Thermographic Technology Training Manual

for Infrared

Cervical, Thoracic, and Lumbar

Thermography

by

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The Electronic Apparatus

Although there are different analog infrared machines on the market, they all function in basically the same manner. Computerized machines may or may not function in the same manner and have to be judged individually, according to their own merits.

The electronic units have the following basic controls:

1. *Focus* - the adjustment for the focus is located on the infrared detector. Every image to be thermographed must be properly focused.
2. *Polarity* - the polarity can be set for black representing hot or white hot, depending on the type of photographic film utilized. The end result of the black and white imaging should be in which black represents hot.
3. *Temperature Range* - the temperature range setting changes the sensitivity between adjacent color bands. 5 represents ½°C per adjacent color, 10 represents 1°C per adjacent color, etc. The temperature range should be set at 10 (1°C) for cervical, thoracic and lumbar thermography.
4. *Isotherm Control* - the isotherm control knob puts the system into isotherm mode. This control should be off during all color pictures. The isotherm function is utilized with specific black and white imaging procedures. This is discussed in chapters 7 and 8.
5. *Level Control* - This is the primary control knob which changes the level of colors in the area to be thermographed. This is discussed in chapter 6, *Technique.* The level control knob is also used in conjunction with the isotherm control when doing thermal focusing (chapter 8).
6. *Function* - Black & white/color. This control puts the system into color or black & white mode.
7. *Character Generator* - The character generator displays the patient's name, identification number, or any other desired information on the screen.
8. *Time and Date Display* - This displays the time and date on the monitor, which can then be photographed onto every thermogram.

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Medical Thermography

A thermogram is a picture of heat. Whether it be in color or black and white, thermography measures the natural heat distribution being emitted from the body. There is no radiation involved in the process, nor hazard to the patient. The body emits infrared radiation which cannot be perceived by the naked eye. The thermographic apparatus is sensitive to this infrared spectrum.

There are basically two types of thermographic equipment: infrared and liquid crystal (contact thermography). This manual is written specifically for infrared thermographic evaluation of the human spine and extremities for nerve damage - *cervical, thoracic, and lumbar thermography* (hereafter abbreviated C-T-L thermography).

A thermogram demonstrates physiologic function. It is unique in that it can detect sensory nerve impairment.

The procedure for C-T-L thermography is a meticulous one, and proper technique is necessary for accurate evaluation.

Both qualitative as well as quantitative information are recorded. The color being quantitative and the black and white being qualitative.

Color Thermograms

In the color pictures, diagnosis is made via left-right comparison along the course of the dermatome path (which represents the sensory nerve distribution) with relative symmetry being the expected norm. In most cases the problem area, due to constriction of blood circulation, is colder than the opposite side. There are, however, exceptions.

Black and White Thermograms

The lumbar area specifically requires qualitative as well as quantitative views. (This is discussed in Chapter 8, *Thermal Focusing*). Positive findings in the lumbar area are an increase in the vascular heat emission pattern that are specific in configuration and location. These "hot" lumbar findings are due to altered muscle metabolism at the site of irritation and are *myotome* as opposed to *dermatome* changes seen with extremities.

Examination Procedure

Preparation prior to examination

The exam must be conducted in a draft-free environment. Absolute temperature control is not necessary. However, the room should be uniform in temperature (68° - 72°) so that the patient is comfortable.

If there are air conditioning vents in the exam room which cannot be turned off without turning off adjacent room vents, the individual vents must still be covered or closed off in some manner. If there is a window in the room, it must be shut and covered to prevent incoming solar heat. The window(s) should first be covered with foil to reflect the heat, then cardboard should be placed over the foil, followed by heavy draperies. This will insure uniformity in overall room temperature. The floor should be carpeted. During the exam, the patient must not be placed in any corner. Differential heat reflections from the different wall surfaces could possibly cause dynamic changes.

Prior to the exam, usually at the time the appointment is made, the patient must be instructed as follows:

