

# EVALUATION OF PATIENT PREPARATION AND POSITIONING ERRORS ON DIGITAL PANORAMIC RADIOGRAPHS

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## ABSTRACT

*Dental panoramic radiograph, in addition to clinical examination, is a valuable diagnostic tool for the dentist to obtain information. Quality of each radiograph is of supreme importance. Unsatisfactory quality of radiograph can lead to misinterpretation that may result in inadequate diagnosis and treatment plan. Good quality radiograph will avoid any further need of repeating radiograph, thus reducing any unnecessary exposure of ionizing radiation to the patient. The objective of this study was to determine the relative frequency of common preparation and positioning errors observed on dental panoramic radiographs & to assess quality of radiographs as well. Dental panoramic radiographs were obtained from pretreatment records of patient undergoing orthodontic treatment & each radiograph was assessed for preparation and positioning errors. A three point quality scale proposed by National Radiological Protection Board was used by the examiner to rate each radiograph as being excellent, diagnostically acceptable or diagnostically unacceptable. Out of 480 panoramic radiographs examined, 100 (21%) radiographs were free from any type of preparation or positioning error while 380 (79%) radiographs had some preparation or positioning errors. The most frequent preparation error observed was patient wearing nose pin (8.3%). While the most common positioning error observed was patient's failure to position tongue against the palate (62.5%). More than one positioning or preparation error was found in 41.6% of the faulty radiographic films. Only 21% of radiographs were rated excellent, 64.5% were diagnostically acceptable, and 14.5% were unacceptable. Quality of panoramic radiograph must be assessed regularly making sure that they are free of any preparation or positioning error. All dental professionals must identify patient preparation and positioning errors and must understand consequence of these errors on diagnostic yield of radiograph.*

**Key Words:** Panoramic Radiograph, Quality Control, Preparation & Positioning Errors.

## INTRODUCTION

Panoramic radiograph is an important tool which is used in multiple disciplines of dentistry for diagnosis and treatment planning of various oral and dental problems.<sup>1</sup> It is used for evaluation of trauma to jaws, location & angulations of third molar, diagnose any developmental anomaly or underlying pathology, analysis of root angulations during and after orthodontic treatment, assess growth and developmental changes in dentition of children and adolescent patients, eval-

uate temporomandibular joint (TMJ) & assess general status of patient dentition.<sup>2</sup> As panoramic radiograph is extra oral radiograph, it can be valuable in patients with limited mouth opening.<sup>3,4</sup> But when compared with intraoral radiographs like periapical or bitewings, panoramic radiographs produces less sharp and less accurate image & are not very useful in detecting early caries & periodontal disease.<sup>5</sup> Quality of any radiograph depends on correct patient preparation & positioning followed by selecting suitable exposure parameters.<sup>6</sup> As processing errors have been minimized by the use of digital processing techniques, the operator must pay special attention on patients preparation and positioning for a sharp and undistorted image.<sup>7</sup> Panoramic radiographs contains image of various underlying anatomical structures, making patient positioning even more crucial. Poor quality of dental panoramic radiograph will reduce its significance in making appropriate diagnosis.<sup>8</sup> Ensuring good quality of dental panoramic radiograph will prevent any misinterpretation leading to incorrect diagnosis & treatment planning.<sup>2</sup> A radiograph which

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TABLE 1: SUMMARY OF COMMON PREPARATION & POSITIONING ERRORS IN DENTAL PANORAMIC TOMOGRAPHY AND THE RESULTING FAULT(S) ON THE FILM<sup>16</sup>

