IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 22, Issue 12 Ser.6 (December. 2023), PP 01-06
www.iosrjournals.org

Evaluating Positional Errors In Digital Orthopantomogram – A Retrospective Study

Dr. Niveditha B[1], Dr. Sarumathi T[2], Dr. Vigneshwaran J[3], Dr. Kavitha M[4], Dr. Suvetha V[5], Dr. Pragatheeswari R[6]

[1](MDS, Associate Professor, Department Of Oral Medicine And Radiology, Madha Dental College And Hospital, Chennai, Tamil Nadu, India)
[2] (MDS,Msc,Phd, Professor And Head Of The Department, Department Of Oral Medicine And Radiology, Madha Dental College And Hospital, Chennai, Tamil Nadu, India)
[3] (Postgraduate Student, Department Of Oral Medicine And Radiology, Madha Dental College And Hospital, Chennai, Tamil Nadu, India)
[4] (MDS, Professor, Department Of Oral Medicine And Radiology, Madha Dental College And Hospital, Chennai, Tamil Nadu, India)
[5] (MDS, Senior Lecturer, Department Of Oral Medicine And Radiology, Madha Dental College And Hospital, Chennai, Tamil Nadu, India)
[6] (Postgraduate Student, Department Of Oral Medicine And Radiology, Madha Dental College And Hospital, Chennai, Tamil Nadu, India)

Abstract:
Orthopantomogram(OPG) have been used in almost all fields of dentistry. Improper positioning of the patient reduces the diagnostic usefulness of these radiograph.
Aim and objectives*: The aim of the present study is to evaluate common positioning errors using OPG images and to assess the influence of age in these errors in order to prevent further occurrence in radiology departments.*
Material and methods*: 210 digital OPG images of patients aged between 10 to 80 years were analysed. Based on age, the OPG's were grouped into; 10-20 years, 21-50 years and, 51-80 years. The images were assessed for common 10 positioning errors.*
Results*: Only 16.7% radiographs did not show any positioning error. Patient's tongue not fully placed against the roof of the mouth followed by ghost image of spinal column due to slumping is most seen positioning errors in the 10- 20 years compared to group I and group II. There is no statistically significant influence of age on positioning errors.*
Conclusion*: Reducing positioning errors is necessary to reduce exposure to radiation, treatment cost, patient time and delay in treatment planning.*
Keywords: *OPG, Orthopantomography, diagnostic imaging, positional errors*

Date of Submission: 12-12-2023 Date of Acceptance: 22-12-2023

I. Introduction

Panoramic imaging, also called as Orthopantomography or OPG, have been used in almost all fields of dentistry. This unique extraoral view allows the dentist to view the entire dentition and related structures, including both the maxillary and mandibular arches and their supporting structures from condyle to condyle in a single topographic image[1].

However, capturing a wide range of structures on a single film makes it prone to unequal magnification and geometric distortion across the image. Occasionally there is presence of overlapping structures in OPG such as cervical spine that can hide lesions in the anterior region of maxilla and mandible[2,3,4]. Improper positioning of the patient complicates it more, reducing the diagnostic usefulness of these radiograph. Moreover, in cases without enough diagnostic quality, radiographs must be retaken, which results in receiving unnecessary radiation by the patients. This necessitates the need to identify and minimize these positional errors in order to improve the diagnostic quality of the radiograph and thereby, increasing the accuracy of diagnosis and appropriate treatment to the patient.

The aim of the present study is to evaluate common positioning errors using OPG images and to assess the influence of age in the occurrence of these errors.

II. Material and methods

In the present retrospective study, the study sample included were 210 digital OPG images of patients aged between 10 to 80 years. The digital OPG radiographs were collected from the Oral Medicine and Radiology Department, Madha Dental College and Hospital, Kundrathur. The Digital OPG radiographs were taken between January 2020 and March 2023. All the digital OPG radiographs were taken by PLANMECA PROMAX machine with three laser positioning guides [antero-posterior, vertical, and mid-sagittal alignment lights] and in pre-set settings of scan time one minute 20 seconds, exposure time 3 seconds/ projection, 30 seconds totally and exposure values 66- 85 kV/6-10 mA.