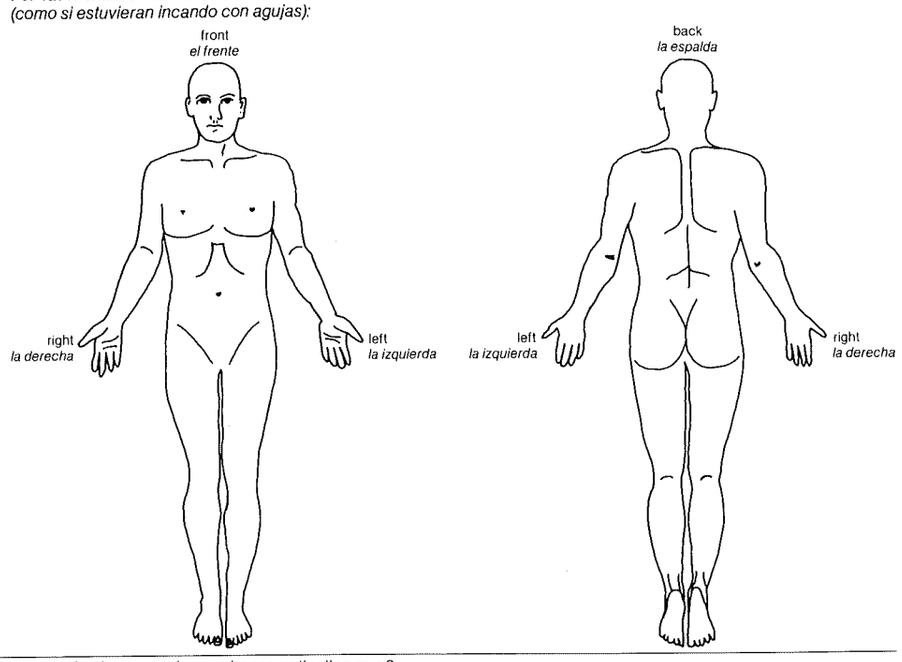
1. Refrain from smoking for 8 hours prior to the exam.
2. No physiotherapy of any kind the day of the exam. (Therapy may be scheduled following exam).
3. No EMG or acupuncture 48 hours prior to the exam.
4. No wearing of a T.E.N.S. unit or similar apparatus 24 hours prior to the exam.
5. Do not apply any creams, lotions or ointments, the day of the exam.
6. Patient should not be sunburned two weeks prior to the exam.
7. Female patients should not be scheduled for a lumbar thermogram during their menstrual cycle.

History Form

1 Name: *Nombre:* Age: *Edad:* Date: *Fecha:*

2 Date of accident: *Fecha del accidente:* Are you left or right handed? *¿Escribe usted con la izquierda o la derecha?*

3 Please mark on picture with an X where you have had pain or other symptoms since your injury. Include symptoms of pain, numbness, or tingling:
Por favor marcar con una X donde le duelle. Que clase de sintomas tiene—de dolor—adormecimientos o incones (como si estuvieran incando con agujas):



4 Are you having any pain, numbness or tingling now?
¿En este momento tiene usted algun dolor, adormecimiento o icones?

5 Put a circle around the areas that hurt at this time.
Dibuie un circulo alrededor de las Xs (donde le duele ahor mismo).

6 Are you taking any medication? *¿Esta tomando medicina?* What kind? *¿Que clase?*

7 Do you smoke? *¿Fuma usted?* Time of last smoke: *La ultima vez que fumo y a que hora:*

8 Do you have gout? *¿Tiene usted gota?* Do you have diabetes? *¿Tiene usted diabetis?* Do you have arthritis? *¿Tiene usted artritis?*

9 Have you had any fractures or surgery on your arms, legs, hands, feet or back?
¿Ha tenido usted alguna fractura o cirujia en sus brazos, piernas, manos, o pie?
Where? *¿Donde?* When? *¿Cuando?*

10 Briefly describe what happened to you at the time of the accident:
De un resumen como sucedio el accidente:

Fig. 3-A. History Form

The Thermographic Examination

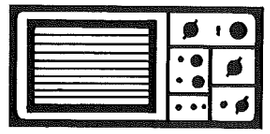
1. History Form: A sample of a history form is shown in Fig. 3-A.
   a. Whether the patient is right or left handed is important for the interpretation of a cervical thermogram. Specific views of the non-dominant arm may be colder, which is an anatomic variant.
   b. The patient should be instructed not to smoke for 8 hours prior to the exam. One hour is sufficient, but 8 hours gives plenty of leeway.
   c. Any fractures or surgeries must be noted, including dates. Visible scars should be noted on the history form's body chart and thermographed in black and white. This is discussed in Chapter 6. If the patient has had back surgery, a stress test must be done. This is discussed in Chapter 8.

2. Equilibration: A cervical and/or thoracic thermogram requires disrobing from the waist up. The patient's hair should be pinned up off the neck, and all jewelry removed. It is necessary for the patient to be completely disrobed for a lumbar exam. The patient must then be cooled in the appropriate area. Cooling simply means wiping the cervical and/or thoracic and/or lumbar region with a cool, water-dampened towel, then drying that area with a hair-dryer set on cool. The extremities should not be cooled. The patient then equilibrates to the ambient room temperature for a minimum of 15 minutes before the examination begins. This procedure eliminates artificial heat from clothing contact and sweating artifacts. The patient may be allowed to sit on a backless stool, even if he or she is having a lumbar exam. The area where they sit is not critical to the interpretation. The patient should be instructed not to touch, scratch, or rub any parts of the body to be thermographed.

3. The equilibration period will allow enough time for machine set-up and equipment check. Prior to energizing the equipment, the vacuum Dewar in the scanner must be filled with liquid nitrogen (abbreviated LN_2 hereafter). *Note:* it may be necessary to replenish the LN_2 supply during the course of any one thermographic examination. The temperature at

which LN_2 can exist at atmospheric pressure is -196°C, (77° Kelvin). Direct bodily contact with the LN_2 itself or with pipes, valves, or containers which are applicable for LN_2, could cause severe burns or frostbite. Splattering into the eyes may cause damage to delicate tissues. A face shield or protective goggles and loose fitting heavy gloves are advisable when handling the LN_2.

