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Panoramic Dental Radiograph: Interpretation by the Radiologist

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Abstract

Dental panoramic radiography is an extremely popular technique, with more than 2 million films taken annually in the United Kingdom alone. Many radiologists are not familiar with the formal interpretation of dental panoramic radiographs. The purpose of this study is to report our experience in interpretation of dental panoramic radiographs in 50 patients. The study included 30 men and 20 women ranging in age from 6 to 78 years; mean 30 years. Dental panoramic radiographs showed caries in 19 out of 50 (38%) patients, periapical infection in 6 (12%) patients, restorative material in 34 (68%) patients, missing teeth in 18 (36%) patients, and an unerupted third molar tooth in 11 (22%) patients. Periapical infection involved the apex of 8 teeth. There were 16 unerupted third molar teeth in 11 patients (4 teeth were horizontal, 4 vertical, 4 mesioangular, and 3 distoangular, and 1 transverse). Spine-shadow ghost artifact was seen in 15 (30%) radiographs. Nine (18%) radiographs were underexposed. A small opacity was seen adjacent to the angle of the mandible in one patient suggesting a salivary stone. In conclusion, dental panoramic radiography is an extremely common radiological examination. Knowledge of normal radiographic anatomy, notation, and radiographic appearance of common pathological conditions is needed. A systematic approach of interpretation and feedback from the dentists would help radiologists provide maximum diagnostic information.

Introduction and Aim of Work

DENTAL panoramic radiography is an extremely popular technique, with more than 2 million films taken annually in the United Kingdom alone (Murray and Whyte, 2002). The term panorama means "an unobstructed view of a region in any direction", and thus a panoramic film shows the mandible and maxilla on one radiograph. Many radiologists are not familiar with the formal interpretation of dental panoramic radiographs mainly because there is no emphasis on this subject during postgraduate radiology residency programs and the absence of co-operation between dentists and radiologists in clinical practice. The purpose of this study is to report our experience in interpretation of dental panoramic radiographs in 50 patients.

Patients and Methods

The study included 50 patients (30 men and 20 women) ranging in age from 6 to 78 years; mean 30 years. All patients underwent a thorough dental examination as well as a dental panoramic radiograph. Indications for radiographic examination included pain, swelling, diffuse disease, or evaluation of the third molar teeth. All radiographs were evaluated for dental caries, periapical infection, peridontal disease, and radiographic artifacts.

Dental caries was considered when there is a radiolucent area in the tooth compared to the unaffected portion while an acute periapical infection is diagnosed by the presence of periapical radiolucency at the tooth apex (White and Pharoah, 2000).

A systematic approach was used in the interpretation of the panoramic radiographs so as not to overlook structures. Extraneous light, from around the film, was masked out by an exposed black radiographic film and dim room light was used. A magnifying lens was used to detect subtle caries or periapical infection.

Results

Dental panoramic radiographs showed caries in 19 out of 50 (38%) patients (table 1), periapical infection in 6 (12%) patients, restorative material in 34 (68%) patients, missing teeth in 18 (36%) patients, and an unerupted third molar tooth in 11 (22%) patients. Periapical infection involved the apex of 8 teeth. The most commonly involved teeth were the first mandibular molars (5 teeth) followed by the second mandibular molars (2 teeth).

There were 16 unerupted third molar teeth in 11 patients (6 patients had a single unerupted tooth and five patients had two unerupted teeth). 4 teeth were horizontal, 4 vertical, 4 mesioangular, and 3 distoangular, and 1 transverse.

Regarding radiographic artifacts, spine-shadow ghost artifact was seen in 15 (30%) radiographs. It was seen as a large radiopaque region in the middle of the film overlying the spine. 9 (18%) radiographs were underexposed. No definite osseous or articular abnormalities were seen in the temporomandibular joints of all patients. A small opacity was seen adjacent to the angle of the mandible in one patient suggesting a salivary stone. Maxillary sinusitis was suspected in two patients. Deviated nasal septum was seen in another two patients.

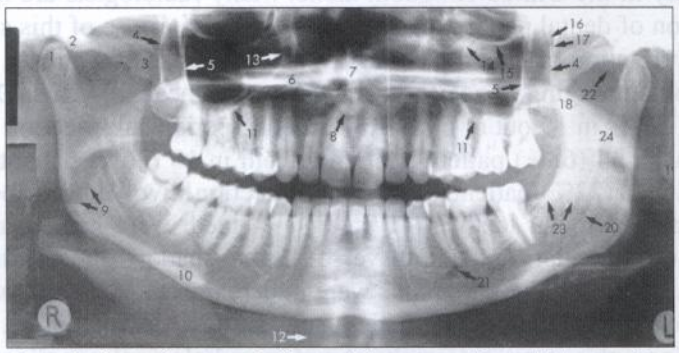

Fig. (1): 1, Mandibular condyle. 2, Articular eminence. 3, Coronoid process of mandible superimposed on zygomatic arch. 4, Posterior wall of maxillary sinus. 5, Posterior wall of zygomatic process of maxilla. 6, Hard palate. 7, Nasal septum. 8, Tip of nose. 9, Dorsum of tongue. 10, Hyoid bone. 11, Inferior border of maxillary sinus. 12, Image of cervical spine. 13, Medial border of maxillary sinus. 14, Infraorbital canal. 15, infraorbital rim. 16, Pterygomaxillary fissure. 17, Anterior border of the pterygoid plates. 18, Lateral pterygoid plate superimposed over soft palate and coronoid process of mandible. 19, Ear lobe. 20, Inferior border of mandibular canal. 21, Mental foramen. 22, Posterior wall of nasopharynx. 23, Inferior border of mandible superimposed from opposite side. 24, Soft palate over mandibular foramen of mandible (Reprinted, with permission from White and Pharoah, 2000).