OPG of patients below 10 years of age and patients with completely edentulous arch were excluded from the study. Patients with developmental anomalies, syndromes, ankyloglossia, radiographic evidence of trauma and surgery in body of mandible and, radiographic evidence of tumors of body of mandible region were excluded from the study.

The processing and handling errors were not considered since the radiographs were taken from a digital panoramic machine with digital printing. The OPG's were grouped into three equal groups based on age of the participant; group I-age group 10-20 years, group II- 21-50 years and, group III -age group 51-80 years. Both males and females were included in the study.

The reconstructed images were assessed with DICOM. The OPG images were assessed by a single maxillofacial radiologist for common 10 positioning errors (Er1 to Er10); anteriorly positioned, posteriorly positioned, head tilted downwards, head tilted upwards, head twisted to one side, head tipped, overlapping of spine in lower anterior region, tongue not placed close to palate, patient movement, and ghost images. (Table 1). OPG's with no errors were grouped as NEr.

The observations were tabulated and the positioning error in each of the image was recorded in Microsoft Excel spreadsheet and analysed using SPSS software (IBM SPSS Statistics, Version 20.0, Armonk, NY: IBM Corp.). Descriptive statistics were used for data summarization and presentation. P value of 0.05 were considered to be statistically significant. Chi-square test was used to compare frequency distribution of Errors between age groups.

Table 1; Common 10 positioning errors in OPG[5]

S.no	Errors
Er1	Anterior teeth in both arches are out of focus, blurred, and narrow, and spine superimposed over ramus — patient positioned too forward in relation to image layer (fig.2)
Er2	Anterior teeth of both arches are out of focus, blurred, and wide in appearance, and excessive ghosting of mandibular spine —patient positioned too far back in relation to the image layer
Er3	Patient head tilted downwards, chin back positioned, and forehead in front — blurring of lower root apices, shadow of hyoid bone on anterior mandible, condyles cut-off, "v" shaped mandible, and spine forms arch or "gazebo" effect
Er4	Patients head tilted upwards, chin placed forward, and forehead tilted toward the back — blurring of upper incisors, hard palate superimposed on roots, flat occlusal plane, mandible is broad and flat, and condyles at edge of film
Er5	Patients head is twisted in machine causing midline asymmetry. The teeth and ramus on one side of mandible appear wide and larger than other side
Er6	Patients head is tilted or tipped in machine — image tilted, one angle of mandible higher than other, condyles not equal in height
Er7	Ghost of spinal column due to slumping — white tapered opacity in middle of image [Washington Monument shape] (fig.1A)
Er8	Patients tongue was not fully placed against the roof of the mouth — dark shadow in maxilla below the palate. Maxillary apices obscured. (Fig.1B)
Er9	Patient movement during exposure — blurred image with step defect
Er10	"Ghost images," reflected images — artifacts
NEr	No Error

Fig.1; A-Ghost of spinal column due to slumping — white tapered opacity in middle; **B-**Patients tongue was not fully placed against the roof of the mouth — dark shadow in maxilla below the palate

