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Radiographic considerations for special patients — modifications, adjuncts, and alternatives

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Introduction

The charge for this presentation is threefold: 1) To describe radiographic techniques advocated for special patient populations, 2) To comment on the adequacy of the techniques, and 3) To discuss alternatives to radiographic surveys.

Special Patient Populations

The term *special,* as interpreted from the literature, includes patients whose age, development, or disease requires modification of usual intraoral radiographic technique or precludes its use. Special patients may require extraoral techniques or may have to be treated without a radiographic diagnosis. Table 1 depicts the dental literature descriptions of special patients in detail. Although these descriptions are somewhat vague, they represent what is available and will be the working definitions used in this presentation.

Criteria for Adequacy

Determination of the adequacy of usual and modified techniques requires application of criteria related to the patient, technician/diagnostician, and technique. Manson-Hing[1] provides eight criteria for choosing a technique. They are:

1. Time expended by personnel,
2. Effort expended by personnel,
3. Radiation dosage patient subjected to,
4. Accuracy of technique,
5. Ability of diagnostician to use the product of the technique,
6. Skill and familiarity of the technician,
7. Patient ability and needs,
8. Available equipment.

Others have described criteria for determining adequacy of individual films,[2,3] Although the literature provides information on most of the criteria above for various techniques, the data using patient ability and needs as a main variable — 7. above — are scanty.

This author could find only three studies that looked at patient ability or need in an organized fashion. Two of these[4,5] compared the supine patient to the upright patient. Another compared intra- and extraoral film survey combinations for patient comfort using children as subjects.[6] Due to the lack of available data on accuracy, comments about the adequacy of alternatives to usual techniques will be the opinion of this author. Manson-Hing's criteria will be the basis for critique of various techniques.

Alternatives to Radiographic Examinations

Finally, the presentation will cover alternatives to radiographic examinations in oral diagnosis. The few available alternative techniques will be described briefly and evaluated in relation to characteristics of special patient populations.

Radiographic Techniques for the Special Patient

The dental literature provides numerous techniques which are purported to be effective with special patients. For the purposes of this presentation, the introral film — the periapical or bitewing — will be considered usual and customary. All of the modifications,

Table 1. Characteristics of special patient populations as described in the dental literature.

Category of Patient	Description Used in Literature
Young patient (chronological)	Birth to 3 years 3 to 5 years
Handicapped patient	Physically handicapped Mentally handicapped Bedridden Homebound Unable to keep mouth open Unable to close mouth to hold film in place
Patient with a Behavioral Problem	Management problem Anxiety Sedation Gagging
Patient with an oral developmental or physical problem	High vaulted palate Crowded dentition Small mouth Traumatic injury

adjuncts, and alternatives will be considered departures from the intraoral film or film survey in which the patient provides complete cooperation.

The alternatives to usual and customary intraoral radiography comprise four major categories:

1. Modifications of the intraoral technique,
2. Adjuncts in the form of devices, personnel, or induced changes in the patient,
3. Alternatives to intraoral filming which include the extraoral film techniques,
4. Miscellaneous approaches.

These four alternative approaches will be described in this section.

1. **Modifications of the Intraoral Technique.** Table 2 (p. 450) depicts the many modifications of intraoral radiography described in the literature. These modifications can be grouped very roughly into four categories:

(1.1) Modifications of the film packet,

(1.2) Modification of the film holder,

(1.3) Supporting devices for the film holder or patient's jaw,

(1.4) Modification of the film or film holder position.

(1.1) **Modifications of the film packet** include bending the corners,[7] using the smallest possible film,[8] or bending an occlusal film for use in either the anterior or posterior area.[9,10] All of these techniques are recommended for young children whose size, anxiety, or both, require a minimum of discomfort. Another modification for comfort is that recommended by Lewis et al.[11] in which cotton rolls are taped to the film packet to provide comfort and to maintain the plane of the film. All of the above techniques are suggested as alternatives to usual and customary techniques. Minimal criteria are provided to suggest when to use these and no data to show they are effective. The choice of one or the other apparently is made from one's experience, or trial and error.

