Getting the whole picture

Dr Laura Fee gives an overview on the use of panoramic radiographs in general dental practice

Radiation regulations stipulate that all radiographs must be justified and reported in the dentist's notes and that a quality assurance programme must be implemented in each practice to optimise the image quality:

Justification: the practitioner must obtain a net benefit from exposing the patient to radiation. The dentist should supply details of the patient's radiographic history.

Optimisation: Radiation doses must be kept as low as reasonably achievable.

Reporting: All radiographs must be reported. Dates, causes and repeat exposures should be documented for any radiographs of no diagnostic value.

Quality Assurance: Factors such as correct positioning, contrast and processing must be checked. A feedback mechanism helps improve the image quality and in identifying any deficiencies.

Striking the balance between limiting the radiation exposure to the patient versus the likely diagnostic benefit is a constant challenge for dentists. Although new panoramic units have incorporated dose-limiting features, the faster film has resulted in a failure to significantly reduce the radiation dose to the patient. Most digital panoramic systems require increased exposure factors compared with conventional methods[1]. Surprisingly, the comparative diagnostic yield with conventional film radiography has been shown to be similar[2].

New patients

It has been found that 63 per cent of general dentists routinely screen new adult patients using panoramic radiography[3]. There is, however, increasing evidence of poor image quality of panoramics

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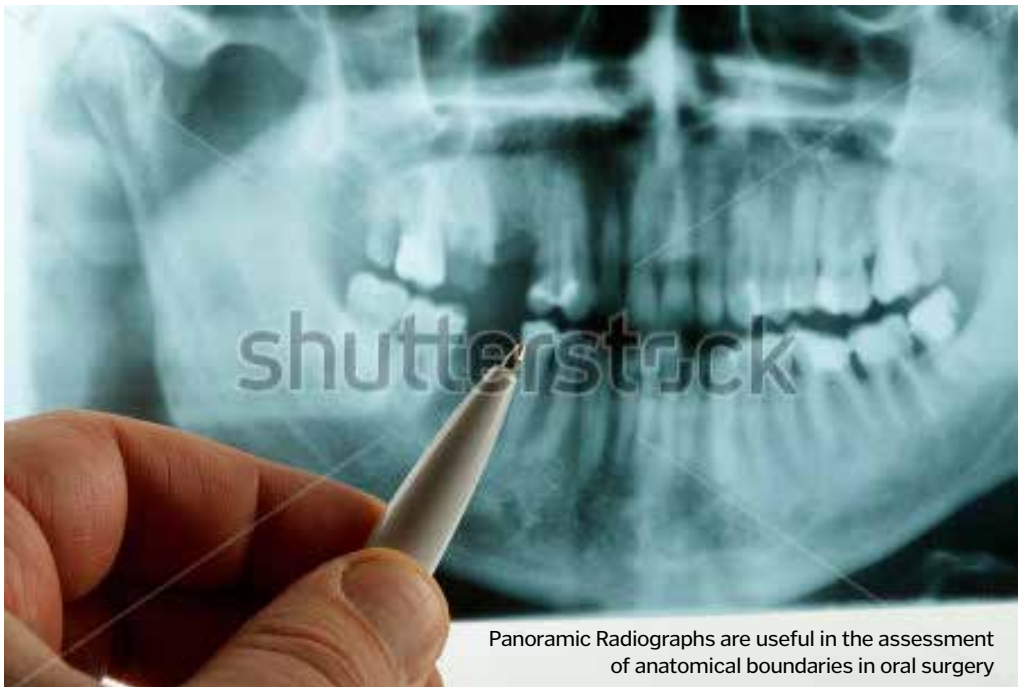
in primary care settings[4]. It is imperative that the patient be correctly positioned and, for film-based radiography, the best processing techniques must be employed. Every dental practice should adhere to a strict quality assurance programme to maximise the diagnostic value of panoramic images.

Disturbingly, it has become routine in some practices to take panoramic radiographs for all new patients. Research has shown that bitewings and periapical radiographs are better for diagnosing caries, periodontal and periapical pathology[5]. Worryingly however, a large number of dentists use only panoramic radiographs to assess common dental pathosis[6].

Furthermore, it has been found that some dentists routinely use panoramics to screen for clinically unsuspected pathology[5]. Taking radiographs routinely in the absence of any clinical signs or symptoms cannot be justified unless implant treatment is planned[7]. It is worth remembering that asymptomatic dental pathology has a remarkably low prevalence.

In cases of gross neglect, it may be expeditious to take panoramic radiographs to help identify teeth requiring a more detailed radiographic examination. Also, it is often appropriate to take a panoramic radiograph for patients in a hospital setting before oral surgery under general anaesthesia[8].



Panoramic Radiographs are useful in the assessment of anatomical boundaries in oral surgery

Edentulous patients

In cases where the clinical exam reveals an abnormality, such as a retained root, an intraoral radiograph of the site is the best radiographic examination.