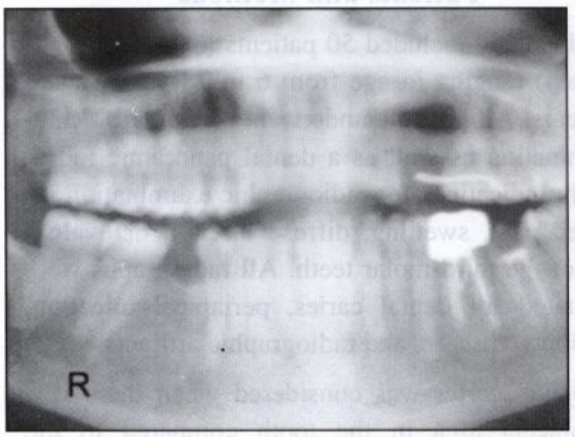

Fig. (2): A 38-year-old female. Dental panoramic radiograph shows restorative material in left first and second mandibular molars. There is relatively large radiolucent area involving crown of the left second mandibular molar denoting caries. A small lucent focus is seen at the apex of left first mandibular molar denoting periapical infection. A radiopaque region is seen in the middle of the radiograph (spine-shadow ghost artifact).

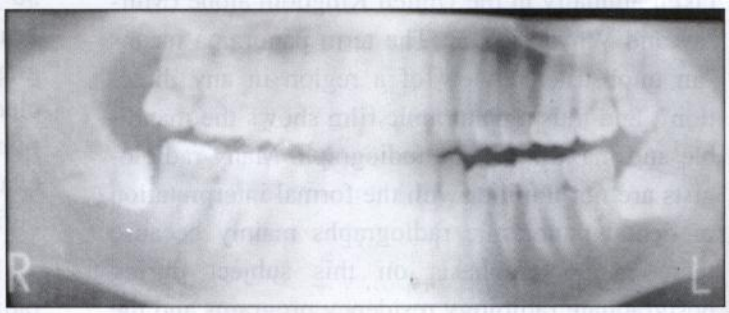

Fig. (3): A 30-year-old male. Dental panoramic radiograph shows bilateral horizontally oriented third mandibular molars. Spine-shadow ghost artifact is also noted.

Table 1. Sex and Age of 9 Patients with the Standard Numbers of their Carious Teeth Seen on Dental Panoramic Radiographs

Patient #	Sex/age(yr)	Nomination Tooth involved*
1	male/36	32
2	male/30	29,30
3	female/38	18
4	male/31	1,16
5	female/44	14, 18, 19
6	male/27	2, 13
7	male/31	15, 18, 19, 26, 27
8	female/23	13, 21
9	female/33	9, 10, 22, 23
10	female/54	17,32
11	male/42	29
12	female/43	30
13	male/44	30
14	female/26	30
15	female/25	2
16	male/37	23
17	male/78	13
18	male/55	4
19	female/10	3

*Based on the on the American system. Please see table 2.

Table 2. Tooth Names and Standard Numbers According to the American System

Name	Right	Left
Third maxillary molar	1	16
Second maxillary molar	2	15
First maxillary molar	3	14
Second maxillary premolar	4	13
First maxillary premolar	5	12
Maxillary canine	6	11
Maxillary lateral incisor	7	10
Maxillary central incisor	8	9
Third mandibular molar	32	17
Second mandibular molar	31	18
First mandibular molar	30	19
Second mandibular premolar	29	20
First mandibular premolar	28	21
Mandibular canine	27	22
Mandibular lateral incisor	26	23
Mandibular central incisor	25	24

Discussion

Panoramic radiography was introduced into the United States in 1959. The design of early unit was based on the work of Dr.Y.V. Paatero, a Finnish dentist, that was published in 1949. The technique used a slit beam X-ray and curved rotational tomography. Tomo is the Greek word for "section", and we are seeing radiographic slices of the objects. The plane of the object that is not blurred on the radiograph is called "the plane of acceptable detail" or focal trough. Clinically this concept is very important because many of the errors in the technique are caused by improper patient position, not having the desired area in focal trough. A panoramic radiography is properly called a pantomogram. The pantomogram is a curved-surface tomogram (Frommer, 2001).

Panoramic radiography is a radiologic technique that produces a single image of the facial structures that includes both maxillary and mandibular dental arches and their supporting structures.

The main advantages of panoramic images are (1) their broad coverage of facial bones and teeth, (2) low radiation dose, (3) convenient examination to the patients, (4) it can be used in patients unable to open their mouths, and (5) short examination time, usually 3 to 4 minutes (White and Pharoah, 2000).