(1.2) **Modifications of film holder** include using the Rinn Snap-A-Ray[a] in place of another intraoral holder, or making a film holder from tongue depressors and tape.[12] The benefit of these modifications appears to be the ease with which the handicapped or young patient can hold the film. The method for choosing these techniques, as well as their advantages, is reported empirically. Starkey[13] also reported a bitewing technique using a rubber band held by the child, but did not suggest indications for the technique other than its use with children.

(1.3) **Supporting devices for the film holder or patient's jaw** include mouth props, helmets with chin straps, or straps with Velcro strips.[12] Jaw control appears to be the criterion for choosing any one of these techniques. The handicapped patient with poor jaw control, either for opening or closing, would be helped by this technique. The Velcro strap and the helmet chin strap are used to keep the jaw closed after the film or film holder has been placed. A similar technique is used for unconscious patients being treated under general anesthesia.[14] The mouth props are used to hold film holders against the teeth.

(1.4) **Modifications of the film or film holder position** have been advocated for gagging, handicapping conditions, and the young or recalcitrant child.[15,16] One technique, the "reverse" bitewing, involves placement of the film in the buccal vestibule and directing the beam through the jaws from the opposite side of the patient's head. The buccal placement minimizes gagging yet provides a radiograph that looks much like a usual and customary periapical or bitewing, except for superimposition of the intervening structures. This technique does require an immobile patient, and with even minimal movement the already compromised quality is jeopardized. The technique may not work unless gagging is the sole problem.

The occlusal film is often advocated as a substitute for periapical views in the young child[17,18,9,10] and the technique is described in several pediatric dentistry textbooks.[19,20,21] The patient who has suspected traumatic injury to the teeth and jaws can also be considered "special" and the occlusal film is indicated for emergency surveys.

A final modification of film position is that described by Beaver[9] in which a pedodontic film is inserted lengthwise in a Rinn Snaparay to provide the smallest mesial-distal length possible while still permitting representation of contacting tooth surfaces.

2. **Adjuncts in the Form of Devices, Personnel, or Induced Changes in the Patient.** Table 3 depicts the behavioral, pharmacological, and physical adjuncts which can be used with usual and customary techniques, or with the modifications suggested earlier in this presentation.

Behavior techniques used as adjuncts include familiarization with technique and machine (also known to pediatric dentists as tell-show-do),[22] distraction of the young patient,[23] postponement of radiographic examination for two or three appointments,[24] and hypnosis.[25,26] The young child may require familiarization, distraction, or postponement while the gagging adult may need help with hypnosis. All of these are usual and customary techniques or modifications. Familiarization may take time, but the raport established may carry over to continuing treatment. Postponement presents the risk of having to begin treatment without radiographs or asking parents to return for visits used mainly to condition the child. Hypnosis requires a skill many dentists do not have; many patients cannot be hypnotized.

Pharmacological agents have been advocated to se-

[a]Rinn Company, Elgin, Illinois

Table 2. Modifications of the intraoral periapical and bitewing film.

Technique	Indications	Diagnosed Yield	Disadvantages	Description of Technique
Modifications of the Film Packet -Cotton rolls -Soften film corners -Bending occlusal film in half	-Child patient who cannot hold film packet	-Same as film technique used (PA = Periapical, BW = Bitewing)	-Supplies or equipment needed -Time consuming	-Attach cotton rolls with tape -Soften film corners by bender -Fold packet in half
Modifications of the Film Holder -Rinn Snaparay -Tongue blade and tape -Rubber bands	-Young child -Patient who cannot hold other film holders (handicapped)	-Same as PA, BW	-Equipment needed -Time consuming -Takes patient cooperation	-Place film as directed -Place several tongue blades together and tape film to blades -Attach rubber band to film. Place BW as usual but have patient hold other end of rubber band
Supporting Devices for Film Holder or Patient Jaw -Mouth props -Helmet with chin strap -Velcro strap	-Patient who cannot keep teeth together or open mouth or bite with enough force to keep film in place	-Same as PA, BW	-Equipment needed	-Use prop to hold film holder against teeth -Use helmet strap to hold jaw closed -Use Velcro strap to wrap around head to keep jaw closed
Modifications of the Film or Film Holder Position -"Reverse" bitewing or periapical	-Handicapped -Gagging -Behavioral problem -Young child	-Same as PA or BW	-Equipment needed -Unfamiliar technique -Superimposition of intervening tissue -Lack of contrast	*Reverse Bitewing or Periapical* 1. Place film in buccal vestibule 2. Use settings: 1¼° 70 kv 15 MA 3. Angulate head at -15° 4. Double developing time to improve contrast
-Occlusal films	-Same as above -Trauma victim	-Identification of traumatic injury -Interproximal caries -Developmental problems -Anterior survey	-Overlap of teeth at peripheries of film	Occlusal Film 1. Place film between teeth 2. Use settings: 1° 65 kv 10 MA 3. Angulate at 60-65° for the maxilla and -45° for the mandible
-Lengthwise film placement in Rinn Snaparay for bitewing	-Young Child	-Same as BW	-May not include all teeth in a wide-spaced arch	-Place film lengthwise in holder