4. Turn on all power.
5. Set date and time.
6. Program the character generator. The character generator can be used to describe the patient's name and/or identification number, the technician number or identification, and the examination set number. There is a minimum of 3 sets to each thermographic examination. This is discussed in Chapter 3.
7. Check all constant controls before every exam.
   a. The shutter speed, aperture, and focus should be checked on the 35 mm camera. One f-stop change could make the pictures too light or too dark to read. Make sure there is enough film for the examination and that the camera is loaded correctly. The frame counter on the camera should be checked periodically throughout the examination.
   b. The isotherm control knob should be turned off. It is used only at the end of the lumbar examination or at the end of the cervical examination to perform step isotherm imaging. (This is discussed in Chapters 7 and 8).



Technique

In C-T-L thermography the color imaging is relative. The colors do not represent specific or absolute temperatures.

The technician's objective is to consistently provide the physician with optimum-quality images. To maintain this standard, it is important to adjust the image so that the area of interest is within the middle range of the color scale. This allows latitude on either side of the selected colors so that any 2°C variance will be visualized within the parameters of the color scale.

This is referred to as "setting a technique" and is simply accomplished by adjusting the level control knob.

The colors never change the information present, but are there merely to help extract the data.

In setting a technique, the technician's job is to demonstrate any asymmetry that may be present with the most visually effective contrasting colors, found in the middle of the color scale.

Positioning

For C-T-L thermography the infrared scanner must be perpendicular (or as perpendicular as feasibly possible) to the area being thermographed. When obtaining right-to-left comparisons in separate frames (laterals and obliques), both sides should be the same distance from the infrared scanner, and the level control knob must not be changed. Once the technique is set on one side, it must remain the same for the opposite side. This will provide a true comparison.

Each individual image must be focused.

Fill the entire frame with the area of interest only. The patient should not be too far from, nor too close to, the infrared scanner. Being too far may obliterate important information, and being too close may eliminate or cut off pertinent information.

Fig. 5-A shows the sequence in which the examination should be done.

Fig. 5-A. Sequential Views for C-T-L Examinations

Cervical
- C 1. Posterior neck
- C 2. Posterior shoulders
- C 3. Right oblique
- C 4. Left oblique
- C 5. Right lateral arm
- C 6. Left lateral arm
- C 7. Anterior arms
- C 8. Posterior arms
- C 9. Right medial forearm
- C10. Left medial forearm
- C11. Lateral forearms
- C12. Dorsal forearms
- C13. Dorsal hands
- C14. Ventral hands
- C15. Ventral forearms

Thoracic
- T1. Thorax
- T2. Right oblique thorax
- T3. Left oblique thorax

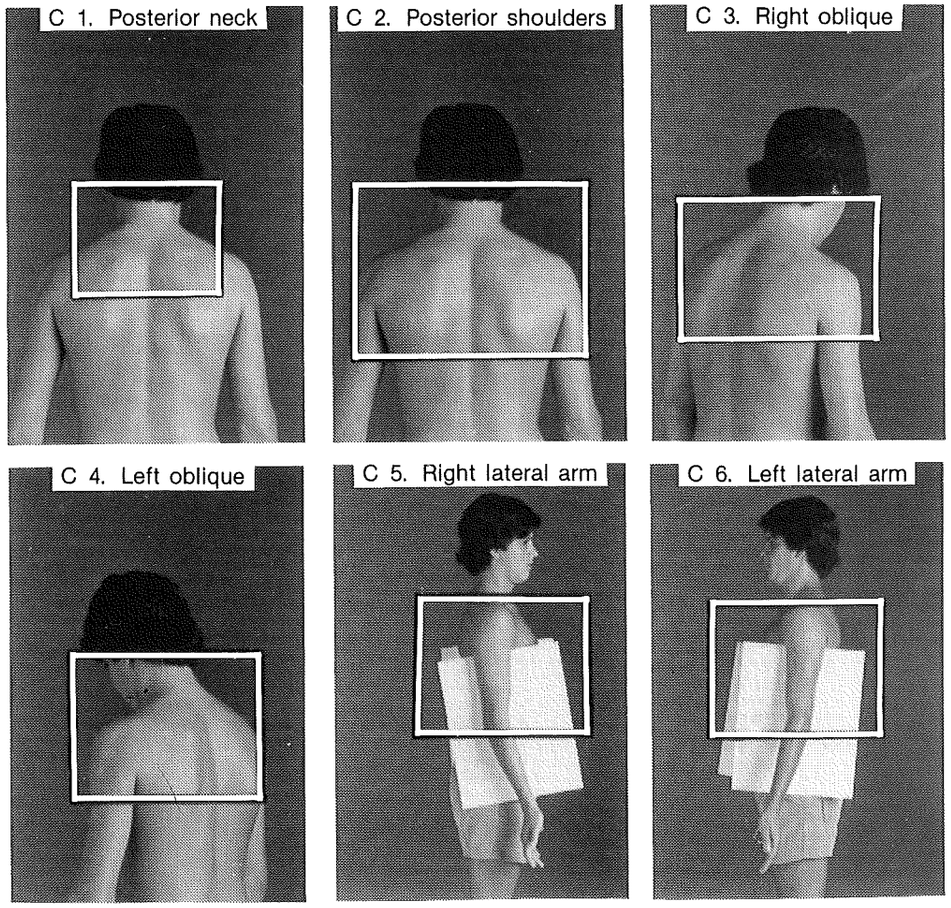
Optional Views
- V1. Anterior shoulders
- V2. Top of right shoulder
- V3. Top of left shoulder
- V4. Left medial thigh
- V5. Right medial thigh
- V6. Plantar feet