<b>PATIENT PREPARATION ERROR</b>	<b>FILM FAULT</b>
Patient Wearing; 1. Earrings, 2. Jewellery 3. Necklace, 4. Spectacles, 5. Prosthesis Or Orthodontic Appliances	Presence Of Artefactual Shadow Of The Offending Object On Radiograph.
<b>PATIENT POSITIONING ERROR</b>	<b>FILM FAULT</b>
<b>Patient Positioning Errors in Horizontal Plane</b>	
1. <b>Patient Positioned Far Backward</b> Patient is positioned Away From Image layer (Film).	<ul style="list-style-type: none"> <li>• Upper &amp; lower anterior teeth appear magnified and out of focus.</li> </ul>
2. <b>Patient Positioned Too Forward</b> Patient is positioned too Close To Image layer (Film).	<ul style="list-style-type: none"> <li>• Upper &amp; lower anterior teeth appear narrow &amp; fuzzy.</li> <li>• Spine superimposed on ramus area.</li> <li>• Premolars severely overlapped.</li> </ul>
<b>Patient Positioning Errors in Vertical Plane</b>	
3. <b>Patient's Chin Raised Too High</b> Patient head is titled upward. Forehead is positioned backward while chin is positioned forward.	<ul style="list-style-type: none"> <li>• Flat or reverse occlusal plane.</li> <li>• Mandible is broad and flat.</li> <li>• Increased intercondylar distance.</li> <li>• Magnified and out of focus anterior teeth.</li> </ul>
4. <b>Patient's Chin Tipped Too Low</b> Patient head is titled downward. Forehead is positioned forward while chin is positioned back.	<ul style="list-style-type: none"> <li>• Excessive curvature of occlusal plane (smile line).</li> <li>• Mandible is V shaped.</li> <li>• Decreased intercondylar distance.</li> <li>• Narrow and out of focus anterior teeth.</li> </ul>
<b>Patient Movement During Exposure</b>	
5. <b>Patient Movement During Radiation Exposure</b>	<ul style="list-style-type: none"> <li>• Blurring and distortion of the part of image produced at the time of the movement.</li> </ul>
<b>Slumped Position</b>	
6. <b>Neck Of The Patient Not In An Erect Position</b>	<ul style="list-style-type: none"> <li>• Ghost image of the cervical vertebra producing white opacity in the anterior region.</li> </ul>
<b>Tongue Positioning Error</b>	
7. <b>Failure To Position The Tongue Against The Palate</b>	<ul style="list-style-type: none"> <li>• Radiolucency between palate and dorsum of tongue.</li> <li>• Root apices of maxillary teeth are obscured.</li> </ul>
<b>Patient Positioning Errors in Midsagittal Plane</b>	
8. <b>Head Of The Patient Twisted/ Rotated</b> Head of patient is rotated to either right or left side (Patient positioned asymmetrically)	<ul style="list-style-type: none"> <li>• Structures away from the film are magnified and closest to the film are minified.</li> <li>• Posterior teeth are wide on one side and narrow on the other.</li> <li>• Height and width of condyles are not normal.</li> </ul>

TABLE 2: SUBJECTIVE QUALITY RATING OF RADIOGRAPHS BY NATIONAL RADIOLOGICAL PROTECTION BOARD<sup>11</sup>

1. <b>Rating1</b>	<b>Excellent</b> - No errors in patient preparation and positioning.
2. <b>Rating2</b>	<b>Diagnostically Acceptable</b> - Some errors in patient preparation and positioning, but which do not detract from the diagnostic utility of the radiograph.
3. <b>Rating3</b>	<b>Diagnostically Unacceptable</b> - Errors which render the radiograph diagnostically unacceptable.

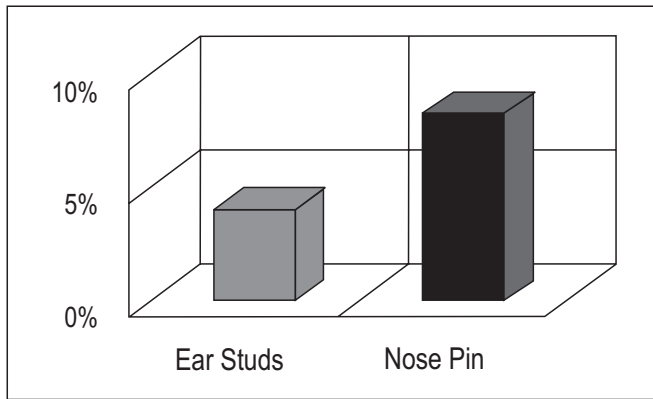


Fig 1: Frequency distribution of common preparation errors in the studied sample

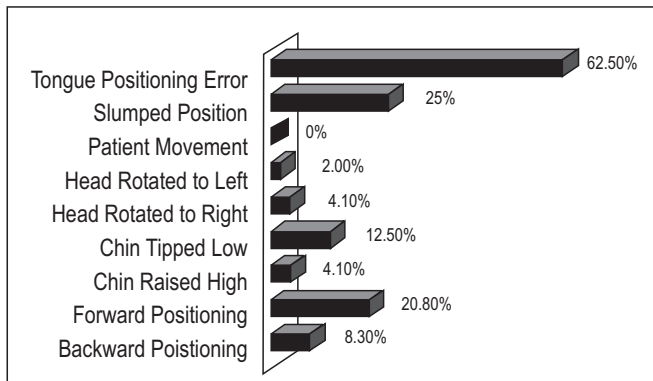


Fig 2: Frequency of distribution of common positioning errors observed in the studied sample.

