Interpreting Office Radiographs

A Guide to Systematic Evaluation

John G. Halvorsen, MD, MS, and David Swanson, MD
Minneapolis, Minnesota

Office radiographs are important diagnostic tools for most family physicians, and most family physicians believe that they should be capable of interpreting 90% of these films without referral to a radiologist. Optimal use of these radiographs requires that patients are appropriately selected, that the examination is adequately conducted, and that the films are accurately interpreted. Interpretive accuracy is enhanced if radiographs are analyzed by physicians skilled in observing and interpreting them and if the images are examined in a logical, systematic manner to minimize observer bias. A systematic search pattern is proposed to facilitate family physicians' interpretations for the most common office radiographs: chest, extremities, abdomen, skull, and spine. **J Fam Pract 1990; 31:602-610.**

Radiology is important in the office practice of most family physicians. Almost 90% of family physicians in one survey indicated that they have x-ray equipment in their offices and that they use it to obtain as many as 28 different types of radiographs.[1] The most common studies, however, are of the extremities (42%), chest (40%), spine (7.5%), and abdomen–pelvis (4%).[2,3]

Not only are office radiographs important in diagnosing patient problems, but most family physicians believe that plain film radiographic interpretation is a fundamental clinical skill for the family physician, and that he or she should be capable of interpreting 90% of the office films independently.[1] A study that compared family physicians' interpretations with those of a radiologist on office radiographs found that this goal is indeed achievable.[4] In that study, family physicians were concordant with the radiologist over 90% of the time, and all radiographs about which significant interpretation discordancy existed were selected for referral to a radiologist for a second interpretation. Therefore, no problem escaped detection.

If radiographs are part of the family physician's office practice, it is legally, ethically, economically, and medically prudent that they be used optimally for patient care. Brown et al,[5] in their monograph *The Selection of Patients for X-ray Examinations*, identify three specific activities that are critical for optimal utilization: (1) patient selection—deciding to request an x-ray examination on a particular patient, (2) conduct of the examination—applying the optimal technique to obtain the requested radiograph, and (3) interpretation—analyzing the results of the radiographic examination. The first activity is discussed in a separate article focused on proper indications for a radiograph examination in the office.[6] The second activity is also discussed in a monograph written to accompany a curriculum for training residents in the use of office radiographs.[7,8] The focus of this article is on interpretation, specifically on the first step of the interpretive process, the systematic evaluation of the radiograph.

The data from any radiograph must be transformed into information that is useful for patient management. Interpretation is the process of converting those data into useful information. To maximize the interpretation process—to extract as much information as possible—certain conditions, outlined by the American College of Radiology (ACR)[9] in its *Guide to Good Practice*, must be met:

1. Diagnostic images must be analyzed only by physicians skilled in their observation and interpretation.
2. Films must be viewed on viewboxes that have adequate, constant, and uniform levels of brightness.
3. Room light must be subdued, and the interpreter's

Submitted, revised, June 5, 1990.

From the Department of Family Practice and Community Health, and the Department of Radiology, University of Minnesota, Minneapolis. Requests for reprints should be addressed to John G. Halvorsen, MD, Department of Family Practice and Community Health, 3-100 Phillips-Wangensteen Bldg, 516 Delaware St SE, Box 381 UMHC, Minneapolis, MN 55455.

environment must be free of distracting influences so that full attention can be devoted to the task.

4. Images must be examined in a logical, systematic manner to minimize observer bias in the detection of abnormalities.

5. Magnifying lenses and "hot lights" should be used to increase perception of both resolution and contrast.

6. Radiologic data must be integrated with other data concerning the patient to arrive at a decision that affects patient management.

Conditions 2, 3, and 5 relate to the interpretation environment that must be structured into the individual clinic setting. Because family physicians evaluate patients before obtaining radiographs, condition 6 is met by most. Examining patients before evaluating the radiograph, however, also makes them vulnerable to the potential risk of observer bias when interpreting the film. The content of this article focuses on helping family physicians develop interpretation skill (condition 1) and minimize bias by outlining a logical, systematic search pattern for each of the commonly obtained office radiographs (condition 4). The next stage in developing interpretation skill is the educational task of correlating the search pattern with the details of normal and pathological anatomy to really see what one is looking at during the systematic search.

