting conditions.

Intraoral Radiography

Intraoral radiography is a radiograph that shows the teeth and their surrounding structures and intra oral examination is the mainstay of dental radiography. Types of intra-oral radiographs include periapical radiographs, bitewing radiographs and occlusal radiographs. [12]

2.1.1 Periapical Radiography

Periapical radiograph shows the entire tooth, including the bone around the tooth. Periapical radiographs describe an intraoral technique designed to show individual teeth and the tissue around the apex. Each film usually shows 2-4 teeth and provides detailed information about the teeth and surrounding alveolar bone.12 The effective dose for routine dental examinations on periapical radiographs is 0.001-0.008 mSv which is a relatively small dose and is not harmful to the body. The side effects that can occur from a periapical radiograph are vomiting, fatigue and loss of appetite. There are two types of film sizes on periapical radiographs, namely for children and adults. There are two types of film sizes for children, namely size 0 (22 mmx35 mm) and size 1 (21 mmx40 mm), and for adults size 2 (30.5 mmx40.5 mm).

Determination of the maxillary or mandibular radiogram is the first thing that must be done in interpreting. How to determine it can be done as follows:

A. Radiogram of the maxillary posterior tooth [13,14]

1. Trabeculae, some are horizontal and vertical.
2. The zygomatic bone shows radiopaque shape which is shaped like the letter "U"
3. Trabeculae, some are horizontal and vertical.

5. Maxillary sinus is seen.
6. Anatomical shapes, especially the anatomical shape of the first molar teeth, where there are three roots.
7. You can see the coronoid proccessus when making radiograms on the third molar.
8. Maxillary tuber is visible when radiogram is made in the second molar region or third molar.

B. Radiogram of the mandible of the posterior teeth [14]

1. Horizontal trabecular direction.
2. If the mental foramen is visible, it is located between the second premolar and the lower first molar or the first premolar and the lower second premolar. The mandibular canal is visible.
3. Anatomical shape, especially the root first molars are two. The internal and external oblique lines will occasionally be seen.

After being able to determine the region of the radiogram, the next step is to interpret the radiogram. To determine abnormalities on this periapical radiogram, the basis is to look at the lamina dura. If the radiogram shows abnormalities, the lamina dura of the periapical tooth is cut off

The lamina dura is the part of the bone that surrounds the ligaments of the periodontium. So, the radiogram shows an image that looks very radiopaque because the bone structure contains the most calcium

2.1.1.1 Parallel Technique

The parallel technique is known as the extension cone paralleling, right angle technique, long cone technique, and true radiograph. The advantage of the parallel technique is that it is an ideal technique because it uses a film holder so that it is more stable in the mouth.13 The principle applied to the parallel technique is to place the film parallel to the long axis of the tooth to keep the film parallel to the long axis of the tooth by using a film holder. After the film and tooth long axis are aligned, the center of the x-ray is directed perpendicular to the tooth and film.

The technique that is done correctly will produce a clear image according to the actual tooth size, small distortion, easy to interpret. However, this parallel technique has disadvantages such as the difficulty of placing the film holder, especially in children and patients who have a small mouth and it is influenced by the operator's skill in using the film holder because it is less comfortable for sensitive patients.

When shooting mandibular molars, the film is placed on the film holder in a horizontal orientation. The second molar is located in the center of the film with a beam perpendicular to the center of the film. The direction of the point of incidence is located at the bottom of the outer corner of the eye to the central area of the mandible. The contact between the molars should be exposed and the distal area of the third molars should be visible even when teeth are absent. Be careful with film placement as the sharp edges can cause discomfort to the sensitive floor of the mouth. [15,16]

The parallel technique has the advantages of producing geometrically accurate images with little magnification, depicting periapical tissue accurately, seeing the entire crown of the tooth can be well observed so that proximal caries can be detected, the relative position of the film, teeth and the direction of the beam is not affected by the position of the patient's head.[13]

The parallel technique has its drawbacks, namely that the position of the film for taking X-rays of the posterior teeth can cause discomfort to the patient, often triggers a gag reflex, cannot be applied to patients with flat or shallow palates, the image on the apical part of the tooth root sometimes appears very close to it. edge of the film, the film holder is made of non-

sterilizable material. [17]