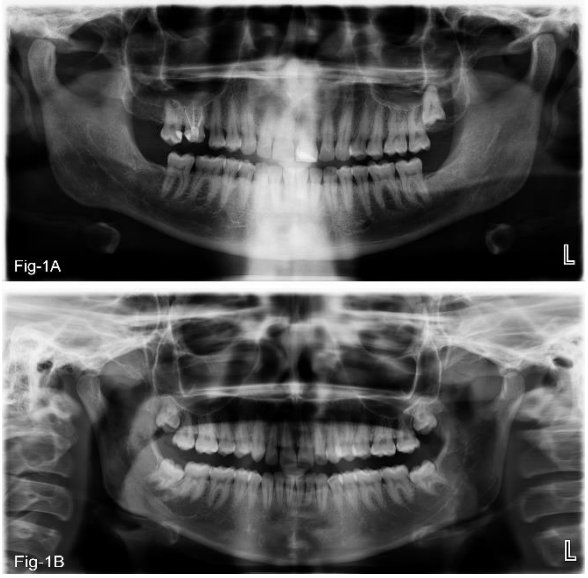

Fig.2; Patient positioned too forward in relation to image layer

III. Results

The study sample of 210 OPG's were grouped into three equal groups based on age. In group I, patients of age 10-20 years (N=70) were included with a mean age of 16.41 years. Group II and group III includes 21-50 years (N=70; mean age=34.30 years) and 51-80 years (N=70; mean age=58.64 years) respectively.

The study sample consisted of 96 females (45.71%) and 114 males (54.29%). On evaluation of the gender distribution in the study sample, group I consisted of 32 males (45.7%) and 38 (54.3%) females. Group II included 38 males (54.3%) and 32 females (45.7%), whereas 44 (62.9%) males and 26 (37.1%) females were included in group III. Chi-square test was performed and a result of 4.14 was obtained.

Out of the 210 panoramic radiographs analyzed, 16.7% (N=35) radiographs did not show any positioning error and were grouped as NEr. The remaining 83.3% (N=175) radiographs showed one or more positioning errors. The most common positioning error was patient's tongue not fully placed against the roof of the mouth (Er 8) followed by ghost image of spinal column (Er 7) due to slumping were noticed in 28.1% (N=59) and 24.3% (N=51) respectively. The least noticed error was due to patient movement during exposure (Er9) in 2.4% (N=5) of the total study sample. Patient positioned too forward in relation to image layer (Er1) were noted in 3.8% (N=8) of the study OPG's with statistical significance. (Table 2)

Table 2: COMMON POSITIONING ERRORS IN STUDY SAMPLE

ERROR	AGE GROUPS			TOTAL	CHI-SQUARE TEST VALUE	P VALUE
	10-20 Years n(%)	**21-50 years n(%)**	**Above 50 years n(%)**			
Er1	1(1.4%)	1(1.4%)	6(8.6%)	8(3.8%)	6.49	0.03*
Er2	8(11.4%)	7(10.0%)	4(5.7%)	19(9.0%)	1.50	0.47
Er3	5(7.1%)	3(4.3%)	6(8.6%)	14(6.7%)	1.07	0.58
Er4	5(7.1%)	5(7.1%)	7(10.0%)	17(8.1%)	0.51	0.77
Er5	8(11.4%)	7(10.0%)	10(14.3%)	25(11.9%)	0.63	072
Er6	6(8.6%)	8(11.4%)	7(10.0%)	21(10.0%)	0.31	0.85
Er7	16(22.9%)	16(22.9%)	19(27.1%)	51(24.3%)	0.46	0.79
Er8	24(34.3%)	18(25.7%)	17(24.3%)	59(28.1%)	2.02	0.36
Er9	2(2.9%)	1(1.4%)	2(2.9%)	5(2.4%)	0.41	0.81
Er10	3(4.3%)	10(14.3%)	4(5.7%)	17(8.1%)	5.50	0.06
NEr	16(22.9%)	11(15.7%)	8(11.4%)	35(16.7%)	3.36	0.18

On evaluating the common positioning errors based on age groups, Er8 followed by Er7 is most seen positioning errors in the group I (10- 20 years). The least common positioning errors in this age group were Er1 followed by Er10. The least seen positioning error in group II (21-50 years) is Er1 and Er9, whereas the commonly seen error is Er8 in 25.7% of the study sample. On analysing the OPG's in group III, the most seen positional error was Er7 (27.1%, N=19) followed by Er8 (24.3%, N=17). the least commonly noted error in group III were Er9 with prevalence percentage of 2.9% (N=2). No positioning errors were seen in 22.9% (N=16), 15.7% (N=11), and 11.4% (N=8) in group I, II and III respectively.