A SYSTEMATIC SEARCH PATTERN FOR CHEST RADIOGRAPHS

Although a strict search pattern is critical for minimizing bias and for assuring that all portions of the film are included in the visual search, maintaining such a pattern while reading chest radiographs is usually difficult. The physical limits of detailed vision (the size of the circle on which one can focus) make it very easy for the eyes to be distracted by peripheral vision. The interpreter must resist the strong natural tendency to deviate and focus on anything that catches his or her attention, thus interrupting the search pattern or discontinuing it prematurely.

Some authorities[10,11] advocate a free search pattern either as the initial approach to the film, which is then followed by an organized search if some abnormality is found, or as the final scan of an apparently normal film. Most experienced radiologists interpret films in this manner. The studied, directed approach outlined in this article, however, should be practiced by the novice until proper interpretation habits are established.

The following steps are helpful in training the interpreter to establish a routine search pattern.

STEP 1. TECHNICAL QUALITY

1. Is the film correctly centered?
2. Is the patient rotated?
3. Does the film include both the apices of the lung and the lower neck as well as enough of the diaphragm and upper abdomen to ensure that the posterior sulci of the lungs are included? Both lateral sulci (costophrenic angles) along with the ribs should be on the film. For a large person more than one film may be necessary to ensure that the entire chest is visualized on the examination.
4. Is the film taken in full inspiration? A film taken in expiration can cause confusion by simulating disease, eg, pulmonary congestion, cardiomegaly, or a widened mediastinum. As a general rule, the diaphragm should cross the anterior end of the sixth rib or fall just below the posterior aspect of the tenth rib with good inspiratory effort.
5. Is the exposure correct? A finger held behind a black portion of the film should be barely visible. One should also be able to trace the line of the descending thoracic aorta behind the heart and identify some of the thoracic spine detail through the mediastinum or heart in a properly exposed film. An underexposed film may be misinterpreted as suggesting pulmonary edema or infiltrate. Significant pathologic findings may also be entirely obscured, especially behind the heart or diaphragm. An overexposed film may suggest emphysema. Slight overexposure is preferable to underexposure, however, since an overexposed film can be illuminated under a high-intensity light source to reveal findings.

STEP 2. SYMMETRY

The reader should next look at general symmetry and take note of any gross findings for further analysis.

STEP 3. PERIPHERAL SOFT TISSUE

Although some interpreters start with the mediastinum and work toward the periphery, the reader should evaluate the peripheral soft tissue, chest wall, and upper abdomen first. These areas are easy to disregard if there are more important appearing areas to view in the lungs or mediastinum. By attending to the peripheral areas first, the reader will make fewer oversights. Specifically examine the chest wall soft tissue, the shoulder girdle area, the neck, and the upper abdomen, addressing the following questions:

1. Is there any increase, decrease, or absence in soft tissue?
2. Is there any asymmetry of soft tissue in the lower neck?

3. Are there subcutaneous gas collections?
4. Are the bowel gas distribution and stomach bubble normal?
5. Is there any free air in the abdomen?
6. Is each half of the diaphragm in its normal position?

STEP 4. OSSEOUS STRUCTURES

Next view the osseous structures.

1. *Ribs*. Force the eye to trace along the outline of the ribs anteriorly, laterally, and posteriorly. Go up one side and down the other. The ribs may be difficult to trace, especially where they overlap laterally or in patients with substantial demineralization. Subtle changes, such as fractures, are easily missed even by experienced observers.
2. *Shoulder girdle*. As the ribs are traced, view the bony structure of the shoulder girdle. Outline the scapulae, which are superimposed on the ribs. Remember that the anterior clavicles and the posteriorly located scapulae can project quite differently with only slight differences in patient position or beam orientation. View as much of the shoulders as possible. The acromioclavicular junctions may be overexposed and require illumination with the bright light.
3. *Spine*. View the spine as well as possible in both the posterior-anterior (PA) and lateral projections. Remember, however, that the spine is often suboptimally exposed on chest films.