date patients with gag reflexes[25] or other uncontrollable reflexes or movements. The literature provides only limited support that pharmacological agents are effective in radiographic diagnosis. This support is empirical. Sedative agents carry with them the problems of drug choice, dosage, side effects, and possible interaction with other drugs. The phenothiazine derivatives, antihistamines, barbiturates, and nitrous oxide are just a few of the agents recommended. The use of local anesthetics such as xylocaine or dyclone in topical or rinse form appears to be effective in temporarily relieving gagging. General anesthesia does not appear to be considered a reasonable approach to obtain radiographs, although radiographic examination is often done in conjunction with treatment in the operating room. Medical radiographs such as brain scans are routinely done after the patient has been sedated, but this practice has not extended to dentistry.

Physical restraint or assistance is a recognized technique, used both with children and the handicapped.[8,12] Parents are most frequent choices to assist, so that the dental personnel are not subjected to excess radiation.

Lead gloves and aprons are standard equipment to protect those assisting. One difficulty with parental assistance is their lack of familiarity with technique. This lack of skill often necessitates repeated filming.

The use of restraining devices such as the Papoose board[b] or Pediwrap[c] is poorly documented. These devices restrain the body, but may not adequately control head or mouth movements.

3. **Alternatives to Intraoral Filming — Extraoral Techniques.** When intraoral filming is not possible or practical due to a child's age or a patient's handicap, extraoral techniques may be the only alternative. The lateral jaw or lateral oblique and the panoramic films are the most common substitues for intraoral surveys. Table 4 shows three alternatives to intraoral techniques.

The lateral jaw exposure provides a unilateral view of the posterior dentition and jaws.[27,28,29] Traumatic injuries, periapical pathosis, and dental developmental status can be seen on the lateral jaw film. The technique involves an occlusal film or lateral film cassette on the side to be filmed. The X-ray head is placed on the opposite side and the beam directed through the face to the cassette or film packet. The patient or parent can hold the film, or it can be taped to the face. A child or handicapped patient may be filmed lying on his or her side with the film between face and dental chair. A lead shield can be placed on half the film or cassette and the same cassette used to display both sides of the patient.

The panoramic film[30] (Panorex[d], Orthopantomograph[e]) is another extraoral technique used for the young child, the trauma victim, or the handicapped patient. The technique yields a general survey covering a large proportion of the face, but in detail too poor for early caries detection or identification of minor periodontal problems.[31] Oral structures are also distorted, but with a head positioner the distortion may be predictable.[32] The dose administered is less than that for a full mouth survey,[33] although in children, the thyroid receives a dose higher than that received by an adult.[34] The technique also allows filming of the handicapped patient without transfer. Valachovic and Lurie[35] feel that the indications for panoramic radiography are limited from the standpoint of decreased radiation exposure since, in many cases, additional intraoral films are taken when pathosis is identified.

The Siemens Status-x[f] provides still another option for extraoral filming. This machine is not common in

[b]Olympic Medical Corporation, Seattle, Wash.
[c]Clark Associates, Inc., Worchester, Mass.

[d]S. S. White Penwalt Corporation, X-ray Division
[e]Siemens Electric Ltd., Medical Systems
[f]Siemens Electric Ltd., Medical Systems

Table 3. Adjuncts to the intraoral or modified intraoral film.

