Available online at https://journal.rescollacomm.com/index.php/ijbesd/index

International Journal of Business, Economics and Social Development

e-ISSN 2722-1156
p-ISSN 27722-1164

Vol. 4, No. 4, pp. 279-286, 2023

Technical Error Factors on Panoramic Radiographic Examination at the Radiology Installation of Unjani Dental and Mouth Hospital

Surdiyah Asriningrum[1*], Ismayanti Sudrajat[2], Mely Meliawati[3]

[1]*Department of Politeknik Al Islam Bandung, Bandung, Indonesia*
[2,3]*Department of Unjani Dental and Mouth Hospital, Bandung, Indonesia*

**Corresponding author email: surdiyahningrum@gmail.com*

Abstract

Panoramic is a three-dimensional curved zone where anatomical structures are well defined on panoramic radiography. Panoramic radiography includes a detailed anatomy of the jaw complex with some superimpositions and distortions that can be exacerbated by technical errors in image acquisition as well as many extra-jaw anatomical structures that are able to give clear descriptionto interpretate. Therefore, in obtaining a panoramic radiograph it is necessary to obtain the desired structure with high quality and minimal distortion. Errors that often occur in producing good panoramic radiographs are technical errors or when positioning the patient and during thepanoramic examination. The purpose of this study was to determine the main factors causing the errors so that technician can produce good quality radiographs, take into account patient placement at the time of examination, perform film processing, and handle general film procedures. The research method used was a quantitative method with a descriptive observational approach. The number of samples was 64 radiographs, which are adult patients over 18 years old with the use of exposure factors in the range of 60kV, 10mA and 16.4s. All radiographs were taken by qualified radiographers with more than 5 years ofexperience. The radiographs were viewed and observed without any modification on a computed radiography monitor screen. Radiographic results will be evaluated by experienced technician who have worked more than 5 years. Evaluation is obtained by analyzing the data descriptively inthe form of assessment of the percentage of rejection of panoramic radiographs to make conclusions. Out of the 2418 panoramic radiographs viewed, 2354 (97%) radiographs had no errors while 64 (3%) radiographs showed one or more positioning error. The most common positioning error observed in the radiographs was failuer to position chin tipped high (56.02%). Whereas the least common error recorded were movement and apron shadow (1.15%).

Keywords: Radiography, Panoramic, Film quality

1. Introduction

The use of X-ray radiation in panoramic examinations has very short wave properties and has high transferable energy through the interaction of atoms. The nature of X-rays is able to penetrate solid objects although with different levels. With the interaction of the ionization process, there will be radiation effects on the body, both stochastic and non-stochastic (Haring & Jansen, 2000).

In the process of panoramic imaging, the x-ray tube and film move simultaneously around the patient during the exposure. During exposure the movement of the x-ray tube and film moves in opposite directions which is called Tomography (Haring & Jansen, 2000). Panoramic radiography aims to view images of facial structures which include the maxillary and mandibular arches and their supporting structures such as the maxillary antrum, nasal fossa, temporomandibular joint, styloid process, and hyoid bone in one film (White & Pharoah, 2014). This examination can yield diagnostic information that is difficult to obtain on intra-oral examination such as evaluation of trauma, impacted third molars, extensive dental, bone disease, extensive lesions, out-of-place tooth growth, retained teeth or edentulous patients.), temporomandibular joint (TMJ) and abnormal growth (White & Pharoah, 2014).

Panoramic images include complex jaw anatomy with multiple superimpositions and distortions which can be exacerbated by technical errors in acquiring the image as well as depicting many anatomical structures outside the jaws which may lead to additional interpretations. The interpretation of panoramic radiography begins with an understanding of the normal anatomy of the head and neck (Perschbacher, 2012).

The use of digital imaging in panoramic examinations can minimize tool processing errors. Therefore, proper patient positioning and preparation is essential to produce sharp, accurate, and undistorted images that are not affected by *shadow ghost*. Panoramic radiographic artifacts may contain radiopaque spots and radiolucencies which are reflections of various structures in the area examined as well as soft tissue shadows and anatomical air spaces making

patient positioning all the more important. Inaccuracies in patient positioning lead to discrepancies between horizontal and vertical magnification, with consequent image distortion (Dhillon *et al.*, 2012). This is in accordance with the results of a study conducted by and Dhillon, *et al* in India in 2012 found on panoramic radiograph results, 55.7% was a failure of the tongue position against the palate and also in a study conducted by Bagherpour in Iran in 2012 2018, 94.8% found that the tongue was not on the palate.

