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Positioning errors in digital panoramic radiographs- A retrospective analysis

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ABSTRACT

Objectives of this paper are to analyze the most prevalent positioning errors in panoramic radiographs. 560 OPG taken from January 2016 - January 2017 in the department of maxillofacial radiology were assessed by two maxillofacial radiologists for positional errors. All radiographs were viewed on a computer monitor using the OHP sheet to demarcate the 6 zones. Results 74 radiographs (11.97%) were error-free and 486 radiographs (88.13%) were with errors. The radiographs with single positional error were 423 (84.3%). The radiographs with 2 positional errors were 57(9.89%). The radiographs with 3 positional errors were 6 (1.04%). The outcome of the analysis reveals that the percentage of positioning errors in panoramic radiographs is fairly high reducing its diagnostic value. Technicians are made aware of the errors and are instructed to recheck the patient position before taking radiographs. A similar audit will be repeated on a regular basis to check the change in the prevalence of positional errors.

Keywords— Panoramic radiograph, Positioning error, Diagnostic quality

1. INTRODUCTION

A panoramic radiograph provides an overview of both dental arches and a close view of a large number of anatomical structures such as the maxillary sinuses, Temporo-mandibular joints (TMJ) and hyoid bone. [1] Simple technique, easy and quick processing with a minimal amount of radiation to patient and operator are the reasons for its developing popularity. [2]. Panoramic images are useful clinically for diagnostic problems that require broad coverage of jaws. [3] Positioning of the patient not in accordance with accepted standards complicates it further and thus diminishing the diagnostic usefulness of these radiographs. Recognizing the positioning errors is important in the interpretation of panoramic radiographs. The current study was done as a quality check on our technique of taking radiographs.

The aim of this study is to analyze the most prevalent positioning errors in panoramic radiographs.

2. MATERIALS AND METHODS

From the stored patient data files of the radiology department of our institute, 560 digital panoramic radiographs were selected in a random manner. Each one of the radiographs was taken by the same technician with an experience of 8 years during the period of January 2016 - January 2017 using Planmeca digital panoramic machine operating at 68 kVp, 11 mA with an exposure time of 18 s. The exclusion criterion of this study includes radiographs of children less than 14 years of age, edentulous patients and patients with fracture of jaws.

The selected radiographs were imported to a laptop (HP laptop with a 14.1-inch screen, 1280 × 800 screen resolution, 32-bit colour mode) and were displayed and viewed under optimal brightness and contrast. OHP (Over Head Projection) sheet on which lines were drawn horizontally and vertically to simulate the 6 zones as described by Langland and Langlais was attached to the laptop monitor (figure 1). [1]

Each one of the radiographs was evaluated by two oral and maxillofacial radiologists with an experience of 9 & 10 years for the positioning errors. Data were analyzed using the statistical package for the social sciences 15.0 software.

3. RESULTS

560 patients' panoramic radiographs were evaluated for the presence of positioning errors. Of these 74 radiographs (11.97%) were error-free and 486 radiographs (95.3%) were with errors. The radiographs with single positional error were 423 (84.3%). The radiographs with two positional errors were 57(9.89%). The radiographs that contained three positional errors were 6 (1.04%). The most typical error observed (table 1) was the patient's chin is tipped too high (16.8%) (Error 4), followed by the head is twisted/rotated (21.1%) (Error 5). The least frequent error observed was positioning the patient too forward in relation to the focal trough.

4. DISCUSSION

There has been a marked increase in the use of panoramic radiography in private practice, in hospitals and within the community dental services. A panoramic dental x-ray uses a very small dose of ionizing radiation to capture the entire mouth in one image. It is commonly performed by dentists and oral surgeons in everyday practice and may be used to plan treatment for dentures, braces, extractions and implants.

In this study, the OHP sheet used on the monitors ensured that none of the errors was missed out and further it helped in standardizing the technique.

The focal trough is a three-dimensional curved zone or image layer where the structures lying within this zone are reasonably well defined on final panoramic image and it is important for obtaining high-quality images. Objects outside this zone of sharp focus are blurred, magnified or reduced in size. The final quality of the image is related to both the position of the patient during the exposure and the accuracy of the jaw position within the image layer.

From the 560 panoramic radiographs evaluated, the most typical error observed was "Chin is tipped too high" (16.8%) (Figure 2). This result is almost identical to the other studies.^[5] To rectify this error the vertical plane of occlusion should be positioned parallel to the floor.

The second most common error in this study was "Patients head twisted/rotated" (12.13%). This result is similar to the other studies.^[6, 7] Rotation of the head hinders the diagnostic interpretation. Proper attention must be paid to the position of the light beam marker for the midsagittal plane before the exposure is accomplished.

The third error was "Patient tilted to one side" (11.97%) (Figure 3) which is in accordance with the study by Granlund *et al.*^[8] The fourth most common error was "chin tipped too low" (11.65 %) (Figure 4). Constricted arches, closer appearance of the condyles and cut off from top of the film will give an overall appearance of a "Cheshire cat grin" due to the accentuated curve of speed.^[9] The error can be rectified by positioning the midsagittal plane perpendicular or at a right angle to the floor and centred right to left.

