

## IMAGE QUALITY ASSESSMENT OF ORTHOPANTOMOGRAMS

Mioara Decusară, Viorica Milicescu

“Carol Davila” University of Medicine and Pharmacy, București, Romania

### ABSTRACT

Orthopantomography examination is a method of dental and maxillofacial radiology and consists of a panoramic image, the overall of a dental arches, the elements supporting the teeth, the maxillofacial skeleton and the related anatomical structures (maxillary sinus, nasal complex, temporomandibular joints, etc.), recorded on a large format radiographic film. Practitioners that recommend orthopantomograms should be aware and had knowledge about radiation doses, risks to patients, previous exposure history, so as to affect the patient less. To achieve a high-quality image of orthopantomogram need special attention to the correct positioning of the patient, followed by the optimal processing of the radiograph. Many deviation from the correct panoramic technique can lead to the production of a low quality of orthopantomograms and this may compromise or prevent the diagnosis.

**Key words:** orthopantomograms, quality image, errors.

### INTRODUCTION

Orthopantomogram consists of a series of sequentially narrow tomograms scanned into the detector (film, storage phosphor or digital) resulting a complete view of both dental arches and their adjacent structures with minimal distortion and with minimal overlap of anatomic details from the contralateral side. As any other radiographic method, optimum interpretable diagnostic images can be achieved only if the following criteria are met: correct patient positioning, selecting appropriate exposure parameters and correct processing or film handling [4].

The aim of this paper is to outline the range of problem that can affect panoramic image quality and to emphasize the importance of identifying the causes that generated poor quality of orthopantomogram.

325 orthopantomograms of treated patients in the author's private dental practice were analysed, taking into account the following typical quality criteria of ideal image [5, 6]:

- Alveolar processes with all upper and lower teeth must be clearly represented;

- The image should show the entire mandible, including TMJ;
- The dimensions of anatomical structures in vertical and horizontal plan must be „relatively” equal and symmetrical;
- The right and left molars should be equal in size;
- Density image appearance should be uniform, free of air over the tongue, with the appearance of transparent tape (black) over the roots of upper teeth;
- The image of hard palate must be appear above the apices of upper teeth;
- The ghost images (artefacts) of the cervical spine and mandibular angle on the contralateral side must be very little evidenced;
- The panoramic image should not occur artefacts due to dentures or removable orthodontic appliances, glasses, earrings and another jewellery, apron, “forgotten” to the patient;
- Label of patient's identification data does not cover anatomical structures visible on orthopantomogram;

- The patient's identity data must be clearly written and should include patient name and date of examination;
- The image must be clearly marked with the letters **Right** and **Left**. (Fig. 1)

Getting a low quality of orthopantomogram is due to errors caused by incorrect preparation of panoramic machine, incorrect positioning of patient for radiographic exposure and incorrect processing or film handling [5, 7, 8]; these errors will be briefly presented in the following, with examples of panoramic radiographs of author's patients.

**Incorrect preparation of panoramic machine:**

- Inappropriate selection of exposure parameters, depending on physical constitution (weak, athletic, overweight) and patient age (child, adult); to a low exposure, radiographic images are under-represented, deleted, unclear, and to

overexposure to radiation, the film is dark, with loss of anatomical elements detail (Fig. 2);

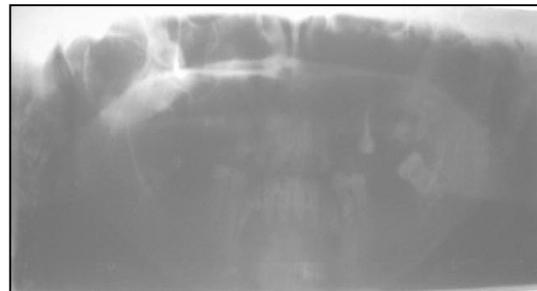
- Incorrect preparation of orthopantomograph device, when the collimators are not set by the size of anatomical area.
- Incorrect handling of port-film cassette or image receptor or using of damages tapes which can penetrate light; it can see gray or dark stripes on radiographic film, scratches or under-represented images of anatomical structures of jaws (Fig. 3).

