

Radiographs can only be prescribed by a dentist and then only **after** a **clinical examination** has been performed to determine **which** projections are required to give the maximum diagnostic information. After considering the clinical findings, medical and dental history, [the radiographic needs of each patient must be considered **individually**. Radiographic views must be **selected** to give the **maximum diagnostic yield** with the **minimum exposure** to ionizing radiation.

Radiographic examination does carry the potential for harm. One of the most effective means of reducing possible harm is to avoid taking radiographs that will not contribute diagnostic information pertinent to patient care. If a patient is complaining of sensitivity to cold, taking a radiograph to examine the periapical area for pathosis is not required because no pathological periapical lucency will be seen in a vital tooth.

Factors that will assist in decision making are the **prevalence** of a disease, **rate** of **caries**, **diet**, the **number** of restorations, the **oral hygiene**, the **periodontal condition**, **impacted teeth**, available radiographs, etc. Some say age of the patient as well.

As a general principle, radiographs are indicated when a **high probability** exists that they will provide information about a disease that can not be seen clinically; i.e. the probable benefit to the patient outweighs any possible disadvantage.

The **cost** of the examination and the **radiation dose** should be considered when selecting views. Conventional tomography, CT or MRI will often be required to best see the lesions. However, do not request a CT where you feel a panoramic radiograph will be adequate. If one wishes to visualize the disc [or position of the disc] in the TMJ or soft tissue then MRI is required.

## **CARIES.**

As more older people are keeping their teeth, the rate of caries is increasing, particularly root caries [and interproximal and caries associated with existing restorations]. **Early** interproximal caries can often only be seen radiographically. The **rate** of caries varies from person to person and the length of intervals between exposures must be determined clinically. The rate of caries progression is more rapid in deciduous teeth. In carious prone patients radiograph should be taken every 6 - 12 months; in non-caries prone patients every 18 - 24 months is adequate.

The best radiographic view for visualizing both interproximal caries and periodontal bone height is **bite-wing** radiographs. These can be either **vertical** or **horizontally** placed in the mouth.

## **PERIODONTAL DISEASES.**

Generally, in younger patients one sees gingivitis and as people get older they are more likely to get periodontal bone loss. One should always bear **juvenile periodontal disease** in young people in mind. Periodontal diseases are the most common cause of tooth loss. When a patient is initially seen, and there is gingival inflammation and pocketing, the radiograph is important in determining the amount of periodontal involvement.

The radiographic examination shows the **amount** and **type** of bone loss and also whether it is localized or generalized. With subsequent radiographs the **rate** of bone loss can also be

determined. Strictly speaking, radiographs show the amount of **remaining** bone. After treatment, follow-up radiographs are important to monitor the progression of the condition.

## DENTAL ANOMALIES.

Dental anomalies / variants are more common than generally realized. If you look you see and if you don't you won't. Abnormalities occur less frequently in deciduous teeth. The impact of anomalies on the permanent dentition is more serious.

The most common finding are **additional** or **missing teeth**. **Mesiodens** is the most common additional tooth. The most common tooth missing is the **last one in the series**; incisors - the maxillary lateral; premolars - mandibular second; molars - all third molars. The same teeth are also most commonly peg shaped.

A panoramic radiograph is the best view for anatomic anomalies but there is no need for this before the age of about 10 years. Should there be a missing tooth, a periapical or an occlusal view of that area may be required.

## GROWTH, DEVELOPMENT AND MALOCCLUSION.

A radiographic examination for growth, development and dental malocclusion can involve several different views, depending on what is being examined. These can vary from **periapicals**, an **occlusal**, a **panoramic** view to a **cephalometric** and a **lateral skull** for orthodontics. Sinus involvement could require an **OM** [Occipito-mental]; non symmetrical growth of the mandible could require a **PA** [in radiology a PA always means a postero-anterior].

For impacted teeth, a panoramic radiograph is required at the age of about 17 - 20 years of age. To take the radiograph at 14 years of age is of very little value.

## OCCULT DISEASE

Occult disease refers to a disease process presenting **NO signs or symptoms**; they can be dental or osseous. Dental findings vary from interproximal caries to root resorption, dilaceration, concrescence or hypercementosis.

Intra-osseous findings can be impacted teeth, sclerosing / condensing osteitis, idiopathic osteosclerosis [or bone whorl / enostosis] to tumors [benign or malignant] and cysts. Sometimes a slight but unusual bone contour or a missing third molar without a history of extraction may give a clue.

