

Extraoral Radiography as an Alternative During Covid-19 Pandemic

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ABSTRACT

Purpose: The purpose of this literature review was made as a recommendation radiography materials for dental practitioners to use extraoral radiography as an alternative during the Covid-19 pandemic.

Methodology: This literature review is created by collecting journals and case reports with keywords “extraoral radiography” and “Covid-19 pandemic”. The inclusion criteria used in this articles review are articles published in English and Bahasa Indonesia, scopus indexed articles and research articles, and also from dental radiology books.

Results: Some dentistry organizations have suggested using extraoral radiography examinations as an alternative during the Covid-19 pandemic. These include panoramic, CBCT, extraoral bitewing and extraoral periapical radiography.

Applications/Originality/Value: Using extraoral radiography with panoramic, CBCT, extraoral bitewing and extraoral periapical radiography can be used as an alternative in radiography examination during the Covid-19 pandemic.

INTRODUCTION

The emergence of Covid-19 disease caused by the SARS-CoV-2 virus has affected all aspects of human life. One of the spread of SARS-CoV-2 is through the transmission of oral droplets and aerosols that are very closely related in dentistry. Dental practitioners and staff who participate in dentistry activities have a high risk of SARS-Cov-2 virus transmission (Little et al., 2020).

Air contamination caused by aerosols is mostly obtained from dentistry activities, such as: the use of ultrasonic scallers when scaling, the use of high speed handpieces during preparation, the use of water / air syringe, and intraoral radiography (Anu Sushanth et al., 2020). These activities need to be controlled and limited during the Covid-19 pandemic. The world dental organization has agreed on the application of limitations to the practice of dentistry and follows the guidelines that have been recommended by the Centers for Disease Control and Prevention (CDC). However, in its application radiography dentistry is still very limited for the control of SARS-Cov-2 transmission (Macdonald et al., 2020).

Radiography examination in dentistry is a very important action to establish a diagnosis in certain cases. Dental radiology practitioners are prone to exposure to sars-cov-2 virus transmission, because saliva contamination and oral droplets occur in this activity. Especially during intraoral radiography retrieval, where the radiographer needs to adapt the film into the patient’s oral cavity so as to stimulate salivary secretion from the patient. So the use of extraoral radiography is more filtered during the Covid-19 pandemic. The statement was also delivered by the “Pengurus Pusat Ikatan Radiologi Kedokteran Gigi” (PP IKARGI) at the beginning of the Covid-19 pandemic which advised to postpone intraoral radiography examinations and only using extraoral radiography examinations (Lubis & Rahman, 2020).

Extraoral radiography is a technique of taking radiography from outside the patient’s mouth. Image detectors and X-ray machines are placed outside the patient’s mouth. This condition minimizes the occurrence of saliva contamination and oral droplets when taking radiography images. This literature study aims to provide several alternatives that can be used by dentistry practitioners when they need a radiography picture with minimal salivary transmission and oral droplets (Dave et al., 2020).

REVIEW

SARS-Cov-19 spreads directly, indirectly, or in close contact through the secretion of saliva and respiratory droplets released from those infected. Aerosol (a.k.a air solution) is the suspension of fine-solid particles or liquid droplets in the air. The virus has been shown to survive in free air for hours and on the surfaces for days. The symptoms of Covid-19 are fever or chills, cough, shortness of breath or difficulty breathing, weakness, muscle or body pain, headache, loss of sense of taste and smell, stuffy or watery nose, nausea, vomiting, and diarrhea. Identification of these symptoms needs to be suspected by dental practitioners when screening on patients who will perform dental care. However, in its application is often found Covid-19 positive patients without having these symptoms. Therefore, it is necessary for dental practitioners to assume that everyone who comes is a person at risk in the transmission of SARS-Cov-19 (Lubis & Rahman, 2020).