**Patient preparation errors:**

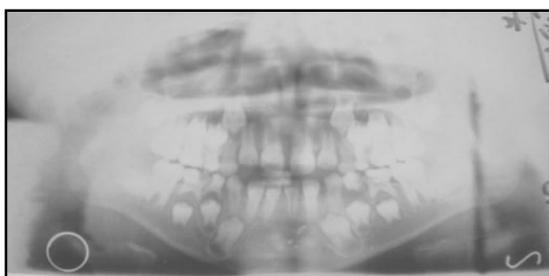
- If the patient did not remove the jewellery (earrings, necklaces, piercings), hairpins, spectacles, dentures and removable orthodontic appliances, they can cause "ghost" images on radiographic film (Fig. 4) or "cover" any existing pathological processes in the area of the sinus (Fig. 5)



**Fig. 1. Correct positioning of patient's head in the panoramic machine (personal casuistry).**



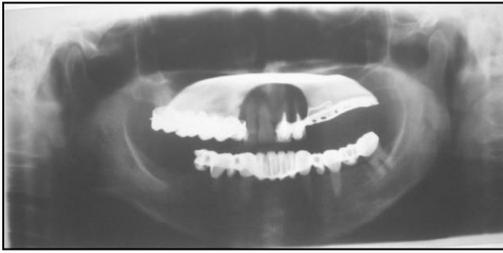
**Fig. 2. Radiological overexposure-dark image and poor representation of anatomical details- (personal casuistry).**



**Fig. 3. Orthopantomogram with black vertical stripes and poor representation of ascending mandibular ramus and TMJ (personal casuistry).**



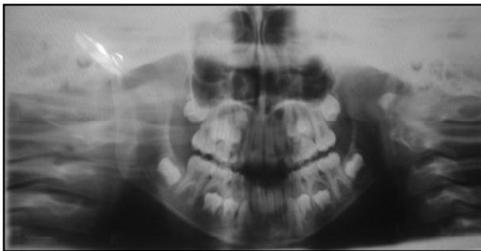
**Fig. 4. Orthopantomogram with patient preparation errors: failure to remove the earrings (which cause "ghost" images of them in the maxillary second molars areas), chin tipped up (vertical error) and head movement during exposure (personal casuistry)**



**Fig. 5. Failure to remove upper metallic partial dentures: are not clearly the maxillary canine-premolar-molar areas, hard palate, inferior walls of sinus. (personal casuistry).**



**Fig. 6. Orthopantomogram with the presence of two radiopaque images, paramedian, represented by the edge of the protective lead apron (personal casuistry).**



**Fig. 7. The patient's head is positioned anterior to the focal trough, producing horizontal demagnification, giving the illusion of missing anterior teeth; note the upward curvature of the occlusal plane and the medial tilt of the ascending mandibular ramus (personal casuistry).**



**Fig. 8. The patient bitten too far back on the bite rod, resulting in an enlarged image of the jaw, with incisors wide and blurry and ghosting of mandible (bilateral, on mandibular ascending ram area) and the cervical spine (a radiopacity in the midline) – (personal casuistry).**



**Fig. 9. Vertical positioning errors: patient's head is tilted downwards, that is, the chin is positioned too low; note the upward curvature of the occlusal plane and the rami are tilted medially- (personal casuistry).**



**Fig.10. Patient's head is in extension and the chin is positioned upwards; note flattened occlusal plane, the palate is superimposed on the apices of the maxillary incisors and the mandibular ascending ramus are tilted laterally (personal casuistry)**

- If the radiological protection apron is placed improperly, extending above the collar, it may appear on the X-ray film, in the mandible body area, of some radioopaque artefacts (Fig. 6)

**Patient positioning errors:**

- If the patient did not bite correct, into the groove of the bite rod, so that the incisors

are in head-to-head position, can result anterior-posterior errors. Thus, when the patient bites too far forward on bite-block, the anterior teeth appear narrow and elongated and cervical vertebrae are more visible on both sides on the film (Fig. 7); when the patient bites too far back on bite rod (back on grooves of bite rod), the incisors appear blurry and wide and the

condyles are near the lateral and top edges of radiographic film (Fig. 8).

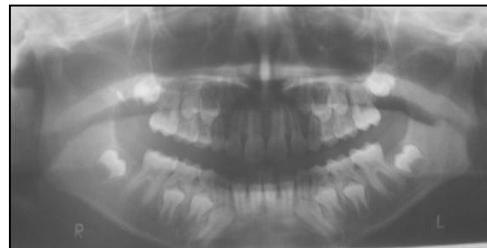
- Improper adjustment of the chin support or incorrect positioning of the patient's chin onto the support, according the guidelines (alar-tragus line), can result a vertical positioning errors. If the chin is tilted far down (head is in flexion), lower incisors roots appear blurred, the mandible is V-shaped, "smile line" is much deepened and mandibular condyles are at the top of the radiographic film (Fig. 9). When the chin is tipped too far up (the patient's head is tilted backwards, in extension), maxillary incisors are blurred, hard palate superimposed on roots, occlusal plane is flattened, mandible is flat and broad (Fig. 10).
- If the patient's head is twisted or rotated, result a midline asymmetry. Thus, the teeth appear wide on one side and narrow on the other side, ascending mandibular

ram is wider on one side than the other and anatomical structures of the nose and are not clear (Fig. 11).