STEP 5. MEDIASTINUM

Next examine the mediastinum. One should think separately about the upper, middle, and lower mediastinum on the frontal view, and the anterior, middle, and posterior mediastinum on the lateral view. It is very important to think three-dimensionally while observing one or two plain film views, especially in this portion of the chest. Even though the heart and great vessels are part of the mediastinum, they are considered separately. By viewing the mediastinum separately, the reader can key in on the following aspects of the mediastinum apart from the heart and vessels:

1. Mediastinal widening that is due to other soft tissues
2. Normal, abnormal, and missing lines
3. Other soft tissue structures
4. Tracheobronchial tree
5. Esophagus

STEP 6. HILUM

Before looking at the cardiovascular structures, examine the hilar areas for extravascular structures. The normal hilar shadows should show individual vessels representing the pulmonary arteries and major veins, and very little else. It may be difficult to see other pulmonary veins. The left hilum should be 1 to 3 mm higher than the right. The hila should be carefully compared for overall density and overall contour. The hila are best analyzed on the lateral projection.

STEP 7. HEART AND GREAT VESSELS

Next examine the heart and great vessels, including the extramediastinal vasculature, for the following:

1. *Cardiac size*. Normally the maximum transverse dimension of the heart measures 11.5 to 15.5 cm, or less than 50% of the maximum transverse dimension of the thorax inside the rib cage.
2. *Cardiovascular silhouette*. Examine the aortic arch and the course of the descending aorta. Examine the cardiac borders, keeping in mind their constituent structures: inferior border—from right to left, the right atrium, right ventricle, and left ventricle; right border—from top to bottom, the superior vena cava, right atrium, and inferior vena cava; left border—from top to bottom, the aortic knob, descending aorta, pulmonary artery, left atrial appendage, and left ventricle.
3. *Cardiac position*. The extremes in position vary from the narrow, vertical, centrally placed, flask-shaped heart to the larger, horizontal heart that has a relatively prominent left border and that lies with two thirds of its shadow to the left of the midline and one third to the right.
4. *Evaluate heart and pulmonary vessels as a unit*. This unit or system approach allows one to better categorize any abnormalities that may be present.

STEP 8. LUNG FIELDS

Finally the lung fields can be evaluated. It should be stressed that while analyzing the lungs, the reader should try to subtract in his or her own mind the osseous and vascular structures, since these have already been evaluated in the previous interpretation steps. The lung fields can be evaluated by looking from side to side and comparing similar areas. It is probably more logical, however, first to view the overall appearance of the hemithoraces and lungs for gross difference, and then to look at each lung considering the inner, middle, and outer thirds. A second search, scanning each lung from top to bottom or vice versa, will help to ensure that no pathologic findings are missed. The search pattern of the lungs should include the specific question, "Is there a pneumothorax present in this patient?" Unless the possibility of a pneumothorax is specifically addressed, subtle collections of air in the pleural space (which may be practically asymptomatic) can be easily missed.

A SYSTEMATIC SEARCH PATTERN FOR INTERPRETING EXTREMITY RADIOGRAPHS

It is important to remember that there are several general principles that must be followed for the optimal interpretation of extremity films. The old adage "One view is like no view" contains some truth. It helps to drive home the point that a three-dimensional object cannot be represented in a single plane (unless that plane includes complementary stereo views). It is important, therefore, to obtain at least two views, as close to right angles as possible, for all suspected fractures and dislocations, except in the pelvis, where oblique projections may help. Occasionally more views will be needed, especially for multifaceted and cancellous bone (eg, the scaphoid in the wrist), where a fracture may not be easy to recognize unless it is seen in profile (on edge).