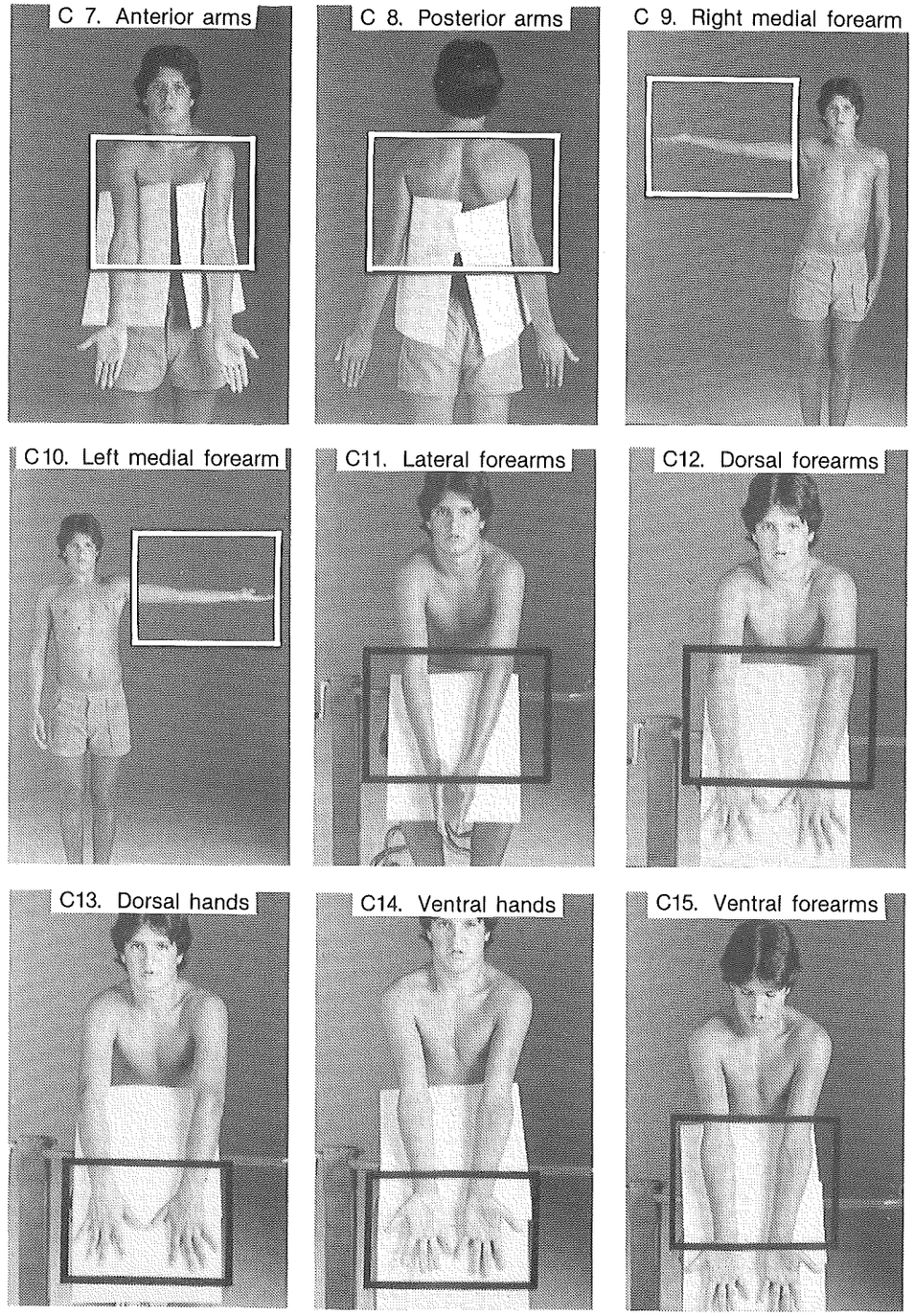
NOTE: The interpretating physician may decide to alter the sequence. In this case, all sets of each complete exam must be performed in the same sequence as the first set.

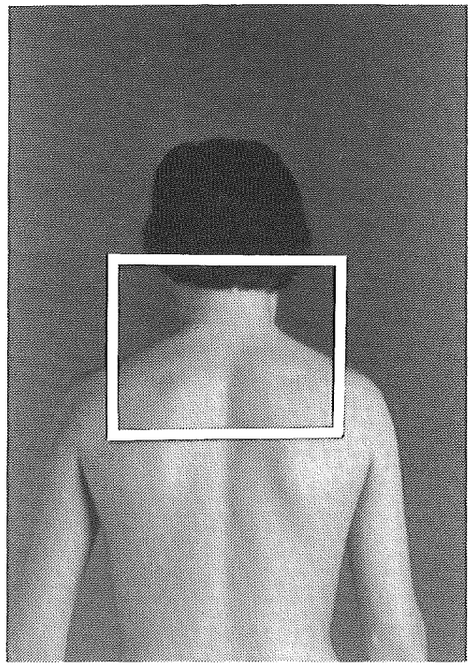
Lumbar
- L 1. Back
- L 2. Posterior buttock
- L 3. Posterior thighs
- L 4. Posterior legs
- L 5. Heels
- L 6. Right lateral buttock
- L 7. Right lateral thigh
- L 8. Right lateral leg
- L 9. Left lateral leg
- L10. Left lateral thigh
- L11. Left lateral buttock
- L12. Right medial leg
- L13. Left medial leg
- L14. Anterior thighs
- L15. Anterior legs
- L16. Dorsal feet
- L17. Toes