Technique	Indications	Diagnostic Yield	Disadvantages	Description of Technique
Behavioral Techniques	-Gagging -Young child -Anxious patient	-Same as film technique used (PA = Periapical, BW = Bitewing)	-Time consuming -Skills may be necessary	-Hypnosis -Tell-show-do -Distraction -Postponement
Pharmacological Agents	-Gagging -Uncontrolled movements	-Same as PA or BW	-Side effects and potential interactions -Available drugs	Gagging 1. IM (12.5mg Phenergan + 9mg Nisentil) 2. PO (2 tsp Donnagel elixir) 3. Suppository (50 mg Cyclizine) 4. Inhalation (N_2O/O_2) 5. Topical (2% Xylocaine or Dyclone rinse)
Parental Assistance	-Young child -Anxious child -Handicapped	-Same as PA or BW	-Equipment needed -Parental exposure -Parental skill required	1. Protect parent with gloves and apron 2. Parent stands behind child or cradles young child 3. Child's body stabilized with one hand while chin or film holder stabilized with other hand

Table 4. Extraoral radiographic techniques.

Technique	Indications	Diagnostic Yield	Disadvantages	Description of Technique
Lateral jaw (Lateral Oblique)	-Young patients -Restricted opening -Gagging	-General survey -Dental developmental status -Traumatic injury -Suspected periapical pathosis	-Poor detail -Superimposition -Unusual projection -Unfamiliar technique -Special film needed -Distortion	1. Film placed on cheek on side to be filmed 2. Settings: 1½° 90 kv 15 MA 1-1½° 65 kv 10 MA 3. Head positioned on opposite side and beam angled at 15°
Panoramic	-Gagging -Physical or mental handicap -Young child -Traumatic injury	-Same as lateral jaw, but bilateral	-Equipment needed -Long exposure -Poor detail -Distortion	1. Patient seated 2. Extraoral film placement 3. Extraoral beam generation 4. Rotating X-ray head
Status-X (intraoral beam generation; extraoral film placement)	-Young child -Bedridden -Handicapped	-Same as lateral jaw or panoramic but of higher quality and smaller area	-Equipment needed -Unfamiliar projection -Unorthodox technique -Distortion	1. Patient seated or in supine position 2. Extraoral film placement 3. Intraoral beam generation

Table 5. Miscellaneous approaches.

Technique	Indications	Diagnostic Yield	Disadvantages	Description of Technique
Reclining (supine patient)	-Bedridden -Handicapped	-Same as filming technique used (PA = Periapical, BW = Bitewing)	-Need contour chair or space for bed	-Place patient in contour chair in supine position or in bed -Take films as usual
Portable X-ray equipment	-Homebound	-Same as PA or BW -Equipment needed	-Transportation	-Take films as usual

the United States, but is used extensively in Europe. It has been recommended for the young child, the child with a high palate, or crowded teeth,[36] and the bedridden patient.[37] The intraoral X-ray source and extraoral film placement provide lower patient dose[38] and, in many projections, an adequately detailed film.[39] The rapid exposure makes the technique good for the handicapped and young child who have problems with movement. Disadvantages include the unfamiliar mode of display, the unorthodox technique, and distortion.[40]

4. **Miscellaneous Approaches.** At least two authors[4,5] have evaluated radiographs taken on the supine patient. This technique, which would be used for the bedridden or handicapped patient, appears to provide films of high quality, is acceptable to the patient, and minimizes both time expenditures and radiation to the gonads.

The literature also describes the use of portable radiographic equipment[41] for the homebound, but no data are available on the effectiveness of this technique (Table 5).

Adequacy of Techniques

None of the techniques described above have been rigorously tested using all the criteria of Manson-Hing.[1] The panoramic,[6,31-34] Status-x,[38] and reclining position[4,5] have been evaluated according to either accuracy, comfort, radiation dose, or technician ability. Whether or not any of the other alternatives are really effective or even adequate remains to be seen. All we have to rely on is the familiar "it works in my hands" dental empiricism.

A subjective view of these techniques by this author suggests that their effectiveness may be in question. The most obvious problem is the lack of detailed criteria or indications for choosing to use a modification over usual and customary techniques. The terms "handicapped," "young child" or "management problem" provide little in the way of specific guidance

for the clinician. Gagging is probably the clearest criterion for modification of technique, but no author provides a suitable method for identifying this problem or measuring its severity other than trial and error.

Manson-Hing[1] considers time and effort of personnel a prime consideration in choosing a technique. It should be obvious that both additional time and effort will be expended if adequate criteria are not available for choosing a technique suitable for a special patient. In addition, the rarity with which these techniques are used in general dental practice make one suspect that additional time and effort will be expanded to obtain a suitable product. The technical process is not rote and may require repetition to obtain even a compromised product.