Films should always show the joint above and below any suspected fracture of the forearm or leg, unless it is clinically obvious that the injury is only in the most distal part of the limb. In this case, only the nearest joint may be included. This principle is important to ensure that the forces transmitted to the bone to injure it did not also injure its articulations.

STEP 1. EXAMINE SOFT TISSUE

The basic approach to any view of an extremity should be to examine the soft tissue first. The reader is thus forced to evaluate the less obvious portions of the film before they are neglected in favor of the obvious density or major focus of interest in the bone itself. Examine the soft tissue for the following items:

1. Generalized soft tissue swelling or wasting of muscle or subcutaneous tissue
2. Localized soft tissue swelling, defect, or ulceration
3. Presence of foreign bodies in the soft tissue. Usually heavy metallic fragments, rock, and some injected substances (iodine, bismuth, barium, iron) are visible. Sometimes glass with a high lead content and overlying bandages are seen. Most often plastics, light metals (like aluminum), plain glass, wood, or thorns are poorly visualized.
4. Presence or absence of certain fat planes or fat accumulations
5. Contour of soft tissue around joints

STEP 2. EXAMINE JOINTS

1. Evaluate the joints proximal and distal to any injured bone for extension of fracture or for any dislocation of the joint.
2. Evaluate the joint spaces for abnormal narrowing or widening.
3. Examine the bone surrounding the joint for degenerative changes or specific arthritic changes (osteophytes, sclerosis, and cysts).

STEP 3. EXAMINE BONE

After analyzing the soft tissue and joints, the reader should direct his or her attention to the bone itself, following a sequential process.

1. Make an overview of the entire bone in terms of overall density and integrity consistent with the patient's age.
2. Consider bony developmental status relative to age in children by evaluating the epiphyses.
3. Consider the relationship of the bone to bones that surround or articulate with it. This step is particularly important, for example, in evaluating the wrist for carpal dislocations.
4. Trace the outline of each bone in all projections, looking at the integrity of the cortex. Examining the entire cortical surface may prove a bit tedious, but it is the only way to avoid missing subtle fractures. A bright light may be needed to view dark or overexposed areas of the film.
5. Scrutinize the internal anatomy of the bone for trabecular pattern and any localized lytic (decreased density) or blastic (increased density) changes.

A SYSTEMATIC SEARCH PATTERN FOR INTERPRETING ABDOMINAL RADIOGRAPHS

The supine film (flat film or kidney, ureter, bladder [KUB]) and an upright anterior-posterior (AP) view are usually obtained to assess the abdomen. The supine radiograph must cover the entire abdomen, including the diaphragm and the pelvis. If the patient is too large for a single film, use an additional film. Occasionally a left lateral decubitus view (left side down and right side uppermost with a cross-table beam) is substituted for the upright view if the patient cannot stand. It may also be obtained in addition to the standard views. If a bowel perforation is suspected, then PA and lateral films of the chest should also be obtained. The interpretation discussion here will concentrate on the search pattern for the standard supine and upright views.

STEP 1. EXAMINE PERIPHERAL SOFT TISSUES

1. *Abdominal layers*. Try to discern the layers of the abdominal wall as they are defined by low-density fat lying between the muscles. All layers may not be well defined, and bright light viewing may be necessary. Usually the innermost fat layer, the properitoneal fat line, however, is discernible. This fat line outlines the peritoneum in the flanks. There may also be skin folds overlying the abdomen in front or in back. These folds may cause some confusion, but they are usually differentiated by their sharp delineation by air, and they often cross from abdomen to chest or abdomen to pelvis and buttocks.

2. *Diaphragm*. Note the position of the diaphragm and look for possible free air under one hemidiaphragm or the other. Free air is frequently best seen over the dome of the liver and may be better appreciated with an AP view centered on the diaphragm. Occasionally a thin subdiaphragmatic fat line or a thin density in the lower lung field paralleling the diaphragm may simulate free air. On occasion it is necessary to recheck very small and equivocal amounts of free air by putting the patient in the left lateral decubitus position for at least 5 minutes and then obtaining a film without disturbing the patient. True free air will shift from under the right hemidiaphragm to a position laterally up against the right abdominal wall between the wall and the right lobe of the liver. Very small amounts of free air (1 to 2 mL) can be detected in this fashion.