The beginning of the Covid-19 pandemic, dental radiography activities are not allowed because they do not include dental emergency. However, dental radiology is one of the most important supporting examinations in dentistry. Dental radiography examination has 2 types, namely intraoral and extraoral radiography. Intraoral radiography has a higher risk of SARS-Cov-19 transmission due to saliva contamination than extraoral radiography. Therefore, during the Covid-19 pandemic dental radiology activities are recommended using extraoral radiography (Cascante-Sequeira et al., 2020).

Radiography examination in dentistry has a high potential in the transmission of SARS-Cov-19. So, dental practitioners need to do infection control to prevent the transmission of SARS-Cov-19 and choose an alternative extraoral radiography examination that has a minimal risk of SARS-Cov-19. Some of the findings of extraoral radiography in this review literature are expected to be an alternative for dental practitioners during the Covid-19 pandemic (Ilhan et al., 2020).

This literature review presents some extraoral radiography that can be used as an alternative to intraoral radiography during the Covid-19 pandemic. The methodology of this literature review by collecting journals and case reports with keywords “extraoral radiography” and “Covid-19 pandemic”. The inclusion criteria used in this articles reviewed were articles published in English and Bahasa Indonesia, scopus indexed articles and research articles, and also from dental radiology books found that panoramic, CBCT, extraoral bitewing and extraoral periapical can be used as an alternative to dental radiography examination during the Covid-19 pandemic.

Panoramic

Panoramic radiography is a type of extraoral radiography that is often used and recommended by dentists that shows the whole of the upper jaw, lower jaw, and supporting tissue in one image. Panoramic radiography has two methods: conventional and digital panoramic radiography. Conventional panoramic radiography is a method of radiography with the process of printing film manually. Digital panoramic radiography is a method of radiography that is not shot using film. The film is replaced by an electrostatic device that sends images to the computer so that it can be directly visible on the monitor screen (Bella et al., 2020).

The success of the results of panoramic radiography is from the patient's position where the patient needs to stand with his shoulders upright, back straight and legs tight. In addition to the position of the body parallel to the Frankfort field with the chin positioned on the chip cup, the patient is instructed to bite the bite block and the tongue is pressed on the palate. Once the patient's position is ready, the image tube and receptor (film or digital sensor) will rotate around the patient's head simultaneously (Figure 1) (Rondon et al., 2014).

The advantage of used panoramic radiography are it can display an overall picture of the curved teeth, upper and lower jaw bone, and other anatomical structures in a single image (Figure 2) (Izzetti et al., 2021). The use of panoramic radiography can minimize the occurrence of contact saliva secretions from patients so as to reduce risk of SARS-Cov-2 transmission (Dave et al., 2020). However, panoramic radiography has a disadvantage where the existence of a superimposition structure causes

errors in interpreting the panoramic radiography picture and the deformation of the image that makes the lack of size accuracy produced (Widyastuti & Suparno, 2019). And often, the occurrence of errors due to the placement of the patient's head when taking panoramic radiography that make the resulting image not good enough (Abdinian et al., 2015).

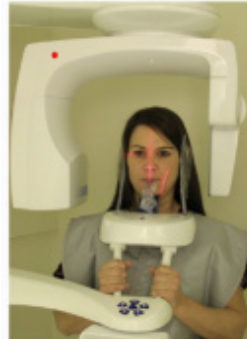


Figure 1. The patient's position during of the panoramic radiography (Pandarakalam & Khalaf, 2014).



Figure 2. The image of panoramic radiography (Izzetti et al., 2021)

Cone beam computed tomograph (CBCT)

Cone beam computed tomography (CBCT) is a type of extraoral radiography that produces 3D imaging. CBCT produces minimal imaging distortion so that visualization of anatomical structure shape and size is close to accurate. CBCT imaging uses tomography reconstructed through projections from the opposite direction through the rotation of cone-shaped x-ray rays (Figure 3) (Ruetters et al., 2020). The position of taking CBCT can be shown on taking panoramic radiography (Figure 4).