Based on preliminary observations at UNJANI Oral and Dental Hospital, the researchers found that the panoramic radiographs were rejected due to an incorrect head position that was not straight and the position of the tongue not attached to the palate which caused the results of the film to contain artifacts, the position of the head that was too down or too up.

2. Literature Review

2.1. Panoramic Radiography

Advances in radiology technology have developed from conventional systems to digital imaging systems. The use of digital radiography in the scope of radiology services makes radiograph results more detailed but still has to pay attention to radiographic quality including contrast, density, sharpness and distortion

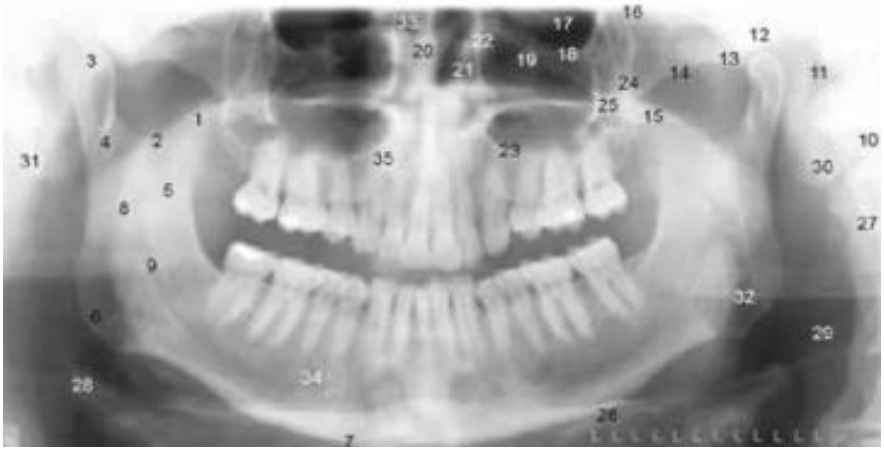

Figure 1: Anatomical panoramic radiograph (Ruth et al, 2021)

Description images:

1. Coronoid process
2. Sygmoid notch
3. Mandibular condyle
4. NeckCondyle
5. Ramus Mandible
6. Angulus Mandible
7. Lower border of mandible
8. Lingula
9. Mandibular canal
10. Mastoid process
11. MAE
12 .Glenoid fossa
13. Articular Eminence
14. Zygomatic
15. Pterygoid plates
16. Pterygomaxillary fissure
17. Orbital
18. Inferior Orbital Rim
19. Infraorbital canal
20. Nasal septum
21. Inferior turbinate
22. Medial wall of maxillary sinus
23. Lower border of maxillary sinus
24. Posterolateral wall maxillary sinus
25. Malar Process
26. Hyoid bone
27. Cervical vertebrae 1-4
28 . Epiglottis
cavity 29. Soft tissue of neck
30. Auricula
31. Styloid process
32. Oropharyngeal air space
33. Nasal air space
34. Foramen mentale
35. Hard palate

Panoramic radiography or Orthopanthomography is a photo technique used to produce a tomographic image showing facial structures that include the maxillary arch and the Mandible and its supporting structures with minimal distortion and overlap, of detailed anatomy on the contralateral side (Ruth et al., 2021).

Panoramic images include complex jaw anatomy with multiple superimpositions and distortions which can be exacerbated by technical errors in acquiring ga image as well as depicting many of the anatomical structures outside

the jaws which may give rise to additional interpretations. The interpretation of panoramic radiography begins with an understanding of the normal anatomy of the head and neck (Perschbacher, 2012).

Other structures of the head and neck that are present in the image, in the form of overlapping hard and soft tissues and airways, create superimposed shadows that can cause errors in interpretation.

2.2. Working Principle of Panoramic Radiography

In panoramic imaging, the x-ray tube and film are connected and rotate simultaneously around the patient during the exposure. The point of the axis around which the receptor and the head of the x-ray tube rotate is called the center of rotation. Modern panoramic x-ray units use a continuous motion of a center of rotation rather than some fixed center location (Figure 2).