In edentulous patients who are usually older individuals, and who require dentures, there are often dental or general problems and this requires a radiographic examination to exclude occult disease. A clinical exam will determine whether a periapical, an occlusal or a panoramic radiograph is required.

## JAW PATHOLOGY.

Imaging of known jaw lesions, such as fibro-osseous diseases or neoplastic diseases, before biopsy and definitive treatment is also important for appropriate management of the patient. For small lesions of the jaws, periapical, occlusal and/or **panoramic** radiographs may be enough as long as the lesion can be seen in its entirety. If clinical evidence exists of swelling, some type of radiograph at **90 degrees to the original plane** should be made to detect evidence of expansion

of the jaw and **perforation** of the buccal or lingual cortical bone. If lesions are too large to fit on standard dental films, extend into the maxillary sinus or other portions of the head outside the jaws, or are suspected of malignancy, additional imaging such as computed tomography (CT) is appropriate. This type of imaging can define the extent of the lesion, and provide information about the nature of the lesion.

## TEMPOROMANDIBULAR JOINT

A wide variety of diseases affect the TMJ, including **congenital** and **developmental malformations** of the mandible and cranial bones; acquired disorders such as disk displacement, **neoplasms**, **fractures**, and **dislocations**; **inflammatory** diseases that produce capsulitis or synovitis; and arthritides of various types, including rheumatoid and osteoarthritis. The goal of TMJ imaging, should be to obtain new information that will influence patient care. Radiologic examination may not be needed for all patients with signs and symptoms referable to the TMJ regions, particularly if no treatment is contemplated.

## IMPLANTS

An increasingly common method of replacing missing teeth is with osseointegrated implants. Preoperative planning is crucial to ensure success of the implants. The dentist must evaluate the adequacy of the **height** and **thickness** of bone for the desired implant; the **quality** of the bone, including the relative proportion of medullary and cortical bone; the location of anatomic structures such as the mandibular canal or maxillary sinus; and the presence of structural abnormalities such as undercuts that may affect placement or angulation of the implant.

Standard periapical and panoramic radiographs can supply information regarding the **vertical dimensions** of the bone in the proposed implant site. However, some type of **cross-sectional imaging**, either conventional tomography or CT, is recommended before implant placement for visualization of important anatomic landmarks, determination of size and path of insertion of implant, and evaluation of the adequacy of the bone for anchorage of the implant. Postoperative evaluation of implants may be needed at later times to judge healing, complete seating of fixtures, and continued health of the surrounding bone.

## PARANASAL SINUSES

Because sinus disease can present as pain in the maxillary teeth and because periapical inflammation of maxillary molars and premolars can also lead to changes in the mucosa of the maxillary sinus, circumstances occur in which the dentist needs to obtain an image of the maxillary sinus. Periapical and panoramic radiographs demonstrate the floor of the maxillary sinus well, but visualization of other walls requires additional imaging techniques such as occipitomental (Waters') view or CT.

## TRAUMA

For patients who experience trauma to the oral region periapical and/or panoramic radiographs are helpful for evaluation of fractures of the teeth. If a suspected root fracture is not visible on a periapical radiograph, a second radiograph made with a **different angulation** may be helpful. A fracture that is not perpendicular to the beam may not be detectable. Thus a tooth with a history of trauma but no associated clinical finding should be monitored and evaluated radiographically on a periodic basis.

Fractures of the mandible can frequently be detected with panoramic radiographs, **supplemented** by images **at 90 degrees** such as a posteroanterior or modified Towne's view. Trauma to the maxilla and midface may require CT for a thorough evaluation.

## RADIOGRAPHIC EXAMINATIONS.

After concluding that a patient requires a radiograph, the dentist should consider which radiographic examination is most appropriate to meet all the patient's diagnostic and treatment planning needs. In choosing one, the dentist considers the anatomic relationships, the size of the field, and the radiation dose from each view. For example, a panoramic radiograph provides broad area coverage with moderate resolution. Intraoral films give more detailed information but a significantly higher radiation dose per unit area exposed. The clinician must use clinical judgment to weigh these factors.

### INTRAORAL RADIOGRAPHS

They offer the dentist a high-detail view of the teeth and bone in the area exposed. Such views are most appropriate for revealing caries and periodontal and periapical disease in a localized region.

#### Periapical Radiographs

Periapical views show all of a tooth and surrounding bone. They are very useful for revealing caries and periodontal and periapical disease.