The use of CBCT has advantages in imaging dentistry including 3D images that has a high degree of accuracy and easy in image acquisition, lack of appearance of artifacts, lack of exposure to radiation doses (on wide projection objects), lack of distortion and overlapping imaging results and CBCT is highly filtered to evaluate hard tissue in the bones and jaw (Figure 5) (Nardi et al., 2017). The American Academy of Oral Maxillofacial Radiology (AAOMR) states that if oral cavity are found in an emergency where the patient is confirmed to be Covid-19 and requires radiography imaging, then CBCT can be used as an alternative (Cascante-Sequeira et al., 2020). The downside of CBCT is that CBCT imaging results have low contrast and difficulty in identifying soft tissues and the need for a deeper understanding of interpreting anatomy resulting from CBCT imaging (Alamri et al., 2012).

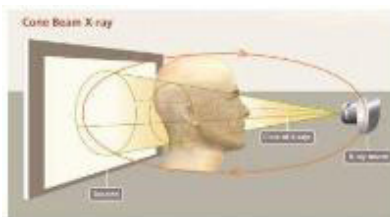


Figure 3. X-ray beam projections on CBCT where the opposite flat-panel source and detector rotate around the patient’s jaw to capture image data in a single loop (Alamri et al., 2012).



Figure 4. The patient’s position during CBCT radiography (Nardi et al., 2017).

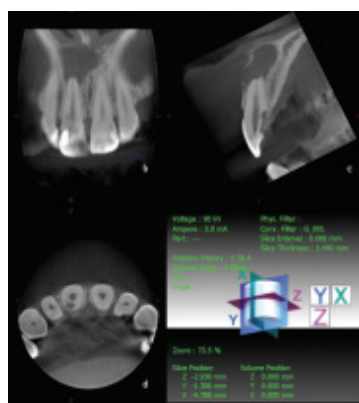


Figure 5. CBCT images from corona (b) sagittal (c) and axial (d) (Dawood et al., 2009).

Extraoral bitewing (EO BW)

The EO BW technique is a developmental form of panoramic engines using two horizontal parallel connections that rotate on the XY axis and move vertically on the Z axis (Figure 6). This technique uses Selective Compliance Assembly Robot Arm (SCARA) technology that developed by Professor Hiroshi Makino of Yamanashi University in 1979 (El-Ela et al., 2016). This technology used a fully programmable 3-axis robot to control the rotation and angles of the radiography beam aimed perpendicularly with the long axis of the patient’s teeth. The radiography program generated bilateral EO BW radiography with 1 movement of the machine. Each EO BW radiography typically captured complete crowns and roots of canines to third molars of both arches (Chan et al., 2018).

The function of using the EO BW technique is to provide a clearer picture of the contact points of premolar and molar teeth in interproximal caries detection (6). Bitewing on a panoramic machine will produce an orthogonal picture by increasing the projection of interproximal angulation. Thus getting a better point of contact than the result of panoramic radiography (Little et al., 2020).

The EO BW technique has advantages including the resulting picture is a clearer picture than panoramic radiography especially in detecting interproximal caries of posterior teeth (Figure 7), radiation doses obtained less than panoramic radiography, can be used in patients with gag reflex complaints, pediatric patients who have difficulty opening the mouth, patients who have difficulty

opening the mouth (Akarslan et al., 2008). In addition, the use of EO BW is very suitable in the circumstances of the Covid-19 pandemic because of the lack of use of intraoral film that can reduce the risk of saliva transmission and oral droplets, but not all panoramic machines can perform EO BW techniques (E Silva et al., 2016).



Figure 6. The position of the skull and mandible during the process of taking radiography images using extraoral bitewing techniques (El-Ela et al., 2016).