Late mixed dentition

If, at 11 years old, the canines cannot be palpated, either buccally or palatally, an intraoral radiograph would be appropriate. Early diagnosis of a misplaced canine is of importance to the child's orthodontic outcome.

Radiographically the preferred means of localisation is parallax. This is the apparent displacement of an image relative to the image of a reference object. It is caused by a change in the angulation of the X-ray beam[9]. The reference object is usually the root of an adjacent tooth. The image of the tooth that is the most far away from the X-ray tube moves in the same direction as the tube, whereas the image of the tooth closer to the X-ray tube moves in the opposite direction to the tube (SLOB rule – Same Lingual Opposite Buccal). A panoramic and anterior occlusal radiograph are commonly used in these cases giving approximately a 60° tube shift.

A limited field-of-view CBCT examination may be needed where the prognosis of the lateral incisor is questionable on a conventional radiograph due to resorption by a misplaced canine.

Deciduous molars

If the second deciduous molars are retained when other successional teeth have erupted, an appropriate field-limited panoramic radiograph can be used. However, in the case of a single second deciduous molar being retained, an intraoral image may suffice.

Permanent molar

A grossly carious first molar will normally require a field-limited panoramic radiograph to assess the prognosis of the other first molars and to confirm the presence of permanent successors. An orthodontic opinion is advisable where the loss of one or more first molars is necessary.

Orthodontics

Radiography is extremely beneficial in orthodontic treatment planning. However, research indicates that it is excessively used within the specialty. Although routine screening of children is inappropriate, the use of selection criteria has been highly effective in determining children likely to benefit from a radiographic examination[10]. Research consistently highlights the limited effect radiography has on altering orthodontic diagnosis and treatment plans[11].

If a specialist orthodontic opinion is necessary, it is imperative that any radiographic images accompany the referral letter once an orthodontic opinion is being sought. However, general dentists should whenever possible leave the choice of radiograph to be taken by the specialist once an orthodontic opinion has been deemed necessary from their clinical exam.

Oral surgery

Panoramic radiographs are frequently used in the assessment of third molars before their surgical removal, however this does not need to be carried out at the initial examination[12] Routine radiography of unerupted third molars is not recommended[10]. Panoramic radiographs provide information about the distance to the lower border of the mandible and the anatomy of the

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inferior dental canal. It must be remembered that panoramic radiography does not provide an accurate indication of a close relationship with the inferior dental canal.

In surgical cases where there is a suggestion of a close relationship between the root apices and the mandibular canal, either a second radiograph using a different projection geometry[13] or a localised CBCT examination should be performed if this is likely to result in a change of the surgical management. However, it should be noted that currently there is insufficient evidence to support the use of routine CBCT in these cases and there is no evidence to indicate any improvement in outcomes when CBCT is used.

For situations such as apicectomy, root removal or enuclation of cysts, an intraoral radiograph may be adequate for treatment planning.

Trauma

Intraoral radiography provides ample diagnostic information when assessing simple dental trauma.

Panoramic radiographs are the first line for imaging mandibular fractures[14]. However, poor panoramic image quality has been shown to be a major problem in general practice which reduces diagnostic accuracy[15]. Additional imaging is often required for diagnosing condylar fractures[16].

Panoramic radiography has limited ability to detect midfacial fractures. If there is clinical evidence of a bone fracture it is best to defer a complete radiographic examination until the patient is at the hospital.

Temporomandibular joint problems

The panoramic radiograph shows an image of the mandibular condyles and is often the first choice as an imaging technique for patients with TMJ symptoms. However, research has proven that, in patients with TMJ symptoms, panoramic radiography provides little or no information that influences the diagnosis or management in most cases examined[17].

Panoramic Radiographs have midline distortion making proper assessment in the anterior region of the mouth sub-optimal

The majority of patients with signs and symptoms related to the TMJ are suffering with myofacial pain/dysfunction or internal disc derangements. Condylar abnormality is not seen in myofacial pain/dysfunction and only occasionally seen with internal disc derangement. Radiography is not recommended for patients with clicking in the absence of other signs/symptoms[18].

Radiographic examination is also indicated where there is evidence of progressive pathology such as trauma, change in occlusion, mandibular shift, sensory motor alterations or change in range of movement.

Periodontal assessment

There is no clear evidence to support any recommendations regarding the frequency of radiographs taken for periodontal reasons. Dentists should always use radiographs taken for caries diagnosis to assess the periodontal hard tissues. Bitewings provide information about bone levels without the need for an additional radiation dose.

If a patient has generalised pocketing of 4-5mm and little or no recession, horizontal bitewings are recommended. These may be supplemented by intraoral periapicals for selected anterior teeth but only if it is likely to change the management of the patient.