3. *Posterior sulcus of the lung* (posterior attachment of the diaphragm). The posterior attachment of the diaphragm is considerably more caudad than its anterior attachment. Lung tissue therefore lies behind the diaphragm. This part of the lung actually shows up much better on an abdominal film than on the PA chest film. Minimal infiltrates or lung nodules may therefore be better demonstrated in abdominal films that include the diaphragm.

4. *Pelvic soft tissue*. Occasionally irregular or ring-like calcific densities overlie the pelvis on either side or project into the soft tissue of the lateral buttocks. These usually represent calcific granulomata caused by previous injection of antibiotics in oily suspension or direct injection of radiodense substances. Overall soft tissue density should also be evaluated for slight increases on one side or the other that might be associated with inguinal or abdominal wall hernias.

STEP 2. EXAMINE BONY STRUCTURES

1. *Ribs*. Note the rib cartilage calcification that often overlies the upper abdomen, and do not confuse these calcifications with gallbladder, renal, pancreatic, adrenal, or other significant calcification. Calcification in rib cartilage can usually be identified by virtue of its shape and position, but occasionally oblique views are necessary. If there has been any recent trauma, trace the outlines of the ribs to look for fractures. Tracing ribs is especially important on the left side where displaced rib fractures could be associated with splenic trauma.

2. *Spine*. Look for any change in bone density, either increased or decreased. Look for any vertebral collapse or abnormal alignment. Look for fractures of the transverse processes of the vertebrae if there has been any significant flank or back injury.

3. *Pelvis and hips*. Make sure there is no pelvic fracture, especially on either side of the pubic symphysis and around the hips. Examine the sacroiliac joints to make sure they are symmetric and sharply defined. Remember that if one fracture is seen in the pelvis, it usually means that at least one more fracture or separation is present as well because of the way forces are transferred to the circular structure of the pelvis.

STEP 3. EXAMINE RETROPERITONEAL STRUCTURES

1. *Kidneys*. Renal outlines can usually be seen, at least in part, because of their contrast with perirenal fat. The right kidney is usually slightly lower than the left. Try to follow the entire outline of the kidney, looking for contour changes or obvious signs of a mass. Note the overall orientation of the kidneys with the long axis usually paralleling the psoas muscle shadows. If both kidneys are aligned in a rather vertical fashion, look carefully at the lower poles for any signs of soft tissue connection between the lower poles that would indicate a horseshoe kidney. Finally, carefully inspect the area of the renal shadows to look for calcifications that might indicate renal or collecting system calculi. Calcifications in the right upper abdomen, however, not only may occur in the kidney, but may also be localized in the gallbladder.

2. *Ureters*. Trace along the course of both ureters looking carefully for small calcifications that might indicate a ureteral calculus, especially if the patient's symptoms are consistent with that diagnosis. Occasionally a silent renal or ureteral calculus may be present. Ureteral calculi may also be obscured by the bony structure of the pelvis, particularly the sacral wings. Calcified phleboliths within the pelvis may be confused with a calculus. Occasionally the tips of the transverse processes of the vertebral bodies will appear more dense, and it will be difficult to appreciate their association with the rest of the transverse process, which may be rather faint. Do not mistake this normal density of the transverse process tip with a ureteral calculus.

3. *Pelvic soft tissue*. Look at the soft tissue within the

pelvis, identifying the bladder shadow and, in women, the uterus, which lies immediately above the bladder and sometimes deforms the bladder shadow.

4. *Psoas shadow*. Note the outline of the psoas shadows as defined by thin radiolucent fat lines. Frequently one of the psoas shadows is poorly visualized in a perfectly normal abdomen. The psoas lines should be straight. An asymmetrical bulge or extra line may indicate retroperitoneal hemorrhage, abscess, or tumor (eg, lymphoma). Occasionally in muscular individuals, the psoas shadows will bulge laterally, but they will be symmetrical.