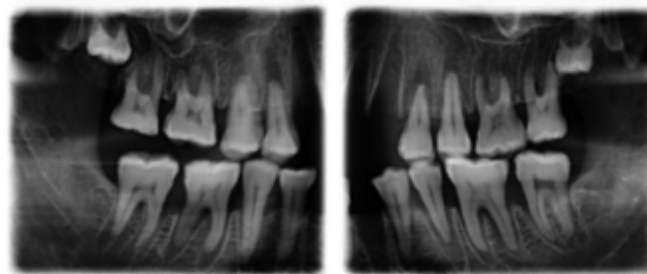


Figure 7. The image of extraoral bitewing (El-Ela et al., 2016)

Extraoral periapical

Extraoral periapical is a technique first developed by Newman and Friedman in 2003 as an alternative in patients who cannot use intraoral periapical techniques. Then this technique was developed by Later Chen et al in 2007 by aligning beam sensor beam (Kumar et al., 2011).

Taking radiography with extraoral periapical techniques by Newman and Friedman has several procedures that must be followed so that the results obtained are minimal errors. Taking in the upper jaw begins by placing the patient sitting upright, the mouth opened as wide as possible to avoid superimposition due to obstruction of x-ray rays from the opposite side, the sensor is placed on the outer surface of the buccal that directly leads to the opening tooth area, placing a cotton roll between the sensor and the buccal to align the x-ray cone is positioned tilted as 55° from horizontal (Figure 8). While, taking radiography in the lower jaw has a different thing than the upper jaw retrieval where the position of the patient's jaw closes but the chin is lifted to avoid superimposition and the x-ray cone is positioned tilted as much as 35° from horizontal (Figure 9) (Saber et al., 2012).

Extraoral periapical techniques have the advantage that they can be used in patients with gag reflex conditions, difficulty opening their mouths, pediatric patients, and disabled patients with growth and developmental disorders. This technique can minimize intraoral sensor sterilization so as to maintain radiography quality and maintain diagnostic information (Dewi & Sitam, 2020), in addition it can also minimize exposure to saliva secretions because there is no need to adapt the film to the patient's oral so as to reduce the risk of exposure of SARS-Cov-2. The disadvantage of this technique is the difficulty of setting the angle of angulation to get good results because each face shape has a different angulation angle due to the race and height of each individual's face. The image resolution obtained is low and cannot be used to get an image of the anterior tooth (Figure 10). This technique is also not suitable to be an evaluation picture in endodontic procedures due to the great

distance from x-ray ray sources and receptors (Kumar et al., 2011).



Figure 8. The position of extraoral radiography intake periapical upper jaw (Kumar et al., 2011).



Figure 9. The position of extraoral radiography intake periapical lower jaw (Kumar et al., 2011).

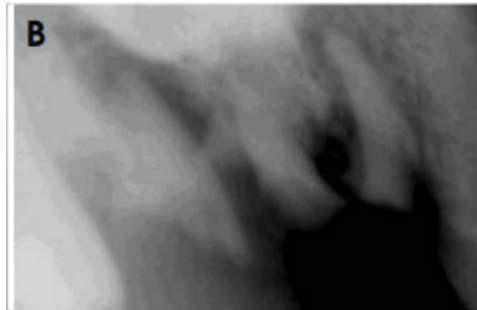


Figure 10. The image of extraoral radiography (Kumar et al., 2011).

DISCUSSION

The Covid-19 pandemic caused by the SARS-Cov-19 virus has changed the order of human life, not least dentistry activities. Dentistry activities can not be separated from exposure to aerosols scattered on airbornes and saliva droplets, while one of the transmissions of SARS-Cov-19 virus is from aerosols and saliva droplets. The dental activities that impacted during the Covid-19 pandemic are dental radiology that serves to assist dentists in the enforcement of diagnosis. Meanwhile, dental practitioners have a high risk of transmission of the SARS-Cov-19 virus (Little et al., 2020).

Dental radiography is divided into two types, including intraoral radiography and extraoral radiography. Intraoral radiography has a high potential in SARS-Cov-19 transmission due to the involvement of saliva droplets in the placement of film in the patient's oral cavity, while extraoral radiography has minimal risk because it does not require the placement of film in the patient's oral cavity. Several world dentistry organizations including Indonesia have suggested making extraoral radiography an alternative during the Covid-19 pandemic (Lubis & Rahman, 2020).