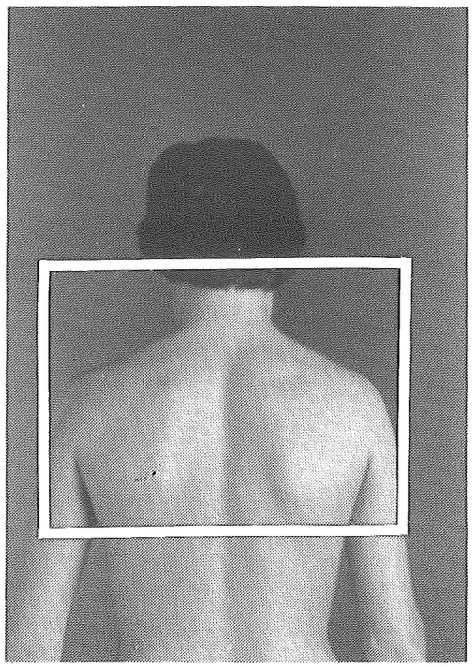
Each sequence is repeated 2 times (or 3 if a stress test is to be performed) for each cervical, thoracic, and lumbar examination. The sets must be obtained with a minimum of 15 minutes from the beginning of one set to the beginning of the next. For example, if it takes 5 minutes to do a set, then it would be necessary to wait a minimum of 10 minutes before beginning the next set. On the other hand, a C-T-L set may take 15 minutes, in which case the next set may begin immediately.

Fig. 5-B. Cervical Examination







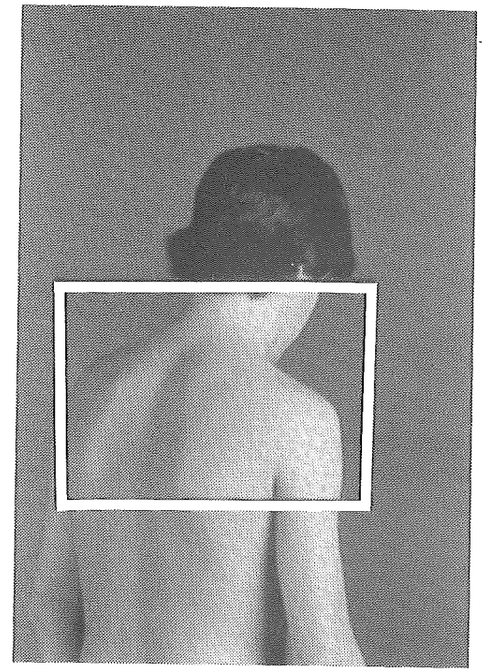


Cervical Examination

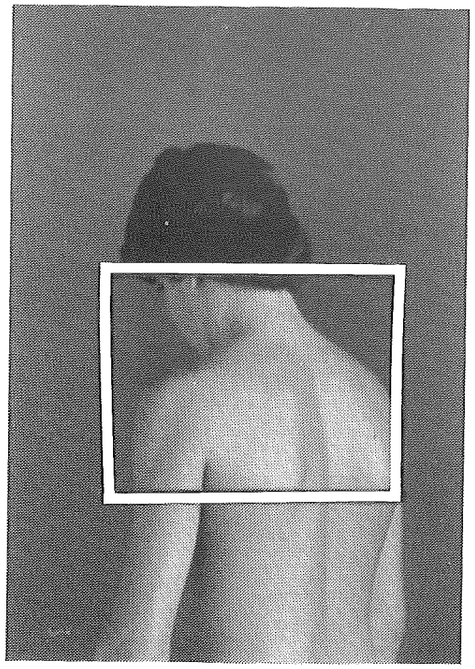
Fig. 5 B shows each cervical examination position with the area of interest outlined.

C 1. *Posterior neck:* The patient should be sitting on a stool with his or her back to the infrared scanner. Have the patient tip his or her head forward slightly. Long hair should be pinned up. Position the scanner and close-in on the neck, angling down perpendicularly to the neck. Focus the scanner, set the technique, and make the exposure.