Assessment of all teeth and their periodontal support can be obtained with the use of a panoramic radiograph alone, a panoramic radiograph with supplementary periapical radiographs, or a complete series of periapical radiographs. When determining which radiographic technique to use, consideration should be given to the clinical presentation, the required image quality and the relative dose-benefit based on the equipment available.

Panoramic radiographs with supplementary periapicals potentially provide a radiation dose advantage over a full-mouth series of periapicals. However, the dose from periapical radiographs may be less than that of a panoramic if periapicals are restricted to affected teeth.

A periapical radiograph using a paralleling technique is indicated if a periodontal/endodontic lesion is suspected.

If a patient has pocketing of 6mm or more, vertical bitewings are recommended, supplemented by intraoral periapical views using the paralleling technique at sites where alveolar bone image is not included. These may be supplemented by intraoral periapicals for selected anterior teeth, but only if this is likely to change management of the patient.

The decision to take further radiographs to assess changes to the periodontium over time should be taken on a case-by-case basis. Radiographs should be secondary to the clinical exam and taken when they have the potential to change the patient's management.

When assessing alveolar bone levels, digital radiography may offer improved measurement accuracy when compared with film radiographs. CBCT is not indicated as a routine method of imaging periodontal bone support. However, where CBCT images include the teeth, care should be taken to check for periodontal bone levels.

Radiographs in implant dentistry

Currently there is little evidence on which to formulate guidelines for the use of radiographs in implant dentistry. Radiography is crucial in implant dentistry for the assessment of bone and reviewing their long-term maintenance. Radiographs are needed to assess existing natural teeth and the healing of extraction sockets. Osseointegration cannot be visualised on routine radiographs, however, a peri-implant radiolucency may suggest fibrous tissue encapsulation warning the dentist of future implant failure. A baseline radiograph is recommended at the end of the prosthodontic phase of treatment. This helps to assess marginal bone levels for future reference and verifies the correct connection of the implant components.

A radiograph one year later can be beneficial in recognising changes in bone levels. In cases of multiple implant placements, a good panoramic radiograph with magnification markers can provide excellent information. The surgeon must of course consider the potential magnification and patient positioning errors.

It is extremely important that the surgeon can assess the inferior dental canal, mental foramen along with the canal's complex morphology in order to avoid damage during implant placement. Panoramic radiographs are considered

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acceptable for implants placed in the posterior mandible, providing a minimum 2mm to 4mm safety margin superscript[19] from the canal and bone width is maintained.

It should be remembered that panoramic images are magnified by up to 30 per cent and that such magnification can vary significantly at different locations within the same radiograph. In order to prevent dimensional distortion, patients must be positioned accurately. It may be useful to employ reference objects, such as ball bearings in a baseplate at the planned implant site. In the case of an edentulous patient, they may leave in their acrylic dentures to allow for more accurate positioning.

Where cross-sectional information is appropriate, CBCT techniques may be employed to formulate treatment plans or to construct guides for surgical implant placement and prefabrication of prostheses.

A radiographic review at one, three or up to five years is advisable to verify stable bone levels or to detect progressive bone loss. Radiographic evidence of bone levels is recommended if signs such as increased probing depths, bleeding, exudate or mobility are present.

The choice of radiographic technique used in implant dentistry is further complicated by the experience of the surgeon. An experienced practitioner may feel that they have adequate information from a two-dimensional imaging technique, whereas a less experience practitioner may feel more confident with the additional information gained by a CBCT image. As with any radiological investigation, dentists must prioritise dose limitation as the principle factor in deciding which imaging modality to prescribe.

Guidelines and recommendations for 3D imaging

The European Association for Osseointegration has made the following recommendations for CBCT imaging in dental implant therapy[20]:

1. Bone defect considerations (extensive bone augmentation)
2. Sinus floor augmentation/elevation considerations
3. Evaluation of intra-oral donor sites
4. Special techniques (e.g. zygoma etc)
5. Computer-assisted treatment planning and placement of dental implants
6. Postoperative complications (specifically nerve damage).

With the increased use of CBCT imaging in dental practice, clinicians must be made aware that the patient radiation dose associated with CBCT imaging are higher than those of conventional radiographic techniques. Strategies which optimise exposure, such as Field of View reduction to the region of interest must be utilised in keeping with the ALARA principle of keeping radiation exposure As Low As Reasonably Achievable.

Conclusion

It should be emphasised that the use of radiography is secondary to a clinical exam and full mouth periodontal assessment. All existing radiographs should be used as much as possible. Previous radiographs may be very useful in assessing the rate of disease progression.

Many studies have been published on the diagnostic accuracy, sensitivity and specificity of panoramic radiology compared to intraoral radiographic examinations. These highlight that panoramic imaging is inferior in the detection of the most common dental diseases. Panoramic radiography is therefore not indicated as a routine radiographic technique for general dental practice.

A panoramic radiograph should be prescribed on a case-by-case basis only in specific situations after careful consideration of the patient's clinical history and examination. ■

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