#### Interproximal Radiographs. (bitewings)

Interproximal views show the coronal aspects of both the maxillary and mandibular dentition in a region as well as the surrounding crestal bone. They are most useful for revealing **proximal caries** and evaluating the **alveolar bone height** of the crest. They can be made in either the **anterior** or **posterior** region of the mouth. The **amount** of bone loss detected **clinically** determines whether **vertical** or **horizontal** views should be made.

#### Occlusal Radiographs

Occlusal views are intraoral radiographs in which the film is positioned in the occlusal plane. They are often used in children in place of periapical views because of the small size of the patient's mouth. In adults, occlusal radiographs may supplement periapical views, providing visualization of a greater area of teeth and bone. They are useful for demonstrating impacted or abnormally placed maxillary anterior teeth or visualizing the region of a palatal cleft. They may also demonstrate buccal or lingual expansion of bone.

### EXTRAORAL RADIOGRAPHS

Extraoral radiographs are examinations made of the orofacial region (e.g., the jaws, skull, TMJ) **using films located extraorally**. The relationships among patient position, film location, and beam direction vary depending on the specific radiographic information desired.

#### Panoramic Radiographs

Panoramic radiographs provide a broad view of the jaws, teeth, maxillary sinuses, nasal fossa, and TMJs. They show which teeth are present, their relative state of development, presence or absence of dental abnormalities, and many traumatic and pathologic lesions in bone. They are the examination of choice for initial examinations of edentulous patients. Because this system is an extraoral technique and uses intensifying screens, the resolution of the images is less than with the intraoral nonscreen films.

When a full mouth set of radiographs is available, a panoramic examination is usually redundant because it does not add information that alters the treatment plan. However, situations may exist in which a panoramic radiograph may be preferred over a periapical examination such as for a patient with **unerupted third molars** that will be surgically removed. Panoramic views are most useful when the required field of view is large. Although the selection of a radiographic examination should be based on the extent of the expected information it is likely to provide, the relatively low dose of radiation from the panoramic examination should be a qualifying factor.

### **Advanced Imaging Procedures**

A variety of advanced imaging procedures such as CT, MRI, ultrasonography, and nuclear medicine scans may be required in specific diagnostic situations.

### **Guidelines for Ordering Radiographs. (Summary)**

The profession has issued guidelines recommending which radiographs to make and how often to repeat them:

- Make radiographs only after a clinical examination.
- Order only those radiographs that directly benefit the patient's diagnosis or treatment plan.
- Use the least amount of radiation exposure necessary to generate an acceptable view of the imaged area - ALARA Principle

### **PREVIOUS RADIOGRAPHS**

Most patients have been seen previously by a dentist and have had radiographs made. These radiographs are helpful regardless of when they were exposed. If they are relatively recent, they may be adequate to the diagnostic problem at hand. Even if they were made so long ago that they are not likely to reflect the current status of the patient, they may still prove useful. They may demonstrate whether a condition has worsened, has remained unchanged, or has shown healing, such as the progression of caries or periodontal disease.

### **Selection Criteria.**

Selection criteria for radiographs are those signs or symptoms found in the patient history or clinical examination that suggest that a radiographic examination will yield clinically useful information. For example, a clinical examination may disclose a disease that is clinically apparent, but the nature and extent of which is not possible to evaluate clinically. Such situations frequently require a radiographic examination for adequate assessment.

A key concept in the use of selection criteria is recognition of the **need to consider each patient individually**. Prescription of radiographs is on an individual basis according to the patient's demonstrated need. The ADA's recommendations on the use of radiography include the following:

- The nature and extent of diagnosis required for patient care constitute the only rational basis for determining the need, type, and frequency of radiographic examination.
- Because each patient is different from the next, radiographic examinations should be individualized for each patient i.e. **after** a clinical examination
- The ADA specifically cautions against the routine use of radiography as a part of periodic examination of all patients.

The guidelines include a description of clinical situations in which radiographs are likely to contribute to the diagnosis, treatment or prognosis. **Two examples** highlight the differences between ordering radiographs for dental diseases with clinical signs and symptoms and dental diseases with no clinical indicators but high prevalence. In the first case, consider a patient with a

hard swelling in the premolar region of the mandible with expansion of the buccal and lingual cortical plates. The clinical sign of swelling alerts the dentist to the need for a radiograph. A radiograph of this region is indicated to determine whether the abnormality in the region causing the swelling involves the bone.

A more common example is the patient who has not seen a dentist for many years who comes seeking general dental care. Even without clinical evidence of caries, **bitewings** are indicated. Because this patient has not had interproximal radiographs for many years, it is reasonable that the patient may benefit from the radiograph by the detection of interproximal caries. Although no clinical signs exist that predict the presence of caries, the dentist relies on clinical knowledge of the prevalence of caries to decide that this radiograph has a reasonable probability of finding disease.