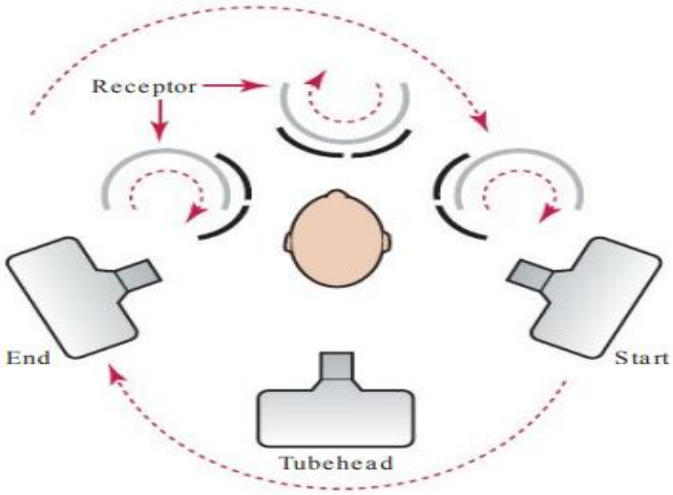

Figure 2: The working principle of the panoramic, tube and receptor rotate simultaneously around the patient (Lannucci et al., 2013)

This change in rotation allows the image layer to adjust to the elliptical shape of the dental arch. The x-ray tube and movable receptor produce an area known as the focal through which is used to determine where the dental arch should be positioned to obtain the sharpest image (Figure 3). Structures that are located inside the focal through appear quite clear on panoramic images, while structures that are outside the focal through appear blurry or unclear and are not easily visible on panoramic images (Lannucci et al., 2013).

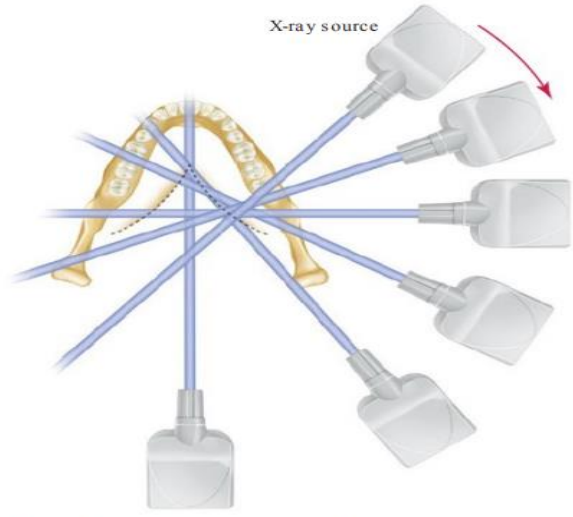

Figure 3: The center of rotation of the X-ray axis which moves continuously as the tube head and receptors rotate around the patient (Lannucci et al., 2013)

In this radiographic technique, the position of the patient is very important to ensure quality final images and focus on the teeth and bone structure surrounding alveoli. Therefore, successful panoramic radiography requires careful patient positioning and proper technique. Proper technical procedures require the patient to be in an upright position with the neck extended, shoulders down, back straight and feet together. In addition, a Frankfort plane

parallel to the ground and a median sagittal plane perpendicular to the ground should be established with a chin brace on the anterior lobe of the chin with the tongue resting on the roof of the mouth (Figure 4) (Rondon et al., 2014).

Figure 4: Patient position on panoramic radiography device

Panoramic radiographs are widely used for screening patients prior to dental prosthesis treatment, to ensure the presence or absence of roots, cysts, foreign bodies, and neoplasms. Measurement of the horizontal direction on panoramic radiographs can be used for tumor treatment plans, evaluation of bone conditions after tumor treatment and jaw fractures, as well as evaluation of TMJ and mandible conditions associated with suspected jaw development anomalies (hyperplasia or mandibular hypoplasia). Panoramic radiographs can be used for extensive radiographic examinations in the maxillomandibular area (Shahidi et al., 2018).

2.3. Panoramic Errors

According to White & Pharoah (2014) panoramic films *rejected* is as follows:

A. Errors in patient preparation

Errors in patient preparation, including:

a. Not removing jewelry, such as earrings, necklaces and piercings;
b. Not removing dentures;
c. Not removing orthodontic appliances;
d. Do not take off the glasses;
e. Improper use of apron.

B. Incorrect patient positioning

Incorrect patient positioning, including:

a. The position of the spine is not straight;
b. Incisors not biting the bite block properly (front fault);
c. Not using a light beam marker that is used to ensure the vertical midsagittal plane and the head is not rotated (horizontal error);
d. Do not use a light beam marker that is used to ensure a horizontal Frankfort plane (vertical error);
e. Failure to instruct the patient to place the tongue against the roof of the mouth (air shadow error);
f. Failure of patient to instruct to remain still during exposure.

C. Equipment position errors

Equipment position errors include:

a. Failure to adjust the height position adjustment correctly;
b. Failure to set exposure factor;
c. Failure to place tape properly.