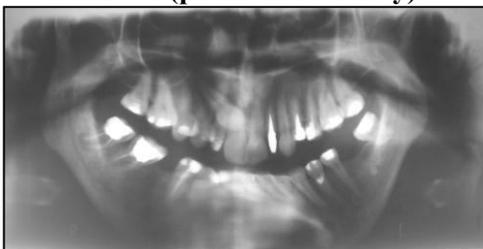
- Failure to instruct the patient to swallow, press the tongue against the roof of the mouth and hold still during the exposure (air shadow error) and this causes the presence on the radiographic film of dark and large shadow over maxillary teeth (Fig. 12)
- Inadequate training of the patient to stand with shoulders straight and to remain still throughout the exposure (approximately 10-15 seconds), resulting in reduced image quality with unclear areas, which not helps establish a full diagnosis and correct treatment plan (movement error) (Fig. 13). Patient movement during exposure may cause on the panoramic radiograph the presence of indentations of the body of the mandible; a similar image is produced when the patient chews gum during the X-ray exposure (Fig. 14).



**Fig. 11.** Due to incorrect positioning of the patient's head (rotated), are not observed ascending mandibular ramus and TMJ of the left part and the cortical mandibular midline (personal casuistry).



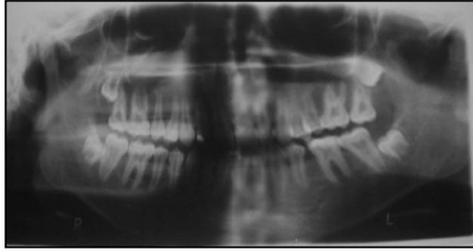
**Fig. 12.** The patient did not swallow and press the tongue against the palate, creating radiolucent areas (round and band) across the film (personal casuistry).



**Fig. 13.** Panoramic radiograph that not allow to clearly be seen the lower anterior teeth and median mandibular basilar edge, because patient's head is tilted downwards, the chin is positioned too low and the patient moved during exposure (personal casuistry).



**Fig. 14.** Multiple vertical movements (personal casuistry).



**Fig. 15. Errors due to incorrect preparation of the patient (with the head slightly rotated) and operator mistakes during exposure (personal casuistry)**



**Fig. 16. Low quality of radiographic image due to the incorrect positioning of the patient and the inadequate chemical processing of film (personal casuistry)**

#### **Errors during exposure due to operator**

- If the exposure settings is changed during the exposure or the cassette is not correctly used (properly inserted in the panoramic machine), it will appear a blurred image with radiolucent areas which overlay some of anatomical structures (Fig. 15).

**Processing or film handling errors** can lead to unclear, washed-out images (when it used for developing the depleted or worn solutions) (Fig. 16) or to very dark images, blurred (when it not use the red filter that prevents awareness of X-ray film from visible green light).

#### **CONCLUSIONS**

The most common failures in obtaining the good quality orthopantomograms are determined by incorrect positioning of the head's patient and the patient to the

panoramic machine, also due to lack of minimum measures to prepare the patient for radiological examination. This leads to deformities, asymmetries and incomplete images of anatomical structures present in the image. Improper preparation of the patient will be reflected, as we illustrated above, in the appearance of artefacts on the image of objects held by the patient. However as panoramic machine performance it cannot fix the errors of patient preparation, exposure, positioning, processing or film handling.

Using this systematic approach to orthopantomogram's image production, the dentist should recognize the problems that can affect panoramic image quality and have the necessary knowledge of how to rectify them, to establish a correct diagnosis and for the minimum patient radiation dose.

#### **REFERENCES**

1. Pasler F.A. Color Atlas of Dental Medicine Radiology, Ed. Thieme, 1993
2. Farman A.G. Panoramic radiology–Seminars on Maxillo-facial Imaging and Interpretation, Ed. Springer, 2007.
3. Milicescu Viorica - Ortopantomograma în practica stomatologică, Curs postuniversitar, Buc., UNAS, iunie 2006.
4. Login S. Tehnică radiologică dentară. Ed. Univ., Buc., 2000.
5. Whaites E. Essentials of dental radiography and radiology. Fouth edition, Churchill Livingstone Elsevier 2007.
6. White SC, Pharoah MJ. Oral Radiology.Principles and Interpretation. Firth Edition. Mosby, St. Louis, 2004.
7. Rushton Vivian E., Rout J. Panoramic Radiology, Quintessence, Londra, 2005.
8. Junfin Glass Birgit – Successful panoramic radiography, 1999.