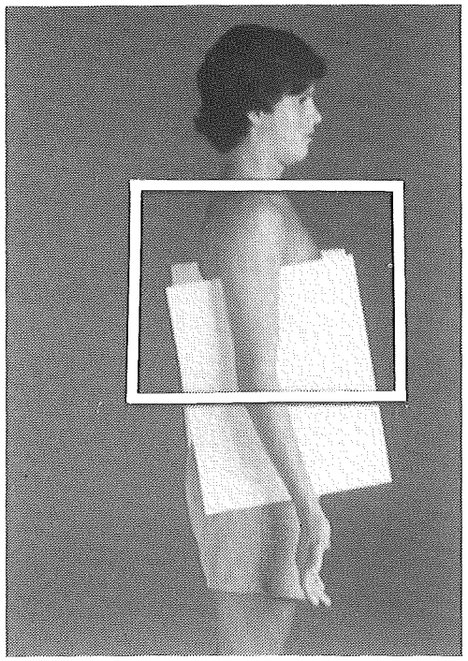
C 2. *Posterior shoulders:* Position the scanner away from the patient to encompass both shoulders. The scanner should be level with the shoulders to maintain a perpendicular relationship. Focus the scanner, set the technique, and make the exposure.



C 3. *Right oblique:* Turn the patient to the right, 45 degrees. It may not be necessary to change the position of the scanner. Focus the scanner, set the technique, and make the exposure.

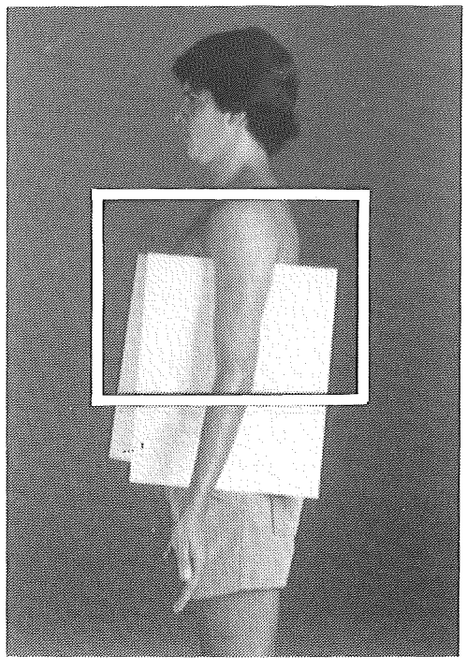


C 4. *Left oblique:* Have the patient turn to the left, equal to the angle of the right oblique. Do not alter the technique setting on this view. This is a right-to-left comparison. Make the exposure.

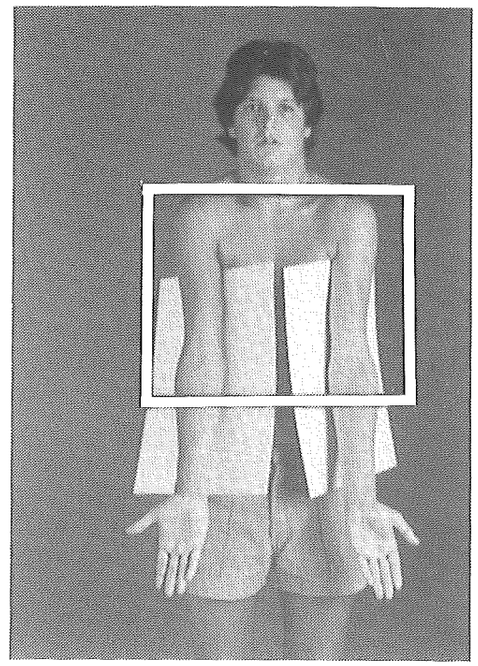


The next four views encompass the shoulders to the elbows. A method to block out background body heat must be used (14" x 17" cardboards are very effective). The patient should be standing.

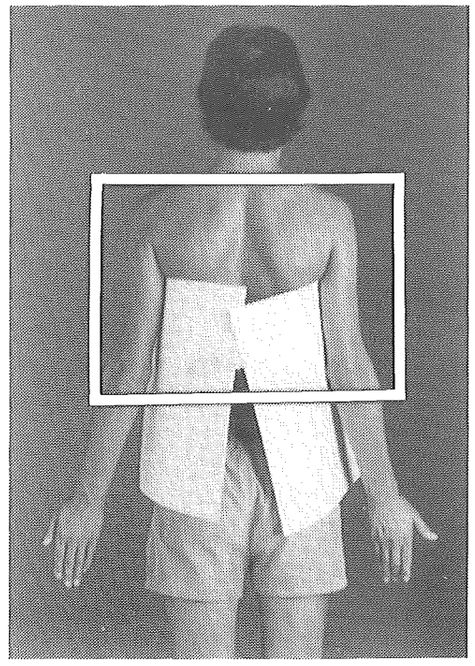
C 5. *Right lateral arm:* The patient should stand with the palms facing forward (anatomic position). The patient's right side should be facing the scanner. The scanner should be centered between the shoulder and elbow. Focus the scanner, set the technique, and make the exposure.