IV. Discussion

OPG is a unique tool being used in various disciplines of medicine and dentistry for diagnosis and treatment planning of diseases. Changes in the quality of radiographs may mislead the interpretation, resulting in incorrect diagnosis and treatment planning. A non-diagnostic quality image often requires a need for supplementary images and a repetition of examinations. Moreover, repeating the radiograph may lead to unnecessary radiation exposure to the patient. Increasing the diagnostic efficacy of the OPG is done by reducing the positional errors.

In our study various errors were observed on panoramic radiographs. Out of the 210 panoramic radiographs analyzed, while 83.3% (N=175) radiographs showed one or more positioning errors, 16.7% (N=35) of radiographs did not show any error. The most common positioning error was patient's tongue not fully placed against the roof of the mouth (ER 8). This was followed by ghost image of spinal column (ER 7) due to slumping and it was noticed in 28.1% (N=59) and 24.3% (N=51) respectively. The least noticed error was due to patient movement during exposure (Er9) which accounted to 2.4% (N=5) of the total study sample. Patient positioned too forward in relation to image layer (Er1) was noted in 3.8% (N=8) of the study OPG's with statistical significance of 0.03.

Manu Dhillon et al[5] conducted a similar study with 1,782 OPG's and the most common positioning error observed in the radiographs was failure to position the tongue against the palate (993, 55.7%) which is in concordance with the results obtained in our study. Another study conducted by Granlund CM et al.[6], Subbulakshmi A C et al.[7] and Newadkar UR et al.[8] also yielded similar results indicating the improper positioning of the tongue against the palate. The cause of occurrence of this error in increased frequency may be due to language barriers or lack of communication between the dental technician and the patients who may find difficulty in instructing the patients to swallow and to keep the tongue in the roof of the mouth. Hence the dental technician/radiographer should improve his/her communication skills which plays a pivotal role in minimizing the errors to a large extent. Sometimes patients may misunderstand the instructions, putting only the tip of the tongue on the palate, or the patients do not pay much attention to the instructions given by the technician.

The ghost image of spinal column (ER 7) due to slumping was the second most common error encountered in our study which was similar to the study conducted by Manu Dhillon et al.[5]. It is due to the fact that there was a natural tendency for participants of our study, to slump when holding the handles of the machine. Hence dental technician needs to be certain before taking the radiograph that the patient's back and spine are erect with the neck extended to minimize the occurrence of this error.

In our study, the error of patient positioned too forward (3.8%) was both clinically and statistically significant. Overzealous nature of patients in positioning themselves beyond instructed resting position on the

bite block may be the reason for this error. On evaluation based on the age group, the Er1 was most commonly seen in age group 51-80 years (N=6, 8.6%) compared to age group II and III. The higher prevalence of this error may be because individuals in this age group have difficulty to follow the instructions given by the radiographer due to aging, and other medical ailments. Postural changes due to aging also play a role in patient forward positioning. Possible technical issues that cause errors might be due to factors like unskilled or improperly trained radiographer, technician shortage, support staff inexperience, improper equipment, limited reporting time, excess work load, missed attention to detail due to frequent repeating of same task. On contrary to our study, this was the most common frequent error in the result obtained by P Poornachitra et al.[9]. This may be due to the unawareness of the radiographer as laser positioning guides doesn't get altered when head placed too far forward.

Age wise analysis:

In our study, the age range was divided into 3 groups; Group I -10-20 with mean age of 16.41 years, Group II-21-50 with mean age of 34.30 years and Group III -51-80 with mean age of 58.64 years. Age group of 10-20 showed more error free OPGs (16 OPGs) when compared to other 2 groups. The lesser number of OPG's with positional errors in 10-20 years age group may be due to higher care in positioning the children compared to the adults. However, there is no statistically significant influence of age on positioning errors. Er8 followed by Er7 is the most seen positioning errors in the group I (10- 20 years) compared to group II and group III. However Er10 and Er9 were found to be less common than in group I compared to other two groups. No studies in literature have compared the positional errors within age groups. However, there is no statistically significant influence of age on positioning errors.