This lack of familiarity leads to several other shortcomings related to radiation dose and quality or accuracy of films. Both the panoramic film and the lateral jaw deliver less radiation than a full-mouth series of intraoral films, but if patient selection is poor or if the technician is not familiar with the technique, films will have to be retaken because of a nondiagnostic product. The low dosage advantages may be lost in order to obtain diagnostic quality.

Another major shortcoming of these techniques is the need for additional equipment or supplies. Many practitioners do not have the option of a panoramic film. Parental assistance requires both a lead apron and lead gloves which accounts for an expenditure of about $200 and parental willingness.

A factor mentioned by Manson-Hing which might go unnoticed is the ability of the diagnostician to read films of varying quality and format. The lateral jaw and panorex present views which are less familiar to the general dentist. Their detail is limited and structures are not only in strange relationships to one another, but distorted in size and form. Whether or not every clinician can sort out these variations from pathosis has not been clearly demonstrated in the literature.

To determine whether a technique is adequate one must also consider the patient's needs. The panoramic film has been shown to be inadequate for diagnosis of fine detail such as early or incipient dental caries.[31] The lateral jaw provides even less information in less detail, and in a more distorted and unusual view. These are not diagnostically equivalent to a full-mouth intraoral survey.

The young child appears to have need for only the most simple of surveys, and postponement is often advocated except for clarification of obvious problems first observed clinically[17] Most authors who advocated deferring radiographic examination did so prior to Headstart program data which indicate that about half of two-year-old children have dental decay. One also has to ask if an occasional occlusal film will suffice, since studies comparing a 3-film survey to an 8-film survey show that the former missed a large proportion of congenital anomalies.[42]

The handicapped patient presents dental needs today which are vastly different from even a decade ago. The panoramic film or lateral jaw that would have been sufficient for the extractions that were the rule in the handicapped population before will not suffice today for the handicapped person whose oral health has improved with increased awareness. Today's handicapped person tends to have fewer carious lesions than in the past, but is still plagued with periodontal disease. Bitewing films or the panoramic film, which would be the minimum of a "survey" for the handicapped patient, do not show either occlusal caries, or early interproximal lesions respectively.[43] This is the disease state being seen more and more often with the handicapped, especially those who have benefited from fluoride.

Periodontal disease, which is the more critical problem for the handicapped person today, is resistant to radiographic examination in its early stages.[44] Even longstanding periodontal defects can be missed on radiographic examination, depending on location.[45]

Based on the above discussion, this author concludes that the available techniques are a last resort when all other possibilities have been tried. They should be considered 1) adjunctive and 2) most effective when used only as indicated.

As a final comment on adequacy, it should be noted that we are currently investigating several of these techniques in an organized fashion at the University of Colorado. We hope to be able to determine specific indications as well as effectiveness according to the criteria of Manson-Hing[1]

Alternatives to Radiographic Examination

Very few alternatives to radiographic examination exist in the special patient population. The reasons for this are that most other adjuncts to a clinical examination require a subjective evaluation by the patient as well as the clinician. The radiograph obtains objective data from the patient which the clinician looks at subjectively. Pulp testing and percussion, for example, require patient input which is difficult to obtain from the handicapped or young child patient.

Transillumination is one objective technique, but it also has limitations in terms of its diagnostic yield. Interproximal caries of anterior teeth can be noted, as can be crown fractures and some forms of soft tissue pathosis. Transillumination does not provide information about deep structures, nor details about existing pathosis.

In summary, short of a thorough clinical examina-

tion, no suitable alternatives exist. It would appear that the ready availability of radiographic examination may have deterred development of other useful techniques. Perhaps in the future, we may have techniques comparable to ultrasound or automated serum testing which are used widely in medicine.

Summary

A large number of alternatives to usual and customary radiographic techniques exist, yet indications are vague and efficacy is largely unproven. These techniques range from modifications of intraoral techniques to extraoral techniques. The varied nature of the special patient population and the lack of significant study data on the alternative techniques make these little better than last resorts. All modifications, adjuncts, and alternatives should be viewed as substitutes rather than equivalents to the usual and customary intraoral film.

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