Examples of common patient preparation and positioning errors:

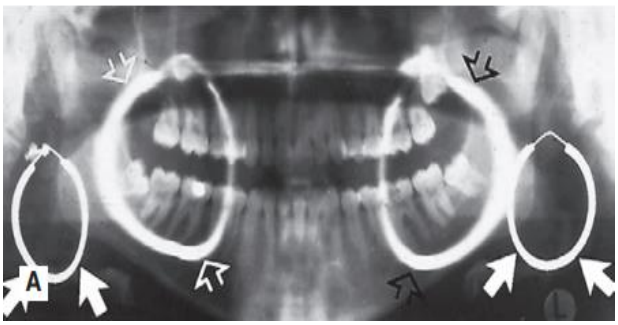

Figure 5: Failure to remove large ring

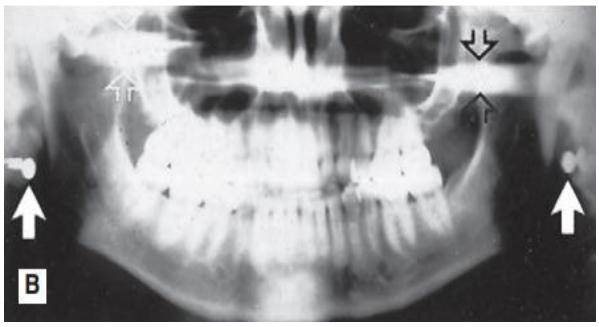

Figure 6: Failure to remove stud earring resulting in horizontal shadows and ghost shadows

Figure 7: The position of the patient is too close to Image Receptor

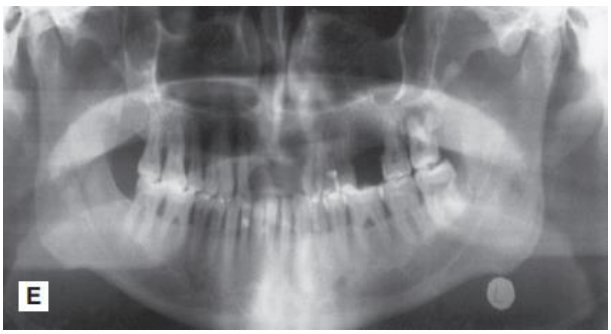

Figure 8: Patient position asymmetry

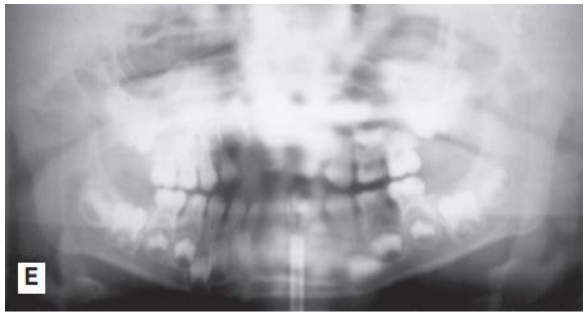

Figure 9: Sudden side to side horizontal movement

Figure 10: Horizontal movement at the end of exposure causes the third molar lesion to elongate (arrow)

Based on the observation results, the repetition of panoramic photos in the digital imaging process, errors due to film processing can be eliminated but the most errors are caused by operator errors during patient positioning and patient preparation.

3. Material and Methods

Based on the problems studied, the method used in this research is descriptive observation method with a quantitative approach.

This study was carriedd on 64 panoramic radiograph that were taken from January to October 2022 in the Unjani Dental and Mouth Hospital. Panoramic examination entirely uses a panoramic Digital technician aircraft brand Soredex Minray Finland, with the use of 66kV kV, 10mA and 16.4s. This examination is carried out by technician who have worked for more than 5 years. The radiograph results are then analyzed.

The assessment of the frequency of errors consisted of the position of the patient's chin tipped high, the head was too close to the IR, Head position is too backward patient, Low Density, Image Artifact, Image Apron Shadow and movement (Figure 11-17). The results of the radiograph can be viewed on a computer screen and then an assessment is made of whether the radiograph results are acceptable or not.

Figure 11: The patient's chin tipped high the space curve is flat.

Figure 12: Too close to the IR, the spine is in front near the mandibular ramus.

Figure 13: Head position is too backward, ghost image of the spine on the anterior teeth.