2.1.1.2 Bisecting Technique

The bisecting technique is also known as the bisecting angle techinique, bisection of the angle technique and the short cone technique. The principle of the bisecting technique uses the geometric principle, the film must be placed along the lingual / palatal surface of the tooth, the film length axis plane is not required because the patient can hold the film with his fingers. The bisecting technique has advantages, namely that the position of the film does not interfere with patient comfort, in any region it is easy and fast, the position of the tooth length in the image is the same as the actual tooth length if the angle is correct so that it is adequate for diagnostic purposes, although it is not ideal. has a drawback, namely the resulting image can experience distortion because inaccurate vertical angulation can produce elongation and foreshortening images,

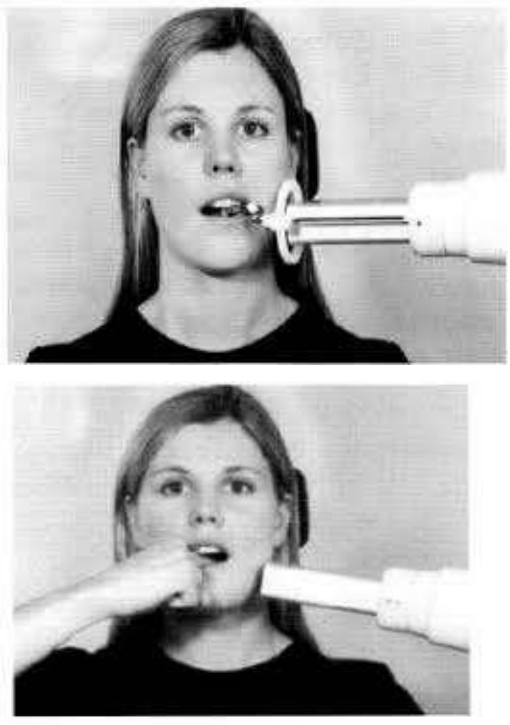

Figure 1 A. Parallel periapical radiograph technique B. Periapical radiography bisecting technique[13]

2.1.2 Bitewing Radiography

The bitewing technique was used to examine the interproximal tooth and tooth surface covering the crown, interproximal area and the alveolar crest of the maxilla and mandible on the same film. In addition, occlusal radiographs are useful for detecting interproximal caries (especially early caries) and alveolar crest between 2 teeth. The dosage of bitewing radiographs is 0.001-0.008 mSv.[13,14]

2.1.3 Occlusal Radiography

The occlusal technique is used for examination of the maxillary or mandibular area. Occlusal radiographs have a useful purpose to see the location of the root of the tooth, supernumerary location, unerupted teeth, impacted teeth, to see the state of the salivary stone in the submandibular gland, to evaluate the extent of lesions such as cysts, tumors or malignancies in the mandibular or maxillary evaluating the maxillary sinus base, examining the cleft palate, and measuring changes in the shape and size of the maxilla and mandible. The principle of occlusal radiography is that the film is placed in the mouth between the occlusal surface of the maxilla and the mandible. The film is stabilized by biting the surface of the film. The dose on occlusal radiographs is 0.008 mSv. [14]

2.2. Endodontic Treatment

Endodontic treatment is a procedure of biological, chemical, and mechanical treatment in the root canal system to eliminate pulp and periradicular diseases to improve the health and repair of dental tissue. The goal of endodontic therapy is to establish and cleanse the root canal system. [2]

Radiography has important functions in several fields. However, radiography has limitations that require a special approach. In addition, a single radiography is simply a two-dimensional image of an object which is in fact a three-dimensional object. In order for the maximum information to be obtained, these dimensions must be visualized and interpreted.14 In performing root canal treatment, the operator must plan exactly how many periapical photographs will be made, so that there is no waste of time, cost, and reducing the risk of radiation received by sufferers and patients. operator. Although according to research, the radiation dose received by the oral tissue on periapical radiographs is very minimal. [2, 18]