While the main disadvantage of panoramic radiography is that the image does not display the fine anatomic detail available on intraoral periapical radiographs. Other problems include uneven magnification and geometric distortion. Occasionally the presence of overlapping structures, such as cervical spine, can hide odotnogenic lesions, especially in the incisor region. Panoramic radiography is most useful for evaluation of trauma, third molars, extensive disease, large lesions, retained teeth or root tips, and developmental anomalies (White and Pharoah, 2000).

Anatomy

Recognising normal anatomic structures on panoramic radiographs (Fig. 1) is channelling due to complex anatomy, superimposition of structures, and the uneven projection orientation. Teeth in human jaws are the incisors, canines (cuspid), premolar (bicuspids), and molars. The sides of teeth are termed mesial or distal by the dental community. The dental term mesial refers to the anatomic term distal; while distal refers to the anatomic term proximal. The incisors, canines, and premolars of the permanent dentition replace two deciduous incisors, a deciduous canine, and two deciduous molars, respectively, in each jaw quadrant. Table 2 shows tooth names and standard numbers according the American system. A completed tooth consists of crown, projecting above gingiva; root, embedded in alveolar bone; and neck (cervix), constriction between crown and root (Rosenberg, 2000). The crown is covered by enamel (calcified layer). Dentine, laid by odontoblasts surrounds the pulp within the crown and the root canal within the root. The root is covered with cementum and the peridontal ligament anchors the cementum to the lamina dura. The central radiolucent pulp contains neurovascular structures and lymphatics, which passes through the root apex (Murray and Whyte, 2002).

Caries

Caries (decay) is due to the action of microorganisms on carbohydrates. This causes demineralization of the tooth and may result in loss of vitality of the pulp and spread of infection into periapical tissue. Caries starts at the enamel (reversible), extending into the dentine (irreversible). The actual size of carious lesions is greater than seen on the radiograph as 30-40% demineralization is needed so the lesion seen radiographically. The most common site for caries is the occlusal surfaces of first and seconds permanent molars, likely because of the presence of many pits and fissures. Followed by the interproximal contact areas where the effect of saliva and cleaning are reduced. Interproximal caries is difficult to be detected clinically unless cavitation had occurred. The most sensitive means of detection is the intra-oral radiograph. However, the larger lesions are visible on the panoramic radiograph (Murray and Whyte, 2002).

In our study, dental panoramic radiographs showed caries in 19 out of 50 (38%) patients with restorative materials in 68% of our patients reflecting high incidence of caries in this randomised selected patients. Caries was seen in 10 men and in 9 women ranging in age from 10 to 78 years with mean age of 37.2 years. The most commonly involved teeth were the first mandibular molars (n = 6) followed by the second maxillary premolars (n = 4). Correlation with clinical findings and oral radiographs seems very important for optimum patient care especially in the early learning curve of interpreting panoramic radiographs.

Periapical infection

Periapical region is part of the peridontum although it is considered separately. Deep carious lesions may spread from the dentine into the pulp, resulting in inflammation. This usually results in periapical radiolucency if untreated. Apical pathology is best detected using intra-oral radiographs, yet chronic lesions can be well seen on panoramic radiograph (Murray and Whyte, 2002).

In our study, periapical infection was seen in 6 (12) patients involving 8 teeth. The most commonly involved teeth were, also as the case with caries, the first mandibular molars (5 teeth) followed by the second mandibular molars (2 teeth).

Third molar assessment

Clinical symptoms associated with third molar teeth are common, the usual treatment being extraction. Many of the factors that determine that decision are revealed by the panoramic radiograph. The third molar could be mesioangular, distoangular, horizontal, vertical, transverse, or inverted (Whaites, 2002). In our study, there were 16 unerupted third molar teeth in 11 patients (6 patients had a single unerupted tooth and five patients had two unerupted teeth). 4 teeth were horizontal, 4 vertical, 4 mesioangular, and 3 distoangular, and 1 transverse.

Artifacts

Although perceived to be an easy technique, one British study revealed that 33% of performed panoramic radiographs were diagnostically unacceptable (Rushton et al., 1999). Errors in interpretation are commonly made in the maxillary and mandibular incisor region (Murray and Whyte, 2002). We have similar results as spine-shadow ghost artifact was seen in 15 (30%) radiographs. It was seen as a large radiopaque region in the middle of the film overlying the spine interfering of proper evaluation of incisor teeth. Nine (18%) radiographs were underexposed. So attention to technical details, training, and quality control measures is mandatory to insure good results.

The relatively small number of patients limited our study so the potential of panoramic radiography in conditions as trauma and osseous lesions of the mandible were not demonstrated. However, radiologists are rather well trained in these areas.

In conclusion, dental panoramic radiography is an extremely common radiological examination and in some instances, radiologists might be asked to give their interpretations. Knowledge of normal radiographic anatomy, notation, and radiographic appearance of common pathological conditions is needed. A systematic approach of interpretation and feedback from the dentists would help radiologists provide maximum diagnostic information.

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