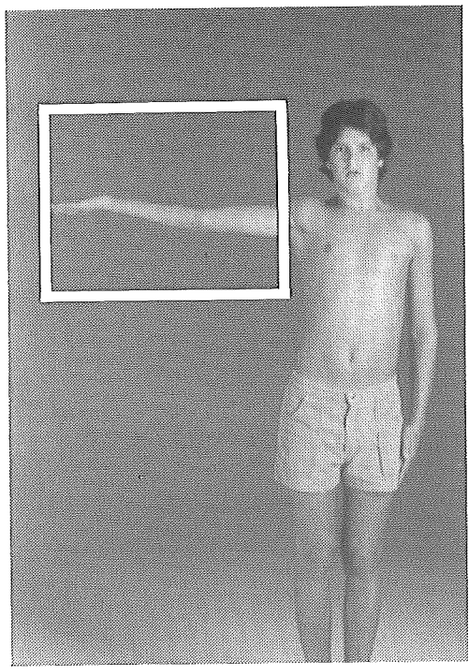
C 6. *Left lateral arm:* Have the patient turn around and face the opposite direction with his or her left side toward the scanner. Again, this is a right-to-left comparison. *Do not* touch the level control. Make the exposure.



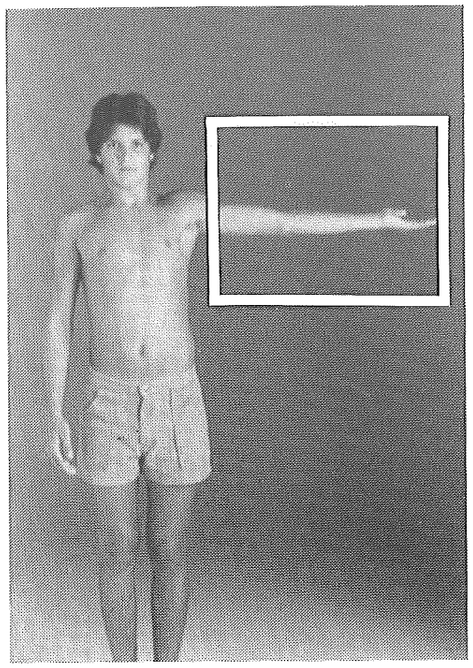
C 7. *Anterior arms:* With the cardboards still in place, have the patient face the scanner and bend forward slightly. Bring the patient's arms as close together as possible, keeping the palms facing forward. Focus, set the technique, and make the exposure.



C 8. *Posterior arms:* With the patient's back to the scanner, have the patient bring his or her arms back with the palms still facing forward (anatomic position) and tape the cardboards together. It may be necessary to back the scanner up, or have the patient step away from the scanner to encompass both upper arms. Focus, set the technique, and make the exposure.

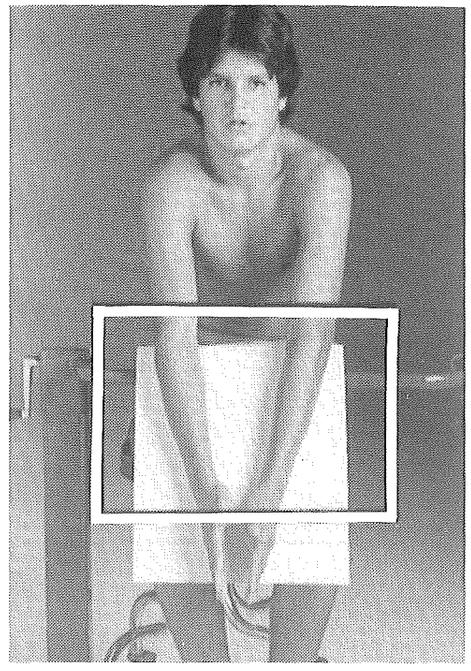


C 9. *Right medial forearm:* With the patient standing facing the scanner, have the patient extend his or her right arm straight out, away from his or her side with the palm facing straight up. The palm must be facing the ceiling to enable imaging of the medial forearm. The fingers must be straight. The scanner must be lowered and slightly angled up at the medial forearm. This will isolate the C8 dermatome. Encompass the elbow to the fingertips. Focus, set the technique, and make the exposure.

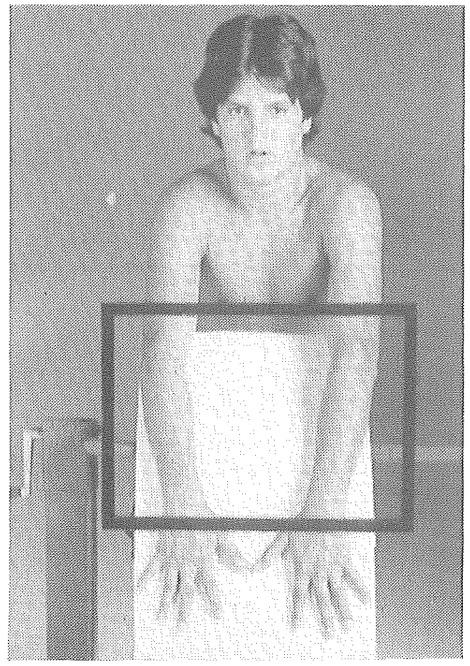


C10. *Left medial forearm:* Have the patient drop his or her right arm and extend the left arm in exactly the same manner as the right arm. Encompass the elbow to the fingertips. *Do not* change the technique. Make the exposure.