The positional errors in OPG appear to be more common than anticipated. This common event can be avoided based on the ability of the patients to follow the instructions given by the radiographer. Hence care should be taken in delivering instructions individually to each patient to ensure that they comprehend and follow easily.

Recommendations to improve the quality of Orthopantomogram and minimize errors:

With regards to the patient positioning the following simple steps could be put into practice with uniformity:

Patient positioning[10]

Patient preparation and positioning can prevent most of the positioning errors in panoramic radiography. It is more important to perfect the panoramic patient positioning technique, than to make unnecessary repeat exposures. Hence models/charts could be prepared demonstrating the patients of the following standing positions:

Midsagittal plane: The midsagittal (horizontal) plane is positioned perpendicular or at a right angle to the floor and centered right to left.

Occlusal plane: The plane of occlusion (vertical) is positioned parallel to the floor. The Frankfort plane, Tragal-canthus plane, and the Ala-tragus plane are used to align the vertical position of the head.

Anteroposterior plane: The anteroposterior plane is aligned between the maxillary lateral incisor and canine contact.

Pre-exposure instructions: Proper positioning of tongue and lips and remaining still during the exposure.

If there is a language barrier between the technician and the patient, the technician must make sure that an interpreter delivers the instructions to the understanding ability of the patient.

V. Limitations

This study had been conducted only within this dental institute in Chennai population, by only one observer. In future, further studies could be expanded as multicentric study in a larger population of variant demographics.

VI. Conclusion

The positioning errors found on panoramic radiographs were relatively common in our study. Relatively the quality of panoramic radiographs could be improved by operator skill, careful attention to patient positioning and better communication with the patient. This is necessary to reduce exposure to radiation, treatment cost, patient time and delay in treatment planning.

References

[1]. Cosson J. (2020). Interpreting An Orthopantomogram. Australian Journal Of General Practice, 49(9), 550–555. Https://Doi.Org/10.31128/AJGP-07-20-5536

[2]. Klaassen K, Ferreira Da Costa J, Murphy A (2019). Orthopantomography. Reference Article, Radiopaedia.Org,

Https://Doi.Org/10.53347/Rid-67987
[3]. Whaites E. The Quality Of Radiographic Images And Quality Assurance: Principals Of Radiographic Interpretation. 3rd Edition. Longman Group UK Limited: Elsevier; C2002. P. 179-93.
[4]. White And SC, Pharaoh MJ, Panoramic Imaging: Oral Radiology Principles And Interpretation. 5th Ed. Westline Industrial Drive, St. Louis. Missouri: Mosby Elseiver; C2008. P. 191-209.
[5]. 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. Https://Doi.Org/10.5624/Isd.2012.42.4.207
[6]. Granlund CM, Lith A, Molander B, Gröndahl K, Hansen K, Ekestubbe A. Frequency Of Errors And Pathology In Panoramic Images Of Young Orthodontic Patients. Eur J Orthod. 2012;34:452-57.
[7]. Subbulakshmi AC, Mohan N, Thiruneervannan R, Naveen S, Gokulraj S. Positioning Errors In Digital Panoramic Radiographs: A Study. J Orofac Sci. 2016;8:22-26.
[8]. Newadkar UR, Chaudhari L, Khalekar YK. Common Errors On Panoramic Radiograph: A Time To Reflect And Review And Not To Sweep Them Under The Carpet! SRM Journal Of Research In Dental Sciences. 2016;7:146.
[9]. Poornachitra P, Uma Maheswari TN, Jayanth Kumar Vadivel. Prevalence Of Errors In Fundamentals Of Patient Positioning In Digital Orthopantomogram. Journal Of Clinical And Diagnostic Research. 2022 May, Vol-16(5): ZC35-ZC39
[10]. Farman AG. "Panoramic Radiology" Getting The Most Out Of Panoramic Radiographic Interpretation. Berlin, Heidelberg: Springer-Verlag; 2007. P. 1-14.