The role of radiography in root canal treatment includes the following:

a. Diagnosis

By distinguishing radiolucent and radiopaque images in the periapical area, pulp lesions, periodontal, and other bone lesions, we can identify disease in the teeth. Radiodiagnosis is not only used to identify the presence and pathological characteristics, but is also used in determining the anatomy of the roots, pulp and determining the characteristics and differences from other normal structures.2 In determining the anatomy of the pulp and roots and the relationship of root canals to each other, the identification of the sagittal anatomy of each root and canal will be of great help. Many structures appear radiopaque and radiolucent due to their close proximity. These structures sometimes overlap each other and fade the appearance of the crown and roots so that the pathological structure must be distinguished from normal structures.

b.Treatment

In the process of root canal treatment, radiographs can be used to determine the length of work or to see the number, location and shape of the root canals, helping determine the master point and evaluate root canal filling.[19] The distance from the reference point on the crown of the tooth to the apex of the radiograph must be determined precisely . This is the length of the root canal from the apex that must be prepared and obturated. [2]

The following is a radiographic view of a periapical area infection requiring endodontic treatment and an uncomplicated root canal shape.

Figure 2. Periapical area infections requiring endodontic treatment reveal an uncomplicated root canal[2]

Radiopaque anatomical structures often obscure the appearance of the roots and apex. Using a special beam tube angulation, the radiopaque image of the anatomical structure can be removed so that the apex is clear. There are special techniques to be able to determine the exact position of the root canals so as to support the success of endodontic treatment. Special skills and techniques are needed in taking radiographic images so that the resulting images are clear enough, especially in determining the number of root canals. The peridontium ligament cavity ends at the surface and furcation and adjoins the lamina dura. Evaluation of root canal obturation with radiographs can be seen the length, density, configuration and general quality of an obturation in each root canal.

Figure 3. Root canal obturation [2]

c. Maintenance control

Radiographs made at the next visit can evaluate the periapical state, detect the healing process of the lesion or identify new diseases that may arise.18 The success of new treatment will be seen several months after treatment. Given that failure often occurs without signs and symptoms, radiographs are very important for evaluating the periapex status. [2]

The presence and nature of the lesions that develop after treatment are best detected by radiography. These lesions may be periapex, periodontium or non-endodontic lesions. It is important to remember that these lesions often present without obvious signs and symptoms and can only be detected on radiographs. Lesions that appeared before treatment should be healing or have healed. With successful treatment, general restoration of normal structures is evident on radiographs. [18,19]

The expected end result of endodontic therapy is a root canal completely filled with fillers. However, usually there are root canals that are not treated because of an error in detecting the many root canals of the tooth. This is what usually triggers the failure of endodontic treatment. Usually this condition is found in teeth that experience anomalies

2.3 Room lighting

Lighting is an important factor in space design. A room that has been designed cannot fulfill its

function properly if there is no lighting access provided. Lighting in the room allows the people who occupy it to see objects. Objects that are not clearly seen will interfere with activities in the room. Conversely, light that is too bright can also interfere with vision. Therefore the level of lighting needs to be adjusted to produce the suitability of vision needs in space based on the type of activity

Room lighting on dental radiographs with endodontic treatment was seen using a viewer box visually seen in different room lighting conditions, namely dim light (25-50 lux) and bright light (1000-1200 lux) and assessed three parameters of dental radiographs with endodontic treatment, namely limits apical, root canal adaptation and homogeneity of root canal material filling. [8]

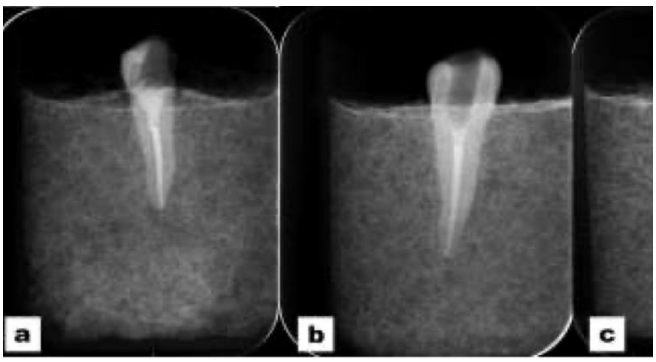

Figure 4. Obturation of the root canal is seen in bright light and dim light (a.better treatment, b.good treatment, c.poor treatment) [8]

CONCLUSION

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