5. *Adrenal*. The adrenal glands are not usually evident on the abdominal film, but occasionally one of them is calcified and can then be seen immediately above the upper pole of the kidney.

6. *Pancreas*. The pancreas will not be manifest on plain films unless it is calcified.

STEP 4. EXAMINE INTRAABDOMINAL-INTRAPERITONEAL STRUCTURES

1. *Liver*. Look at the general size and configuration of the liver. Variation in liver outline is considerable, and sometimes a long extension of the right lobe of the normal liver (Riedel's lobe) will come down to or below the pelvic crest on the right.

2. *Spleen*. The splenic shadow in the upper left abdomen also varies considerably in its configuration. The spleen is located quite far posteriorly as opposed to the liver, which extends from front to back, and the pancreas, which is midline in AP position. The lower edge of the spleen may be visible and extend down for some distance. To call a spleen enlarged, however, one must locate both the upper and lower poles. Frequently small calcified granulomata are present in the spleen, usually secondary to histoplasmosis.

3. *Gas patterns*. Follow the gas patterns through the intestine, from the stomach, through the small bowel, to the colon. In studying the gas pattern in the abdomen, it is useful to look carefully for lines or circles of small staples. These usually indicate previous bowel surgery, which may cause a portion of the bowel to be absent, and therefore produce a pattern of gas distribution that may vary from the norm. Usually alteration of the stomach is manifest by numerous large staples in the left upper quadrant. In examining the gas patterns, start by noting the position of the gastric bubble. Normally there is very little gas in the small bowel, and only a moderate amount of gas is scattered through the colon. There should be gas in the rectum, however. The general position of portions of gas should be analyzed, attempting to locate each portion more precisely by analyzing the pattern of the bowel wall where the gas is located. The upper small bowel is seldom more than 3 cm wide and is usually divided into equal segments by white lines (plicae) across the bowel. The lower ileum is usually smoother in appearance than the upper small bowel. The pattern of gas in the colon is irregular compared with the regular pattern of the small bowel. In addition, the white lines (haustra) dividing the colon separate it into very unequal segments.

4. *Vascular structures*. The abdominal search pattern is completed by noting any calcified vascular structures. In particular, trace carefully any calcification in the walls of the abdominal aorta to note whether an aneurysm may be present. Occasionally an oblique view taken with the patient's right side elevated 45° from the table, his or her left side on the table, and the beam passing anterior to posterior, better visualizes the abdominal aorta projected clear of the spine. This projection is even better than a cross-table lateral view with the patient supine because the aorta is visualized with less intervening tissue.

A SYSTEMATIC SEARCH PATTERN FOR INTERPRETING SKULL RADIOGRAPHS

Skull films are obtained infrequently in the office, and their interpretation is difficult because of so much normal variation and bony overlap. The search pattern outlined here is a survey pattern useful for the office setting. If any question at all arises during the search, further consultation for interpretation or additional imaging is recommended.

The routine office radiograph examination of the skull usually includes two views—a PA (frontal) view, and a lateral one. Before attempting to interpret these films, it is important to quickly assess their technical adequacy. The following quality-control criteria will help to assure the reader that the views are correctly positioned.

In the lateral view, (1) the temperomandibular joints should be superimposed, and (2) the clinoid processes should be symmetrical.

In the frontal view, (1) the sagittal suture should be midline, (2) the outline of the skull should be symmetrical, (3) the orbits should be symmetrical, (4) the nasal bones should be in the center of the film, (5) the mandible should appear equal on both sides, and (6) the dense white petrous bones should be across the lower part of the orbits.

Lateral Skull Search Pattern

STEP 1. GENERAL INSPECTION

Look at the shape of the whole skull, identifying any area that bulges outward or that dents inward.

STEP 2. CORTICAL EXAMINATION

Follow the lines of the inner and outer table of the skull all around the skull vault looking for any discontinuity. Cortical fractures are seen as black lines, unless there is an overlap of the fragments, in which case the lines will appear white.