Extraoral radiography that can be used as an alternative during the Covid-19 pandemic include panoramic, Cone Beam Computed Tomography (CBCT), extraoral bitewing (EO BW) and extraoral periapical. Extraoral radiography consisting of panoramic, Cone Beam Computed Tomography (CBCT), extraoral bitewing (EO BW) and extraoral periapical. It is evident in the lack of exposure to saliva droplets during the retrieval process compared to intraoral radiography that requires placement of film in the patient's oral cavity. Extraoral radiography places a projection film outside the patient's oral cavity so it can minimize salivary droplet intakes between the dental practitioners and patients (Dave et al., 2020). Some extraoral radiography techniques are a developed by previously existing techniques, including extraoral periapical radiography. Extraoral periapical radiography was a developed by Newmann and Friedman who were initially as an alternative in patients with difficulty opening their mouths and having gag reflexes. The placement of the film in this technique is on the cheeks of patients with cotton rolls as a buffer to align the placement of x-ray sensor, so this technique can be used as an alternative during the Covid-19 pandemic. However, the drawback of this technique is that the difficulty in determining the angle of x-ray angulation and the resolution of the imaging is also low (Kumar et al., 2011). Panoramic and extraoral bitewing (EO BW) have the same principle in radiography techniques where the position of the patient's head is perpendicular and the film and x-ray beam projection will rotate. Extraoral bitewing is a modification of the system contained in the panoramic imaging machine. The results obtained specifically can interpret interproximal caries in the posterior tooth. Meanwhile, panoramic imaging interprets the whole from the curve of the upper jaw and lower jaw teeth. The disadvantage of both techniques is the existence of a superimposition image produced and not all panoramic machines that have the ability to use extraoral bitewing techniques (Akarslan et al., 2008). CBCT is an extraoral radiography which is the process of x-ray projection on CBCT is placed outside the patient's oral cavity, where the opposite flat panel source and detector rotate around the patient's jaw to capture image data in one round. So, this technique can be used as an alternative during the Covid-19 pandemic. This technique is able to provide 3D imaging that serves to see the details of hard tissue abnormalities in the jaw and bones. However, the results resulting from CBCT techniques have low contrast and need more knowledge and understanding to interpretation radiography results (Cascante-Sequeira et al., 2020).

In accordance with the direction of the world dental organization during the Covid-19 pandemic that all patients who come to dental health services have a risk of SARS-Cov-19 transmission. The use of dentistry radiography is only in emergencies and recommends using extraoral radiography as an alternative during the Covid-19 pandemic. However, the use of extraoral radiography cannot make it a substitute for intraoral radiography. There needs to be knowledge for dentistry practitioners about accuracy in selecting the type of radiography of each case and the availability of tools.

CONCLUSION

SARS-Cov-19 spreads directly, indirectly, or in close contact through the secretion of saliva and respiratory droplets released from those infected and become aerosol contamination. Air contamination caused by aerosols is mostly obtained from dentistry activities, one of them is intraoral radiography. Intraoral radiography has a higher risk of SARS-Cov-19 transmission due to saliva contamination than extraoral radiography. The placement film on extraoral radiography is outside the oral cavity and can minimize saliva contact when placing film between dental practitioners and patients. Therefore, the dental radiology activities were filtered using extraoral radiography during the Covid-19 pandemic. The extraoral radiography that can be an alternative to the lack of saliva contamination during the Covid-19 pandemic are panoramic, Cone Beam Computed Tomography (CBCT), extraoral bitewing (EO BW) and extraoral periapical. However, extraoral radiography can not replace the accuracy of intraoral radiography but some of these options are expected to be an alternative for dental practitioners especially in the selection of radiography types during the Covid-19 pandemic.

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