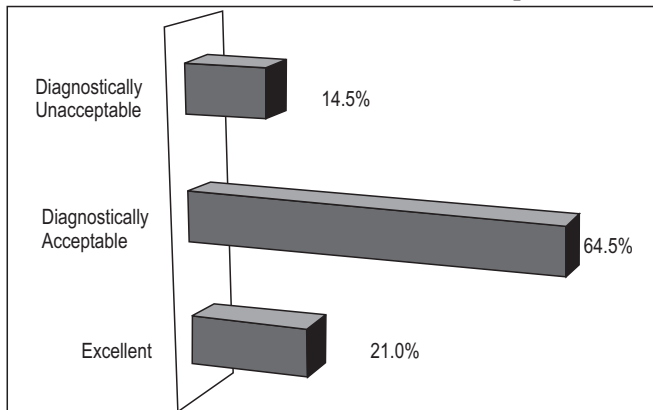


Fig 3: Subjective quality rating of radiographs in studied sample

is diagnostically unacceptable is useless and needs to be repeated.<sup>9,10</sup> Despite all the precautionary measures taken, repetition of panoramic radiograph will expose patient to ionizing radiation again, which involves risk of inducing cancer.<sup>11-13</sup> Diagnostically unacceptable radiographs are generally due to operators fault and negligence to prepare and position patient correctly at the time of exposure.<sup>14,15</sup> Literature review showed that no study has been done in Pakistan to determine common patient positioning and preparation errors on dental panoramic radiographs. The main objectives of

this study were:

- 1 To assess panoramic radiographs for common patient preparation and positioning errors.
- 2 To rate quality of each panoramic radiographic image using three point quality scale proposed by National Radiological Protection Board.<sup>11</sup>

## MATERIAL AND METHODS

All pretreatment digital panoramic radiographs of patients with permanent dentition, presenting to Orthodontic Department from January 2013 to June 2014, were assessed and examined in this study. The frequency of patient's preparation and positioning errors were recorded. The radiographs were viewed & assessed by the single examiner, under identical conditions, for patient preparation and positioning errors according to criteria summarized in Table 1.<sup>16</sup> A three point quality scale proposed by National Radiological Protection Board was used by the examiner to rate each radiograph (Table 2).<sup>11</sup> Intra-examiner reliability was tested by re-examining random panoramic radiographic images a month after initial assessment to ensure the diagnostic consistency. Data tabulation and analysis was done using SPSS 20 software (SPSS Inc., Chicago, IL., USA).

## RESULTS

Out of the 480 panoramic radiographs examined, 100 (21%) radiographs had no errors while 380 (79%) radiographs showed one or more preparation or positioning error. The most common preparation error was patient wearing nose pin (8.3%) followed by patient wearing ear studs (4%). Fig 1 shows the frequency distribution of common preparation errors observed in the studied sample. The most common positioning error observed on radiographs was failure to position the tongue against the palate (62.5%) whereas the least common positioning error recorded was patient movement during exposure (0%). Fig 2 shows the frequency distribution of common positioning errors observed.

Using the recommended criteria by National Radiological Protection Board of United Kingdom<sup>11</sup>, 100 (21%) of the panoramic radiographs assessed were free from any type of preparation or positioning errors and therefore were classified as 'excellent'. 310 (64.5%) were 'diagnostically acceptable', containing errors which did not detract from the diagnostic utility of the radiograph. The remaining 70 (14.5%) were 'unacceptable' (Table 3).

## DISCUSSION

In dental panoramic tomography, minor positioning errors can cause image distortion as its focal plane has limited dimensions. The quality of each radiograph is

of supreme importance as radiographic results may be impaired if any error is introduced during patient preparation & positioning or processing of radiograph. Errors in radiographic image may result in reduced diagnostic benefits that may require repeating radiograph resulting in patient exposure to unnecessary ionizing radiations. Operators must pay special attention in minimizing patient preparation and positioning errors, as most of the processing errors have been minimized by the introduction of digital radiography. But despite all the efforts, some errors are inevitable due to patient's physical stature, facial asymmetry or inability to comply with the instructions while taking radiograph. Dental professionals while making a treatment plan, must be aware of these anatomical variations, understand all these inevitable errors and account for the changes to the best of their experience & clinical expertise.