In this study "Patient is positioned too backwards" (Figure 5) was the fifth common error (10.51%) and the least common error was patient is positioned too forward (7.92 %). This result was in agreement with Subbulakshmi, *et al* study.^[2]

The sixth common error was "Tongue not resting on the palate" (9.7%) (Figure 6). This error has been reported to be the frequent panoramic error in other studies.^[10] It is due to the superimposition of the air shadow above the tongue on the apices of the maxillary teeth.^[3]

The seventh error was "Patient is slumped" (8.9%) (Figure 7). A ghost shadow on the midline created by the superimposition of an increased mass of cervical spine. This shadow obscures the entire symphyseal region of the mandible. When holding the handles of the machine the patient naturally slumps. Before taking the radiograph the operator should ensure that the patient's back and spine are erect with the neck extended. In this study, slumping was seen in only 8.9 % of the radiographs, which is less common than the result obtained by other studies.^[10, 11]

Many times, multiple errors occurred in one radiograph (Figure 8). The radiographs with two positional errors were 57(9.89%) and radiographs with three positional errors were 6 (1.04%). Although most of the positional errors can be avoided by rechecking the position before exposure and repetitive instructions to the patient, there are few reasons that are beyond the operator's control like facial asymmetry, short and heavy neck, over-weight patients, unusually tall patients and patient's inability to follow the instructions due to language barrier.^[6]

5. CONCLUSION

Numerous factors may lead to a reduction of the diagnostic quality of panoramic radiographs. Patient positioning errors are one among them. The outcome of the analysis reveals that the percentage of positioning errors in panoramic radiographs is fairly high reducing its diagnostic value. Technicians are made aware of the errors and are instructed to recheck the patient position before taking radiographs. The similar audit will be repeated on a regular basis to check the change in the prevalence of positional errors.

6. REFERENCES

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APPENDIX

Abbreviations

OHP: Over Head Projection

Table 1: Percentage distribution of positioning errors in panoramic radiographs

	Positioning Errors	n (%)
Error 1	The patient is positioned too forward	7.92
Error 2	The patient is positioned too backward	10.51
Error 3	Chin is tipped too low	11.65
Error 4	Chin is tipped too high	16.8
Error 5	Patient's head is twisted	12.13
Error 6	Patient is slumped	8.9
Error 7	Tongue is not on the palate	9.7

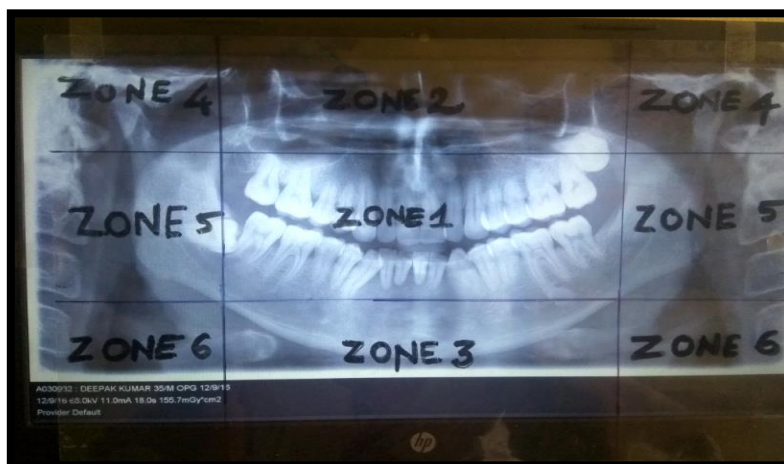


Fig. 1: Six zones according to Langland and Langlais

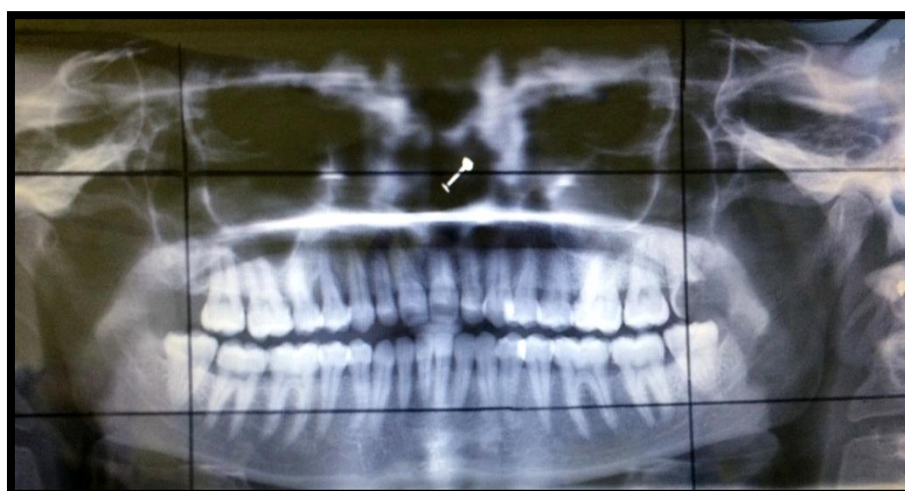


Fig. 2: Patient's chin is tipped too high bring about the appearance of a wide "grimace"



Fig. 3: The Patient head is tilted towards the left side



Fig. 4: Chin tipped too low leading to excessive curving of the occlusal plane with loss of the image of the roots of the lower anterior teeth



Fig. 5: Patient is positioned too backward



Fig. 6: The tongue not resting on the palate



Fig. 7: In slumped position superimposition of the cervical spine on the anterior region noted



Fig. 8: Multiple positional errors