STEP 3. EXAMINE SKULL DENSITY

Next examine the density of the skull. Both the frontal and occipital areas are usually less dense, and the base of the skull is white because of the petrous bone. Look for both lytic defects and areas of localized or patchy increased density.

STEP 4. IDENTIFY VESSELS

Arteries are fairly regular and veins are irregular. Both divide into branches that are smaller than the parent vessels. Veins lead to irregular venous lakes. It is important to recognize that vessels may normally be quite large (especially veins), and that their pattern varies from patient to patient.

Vessels can be differentiated from fractures. Fractures vary in caliber, seldom branch, and may occur anywhere. Vessels must be in the correct anatomical pattern, have white cortical margins, and branch into smaller vessels.

STEP 5. THE PITUITARY FOSSA

Identify the pituitary fossa on the base of the skull in front of the white petrous bone. The clinoid processes should not be eroded, and the floor of the fossa should not be thinned or eroded. Below the pituitary fossa, identify the sphenoid sinus.

STEP 6. THE TEETH

When possible, look at the teeth. Children will have a translucent area around the roots while teeth are growing. A translucent area in adults usually signifies an abscess, or if there are several small translucent areas, osteomyelitis or rarely lymphoma.

Frontal Skull Search Pattern

STEP 1. GENERAL INSPECTION

Again look at the general shape of the skull and for indentations or outward bulges.

STEP 2. CORTICAL EXAMINATION

Follow the cortex from one side over the top of the skull to the other side, looking for cortical irregularities.

STEP 3. SKULL DENSITY

Is there any area of different density? Normally the lateral aspects along the temporal bones are more translucent. Look for any lytic areas or areas of increased density.

STEP 4. IDENTIFY THE SUPRAORBITAL RIDGES AND INFRAORBITAL MARGINS

STEP 5. THE SINUSES

The frontal sinuses are often asymmetrical in shape and uneven in density. The ethmoid and sphenoid sinuses are on either side of the nose. The maxillary sinuses, located below the orbit, should be equally translucent.

STEP 6. INTRACRANIAL CALCIFICATION

One should look specifically for any intracranial calcification. If a calcified pineal gland is visible, it should be in the midline. The identification and differential diagnosis of other calcifications are covered in most standard radiology textbooks.

A SYSTEMATIC SEARCH PATTERN FOR INTERPRETING SPINAL RADIOGRAPHS

Routine office views of the spine usually include an AP and a lateral projection. If the physician wishes to better visualize the neural foramina in the cervical spine, oblique views must also be obtained. The search pattern is basically the same for each region of the spine, whether one is evaluating the cervical, thoracic, or lumbar regions.

It should be emphasized that the craniovertebral level and the C1-C2 level must be very carefully analyzed. Significant abnormalities (especially trauma) can be very subtle in this area. Any questionable finding should be pursued with additional views or other imaging studies. Any patient with trauma to the head and neck (even when that is relatively minor) who comes to the office should be evaluated for possible pathological changes in the C1-C2 level.

AP Spine Search Pattern

STEP 1. ALIGNMENT

First examine spinal alignment. At all levels the vertebrae should be in a straight line or only slightly curved.

STEP 2. VERTEBRAL SHAPE

Vertebral shape must be examined carefully. Each vertebra must be evaluated individually in the following way:

1. Identify the transverse processes and their pedicles.
2. Note the spinous processes; they will vary slightly in shape and angulation.
3. Look at the disc spaces; they should have a uniform width.
4. Look for the paravertebral or facet joints in the cervical and lumbar areas.

Lateral Spine Search Pattern

STEP 1. ALIGNMENT

Examine the posterior margins of the vertebral bodies. A smooth, continuous "line" without any abrupt step or change in direction should connect these margins. The normal spine has a forward (lordotic) curvature in the cervical and lumbar areas and a backward (kyphotic) curvature in the thoracic area. If any part of the spine is straight or has the curvature reversed, an explanation for this deviation must be sought. Some normal spines have very little curvature, however, appearing essentially straight.