Without some specific indication it is inappropriate to expose the patient "just to see if there is something there." The probability of finding occult disease in a patient with all permanent teeth erupted and no clinical or historical evidence of abnormality or risk factors is **so low** that making a periapical radiographic survey just to look for such disease is not indicated.

### ADMINISTRATIVE RADIOGRAPHS

Administrative radiographs are those made for reasons **other than diagnosis**. Examples may include making radiographs for an insurance company or for an examining board. The authors believe that it is appropriate to expose patients only when it benefits their health care. Most administrative radiographs do not serve such an objective. Unfortunately, this recommendation is often not adhered to in practice, and dentists are left to sort out the most appropriate criteria to use in their practices.

### PATIENT EXAMINATION

Ordering radiographs requires a reasonable expectation that they will provide information that will contribute to exposing the diagnostic problem at hand. Accordingly, the first step is a careful examination of the patient. The clinical examination provides indications as to the **nature** and **extent** of the radiographic examination appropriate to the situation. **Transillumination** of anterior teeth should be conducted to evaluate for interproximal decay. Posterior interproximal radiographs form the foundation of the ADA guidelines. Other intraoral or extraoral radiographs should be added as indicated by the clinical examination.

Applying these guidelines to the specific circumstances with each patient requires clinical judgment and an amalgamation of knowledge, experience, and concern. Recognizing situations not described by the guidelines in which patients will need radiographs also requires clinical judgment.

#### Initial Visit.

The guidelines recommend that a child with primary dentition who is cooperative and has **closed posterior contacts** have only interproximal radiographs to examine for caries. Additional periapical views are recommended only in the case of clinically evident diseases and/or specific historical or clinical indications. If the molar contacts are not closed, interproximal radiographs are not necessary because the proximal surfaces may be examined directly. The guidelines recommend radiographic coverage of all tooth-bearing areas for a child with transitional dentition (after eruption of the first permanent tooth, 6 to 8 years of age). This usually consists of bitewings supplemented with either periapical or occlusal views or a panoramic view. At this stage of development a panoramic projection is usually the view of choice because it offers the most general information with the lowest dose of ionizing radiation.

The guidelines group adolescents and dentate adults together to identify the **kind** and **extent** of appropriate radiographic examination. The guidelines recommend that these patients receive an **individualized examination** consisting of interproximal views and periapical views selected on the basis of specific historical or clinical indications. The presence of generalized dental disease often indicates the need for a full-mouth examination. Alternatively, the presence of only a few localized abnormalities or diseases suggests that a more limited examination consisting of interproximal and selected periapical views may suffice. In circumstances with no evidence of current or past dental disease, only interproximal views may be necessary for caries examination.

For the **edentulous patient** it is appropriate to obtain a radiographic examination of all the tooth-bearing areas, either by occlusal or panoramic radiographs. If available, the panoramic projection usually provides the required information at a reduced radiation dose.

### **Recall Visit**

Patients who are returning after initial care require careful examination. As at the initial examination, obtain selected periapical views if any of the historical or clinical signs or symptoms are present.

The guidelines recommend interproximal radiographs for recall patients to detect interproximal caries and monitor the status of alveolar bone loss. The optimal frequency for these views depends on the age of the patient and the probability of finding these two diseases. If the patient has clinically demonstrable caries or the presence of high-risk factors for caries (poor diet, poor oral hygiene), the bitewings are exposed at fairly frequent intervals. Obtain bitewings for children at 6-month intervals until no carious lesions are clinically evident. For the adolescent at high risk of caries, the guidelines recommend bitewings at 6- to 12-month intervals; for the high risk adult, at 12- to 18-month intervals. The recommended intervals are longer for individuals not at high risk for caries; 12 to 24 months for the child, 18 to 36 months for the adolescent, and 24 to 36 months for the adult. Note that individuals can change their risk category, going from high to low risk or the reverse. Similarly, recall that patients with a history or clinical evidence of periodontal disease more serious than nonspecific gingivitis should have a combination of periapical and interproximal radiographs to allow appropriate monitoring.

A radiographic examination may be required in a number of other situations such as for patients contemplating orthodontic treatment or patients with intraosseous lesions. The goal should be to obtain the necessary diagnostic information with the minimal radiation dose and financial cost, which can be substantial for advanced imaging procedures such as MRI. The dentist should determine specifically what type of information is needed and the most appropriate technique for obtaining it.