Current study revealed that 79% of radiographs examined had one or more patient preparation and positioning errors in them thus reducing the diagnostic yield of these radiographic images. The most common positioning error was due to failure of patient to place tongue on the palate (62.5%). Result of various other studies conducted around the globe also showed tongue positioning error to be the most frequent positioning error on dental panoramic radiograph.<sup>17-20</sup> Another study conducted by Bissoon & Whaites<sup>21</sup> reported tongue positioning error as the most common error observed in the dental hospital sample while in private dental practice sample head rotation was found to be the most common error observed followed by tongue positioning error.

Failure to position tongue against the palate may either result from failure of operator to instruct the patient to place the tongue on the palate or as a result of patient misunderstanding operator's instruction and putting only the tip of the tongue on the palate. This error results in dark shadow in the maxilla below the palate obstructing the apices of maxillary teeth.

A ghost image of the cervical spines is superimposed at the centre of the film in patients who are in slumped position while taking radiograph. While holding the handles of the machine, there is natural tendency for patient to slump. Before taking radiograph, operator needs to be certain that patient neck is extended with erect back and spine. In this study this error was found to be the second most frequent error observed on 25% of radiographs, which is slightly higher than reported by Akarslan et al<sup>17</sup> (22.17%) but less frequent than that reported by Dhillon et al<sup>20</sup> (35%).

Errors in horizontal plane resulting either from backward or forward positioning of the patient in relation to image layer were encountered on 29% of radiographic films which are lower than those reported

by Rushton et al<sup>6</sup> (58.8%). These errors can either be due to miscommunication between operator & patients or can be due to patients or operators underestimation of the importance of proper positioning. In this study forward positioning (20.8%) of the patient was more prevalent than backward positioning (8.3%). Dhillon et al<sup>20</sup> reported that backward positioning of the patient (30%) was more prevalent than forward positioning (18.3%).

More than one positioning or preparation error was found in 41.6% of the faulty radiographic films, which could be attributed to spending insufficient time on patient preparation and positioning.

Good quality radiograph not only aids in diagnosis, but it also maximizes the benefits to the patient by reducing the radiation risk and the financial outlay. In order to maximize the diagnostic yield of every radiograph, National Radiological Protection Board of United Kingdom proposed a three point quality scale.<sup>11</sup> A radiograph with no errors in patient preparation and positioning receives rating "1" while radiograph which has some errors, but it does not detract from the diagnostic utility of the radiograph receives rating "2". Radiograph that has major errors which render the radiograph diagnostically unacceptable receives rating "3". Results of our study showed that 21% radiographs were rated excellent (grade 1) while 64.5% radiographs were diagnostically acceptable (grade 2) & 14.5% radiographs were diagnostically unacceptable (grade 3). "Guidance Notes for Dental Practitioners on the Safe Use of X-ray Equipment"<sup>22</sup> recommends that grade 1 radiographs should not be less than 70%, while grade 3 radiographs should not be more than 10%.

Results of our study are similar to previous studies conducted around the globe.<sup>6,20,23</sup> Achieving targets recommended by Royal College might prove to be a considerable challenge as most of the radiographs (79%) in our study exhibited some preparation or positioning fault. But if proper steps are taken then these targets are attainable as in our study only 14.5% radiographs were diagnostically unacceptable, which fell below the results of studies conducted by Dhillon et al<sup>20</sup> (24.9%), Brezden & Brooks<sup>23</sup> (18.2%) & Rushton et al<sup>6</sup> (33%).

The higher frequency of preparation and positioning errors on dental panoramic radiographs clearly reveals that there is a much larger problem than expected and calls into question the standards of operator training in dental radiology. Understanding of patient preparation and positioning errors and their consequence on the diagnostic yield of dental panoramic radiograph is required to minimize unnecessary X-ray exposure.

## RECOMMENDATIONS

Undergraduate curriculum for dental students must include Radiology as a separate subject and all



dental students must receive training in dental radiography which must be sufficient enough for them to be the sole teachers of dental radiography to their staff. Without properly trained operators, dental panoramic radiograph can be equated to photograph taken by amateur photographer. Currently in Pakistan there is no specific legislation that makes training mandatory or outlines the training requirements of operators of dental radiography. One possible reason for the lack of legislation could be due to the fact that problems in field of radiology have never been highlighted.

## CONCLUSION

Dental panoramic radiograph will deliver great value to the patients if all the operators are properly trained and remain up-to-date with latest developments in the field of radiology. Spending time on patient positioning, skills of operator & better communication between patient & operator are some factors that could help in decreasing number of errors and aid in producing high quality radiographs.

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