Figure 14: Low Density

Figure 15: Image Artifact

Figure 16: Image Apron Shadow

Figure 17: Image Movement

Table 1: Positional errors and manifestations on radiograph results

Position error	Manifestation of radiograph results
Chin too high	Maxillary incisors opaque, hard palate resting on root, occlusal plane flat, mandible broad and flat, condyle at film margin
Patient's head too close to IR	Front teeth blurry, too small and narrow, spine visible on film side
Position of head too far from IR	Front teeth blurry and wide, ghosting of mandible and spine, condyles close to edge of film
Apron shadow	Radiopaque shadow over the anterior part of the mandible
artifact	Ghost shadow in the middle of mandible
Low density	Radiograph with high kontras
Movement	Portion of radiograph are blurred

4. Results and Discussion

4.1. Resuts

Out of the 2418 panoramic radiographs viewed, 2354 (97%) radiographs had no errors while 64 (3%) radiographs showed one or more positioning error. The most common positioning error observed in the radiographs was failuer to position chin tipped high (56.02%). Whereas the least common error recorded were movement and apron shadow (1.15%) can seen in the Table 2.

Table 2: Shows the frequency distribution of common errors observed in the sample studied.

Positioning errors	Number	%
Chin tipped high	47	54.02
Patient positioned forward	17	19.54
Patient positioned backward	12	13.79
Low density	7	8.05
Movement	1	1.15
Artifact	2	2.30
Apron shadow	1	1.15

The radiographs free of positioning errors and therefore classifiable as ‘excellent’ using the recommended criteria were 2359 (97%). 56 (87.5%) were ‘diagnostically acceptable’, containing errors which did not detract from the diagnostic utility of the radiograph. The remaining 8 (12.5%) were ‘unacceptable’ can see Table 3.

Table 3: Quality assessment of 2418 panoramic radiographs examined in the study

Quality	Number	%
Excellent	2354	97.35
Diagnostically acceptable	56	2.32
Diagnostically unacceptable	8	0.33

4.2 Discussion

The radiograph panoramic evaluated in the present study were gathered from inactive patient files from the Department of Unjani Dental and Mouth Hospital, Bandung for the purpose of assessing positioning errors and quality in panoramic radiography. In this study, processing and handling errors were not considered since the radiographs were taken from a digital panoramic. The high frequency of positioning errors was striking. Another explanation was that the patients sometimes might misunderstand the instructions or the patients did not pay much attention to the instruction given by the technician, instructs the head to be in an upright position but the head is tilted back. In this study, this error was found in Chin tipped high (54.02%) of the radiographs. While in studies by Dhillon et al. (2012) The most common error observed was the failure to position the tongue against the palate (55.7%). In a study by Glass et al. the highest error reported the same with our studies was a high chin position (Bagherpout et al., 2018).

5. Conclussion

In conclusion, positioning errors are common in panoramic radiographies. Based on our findings, the most common positioning error was chin is placed too high. The need for training for technician, better communication with the patient, and spending time in patient positioning could decrease the number of errors and help produce high quality radiographs. Carrying out this film rejection analysis.

Acknowledgments

We would like to thank the technician in the department of Unjani Dental and Mouth Hospital, Bandung, Indonesia

References

Bagherpour A, Iman MK, Atie Safaee. (2018). Common positioning errors in digital panoramic radiographies taken in Mashhad dental school. Journal of dental materials and technique. (Vol.7, pp 89-96)

Dhillon, M., Raju, S. M., Verma, S., Tomar, D., Mohan, R. S., Lakhanpal, M., & Krishnamoorthy, B. (2012). Positioning errors and quality assessment in panoramic radiography. *Imaging science in dentistry*, *42*(4), 207-212.

Haring, J. I., & Jansen, L. (2000). *Dental radiography: principles and techniques*. WB Saunders.

Lannucci Joen M., Laura Jansen Howerton. (2013). *Dental radiography: principles and technique*, 5th ed, Churchill Livingstone Elsevier.

Perschbacher, S. (2012). Interpretation of panoramic radiographs. *Australian dental journal*, *57*, 40-45.

Rondon RHN, Yamba CLP, Glauce CDN. (2014). *Common positioning errors in panoramic radiography: A review*, Imaging Science in densitry. vol 44, pp 1-6.

Ruth MSMA, Agung Sosiawan. (2021). *The role of panoramic radiography in the field of forensic odontology*, Ed.1, CV Anugerah Imprenta.

Shahidi, S., Zamiri, B., Abolvardi, M., Akhlaghian, M., & Paknahad, M. (2018). Comparison of dental panoramic radiography and CBCT for measuring vertical bone height in different horizontal locations of posterior mandibular alveolar process. *Journal of Dentistry*, *19*(2), 83.

Whaites, E., & Drage, N. (2013). *Essentials of dental radiography and radiology*. Elsevier Health Sciences.

White, S. C., & Pharoah, M. J. (2014). *Oral radiology-E-Book: Principles and interpretation*. Elsevier Health Sciences.