STEP 2. VERTEBRAL SHAPE

Again it is important to examine each vertebral body. Consider the following:

1. In each region of the spine the vertebrae should be about the same size and shape.
2. There is a normal progression of widening of the intervertebral disc spaces in both the cervical and lumbar spine. This progressive widening is extremely subtle in the cervical spine. In the lumbar spine, each disc space is most often slightly wider than the one above it, except for the L5-S1 (lumbosacral) disc space, which is narrower (sometimes substantially so) than the disc spaces above it.
3. The density of the vertebrae in each region should be similar with no localized lytic (lucent) or blastic (radiodense) areas.

STEP 3. LUMBAR VARIATION

Developmental variations are very common in the lumbosacral region. These variations are seldom clinically significant unless there is vertebral displacement. Look for the following:

1. Variation in number. Normally there are five lumbar vertebrae. There may be four when the fifth has become fused to the sacrum (sacralized), or six when a sacral vertebra is not fused, becoming lumbarized. Occasionally the transitional vertebra is at the upper end in a patient who may only have 11 ribs. T12 then has the appearance of a lumbar vertebral body.
2. Bifid spinous processes
3. Asymmetry of the neural arch
4. Absent or large transverse processes

SUMMARY

If radiographs are to remain an integral part of the family physician's office practice, and if interpretation of these radiographs is to remain a fundamental clinical skill of the family physician, then family physicians must become and must remain skilled in radiographic utilization and interpretation. The concerns about patient selection are addressed in a separate publication,[6] as are technical standards for proper conduct of the examinations.[7] Developing the first stage of interpretive expertise is the focus of this article. The physician must learn to "see" everything that his or her eyes "look" at. He or she must collect all the data contained on the radiograph and transform those data into useful information through the interpretive process. One of the most important conditions recognized by the American College of Radiology[9] under which the interpretive process is maximized is that images must be examined in a logical, systematic manner. This systematic evaluation will increase the likelihood that all the data are collected and that observer bias (a problem for any physician who examines the patient before viewing the radiograph) is minimized. The systematic search process outlined in this article for the most common office radiographs will help family physicians satisfy this condition and improve their skills in observing and interpreting these office radiographs.

References

1. Halvorsen JG, Kunian A: Radiology in family practice: Experience in community practice. Fam Med 1988; 20:112–117
2. Halvorsen JG, Kunian A: Radiology in family practice: A descriptive study of office practice. Fam Pract Res J 1989; 9:21–32

3. Halvorsen JG, Kunian A: Radiology in family practice: A prospective study of 14 community practices. Fam Med 1990; 22:112–117
4. Halvorsen JG, Kunian A, Gjerdingen D, et al: The interpretation of office radiographs by family physicians. J Fam Pract 1989; 28:426–432
5. Brown RF, Shaver JW, Lamel DA, Arcarese JS: The selection of patients for x-ray examinations. Food and Drug Administration (Rockville, Md). DHEW publication No. (FDA) 80-8104. Government Printing Office, 1980
6. Halvorsen JG, Swanson D: Indications for office radiographs. In Halvorsen JG, Swanson D: A Residency Training Curriculum in Office Radiology. Minneapolis, University of Minnesota, Department of Family Practice and Community Health, 1989
7. Halvorsen JG, Swanson D: The Utilization and Interpretation of Office Radiographs by Family Physicians. Minneapolis, University of Minnesota, Department of Family Practice and Community Health, 1990
8. Halvorsen JG, Swanson D: Interpreting office radiographs: A research-based curricular prototype for training family practice residents. Fam Med 1990; 22:376–382
9. American College of Radiology: Medical Radiation: A Guide to Good Practice. Washington, DC, American College of Radiology, 1985
10. Tuddenham WJ, Culvert WP: Visual search patterns in roentgen diagnosis. Radiology 1961; 76:255–256
11. Tuddenham WJ: The visual physiology of roentgen diagnosis. A. Basic concepts. Am J Roentgenol 1957; 78:116–123