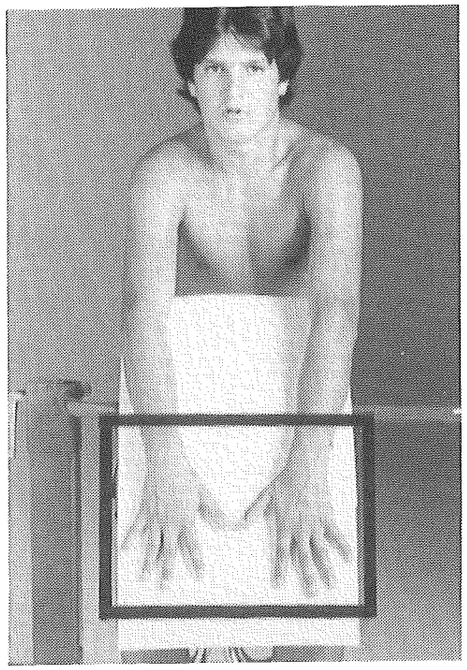
The patient may be seated for the next five views (C11 through C15).



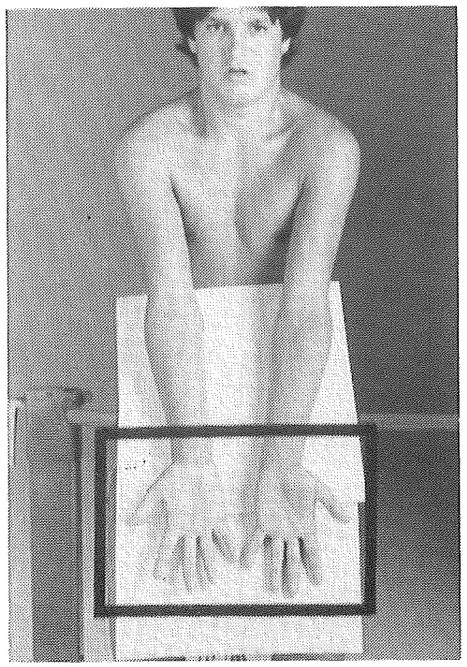
C11. *Lateral forearms:* Extend the patient's arms down and over some type of support apparatus (i.e., a thermographic positioning system). Use the aforementioned 14" x 17" cardboards to block out background body heat from the patient's lap. Next, the patient's palms should be facing each other with fingers extended and thumbs pointed in the same direction as the fingers. The hands should not be touching each other. Raise the infrared scanner and angle down appropriately to achieve the necessary perpendicular relationship between the scanner and the lateral forearms. Encompass the antecubital fossae to the wrists. Focus, set the technique, and make the exposure.



C12. *Dorsal forearms:* Have the patient place his or her palms down on the cardboard. Encompass the antecubital fossae to the wrists. Focus, set the technique, and make the exposure.



C13. *Dorsal hands:* In the same position (palms down), have the patient spread his or her fingers. Adjust the scanner accordingly to encompass all the fingers. Focus, set the technique, and make the exposure.



C14. *Ventral hands:* Turn the patient's hands over, palms up. Replace the cardboards (they may retain the heat from the previous image). Spread the patient's fingers. Check the focus, set the technique, and make the exposure.

C15. *Ventral forearms:* Have the patient extend his or her forearms over a positioning apparatus, angling down, with the palms facing upward. Raise the scanner, angling down perpendicularly to the forearms. Encompass the antecubital fossae to the wrists. Focus, set the technique, and make the exposure.

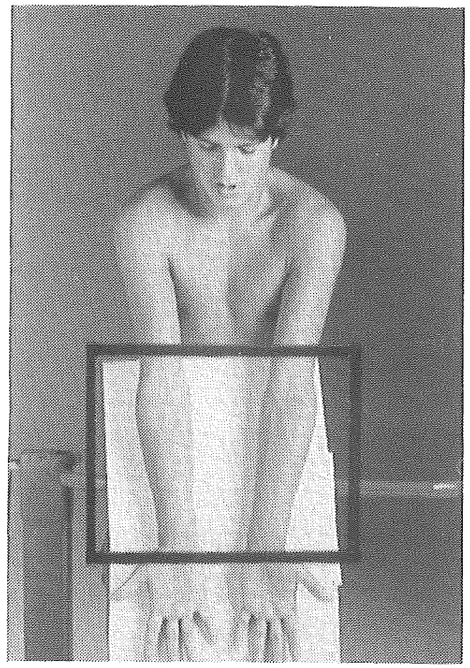
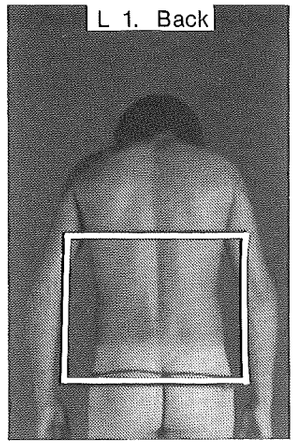
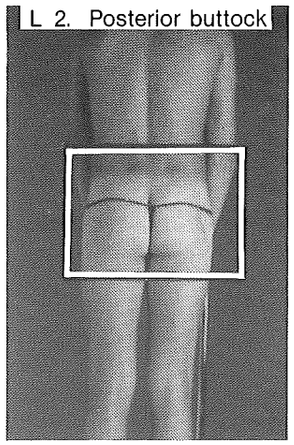
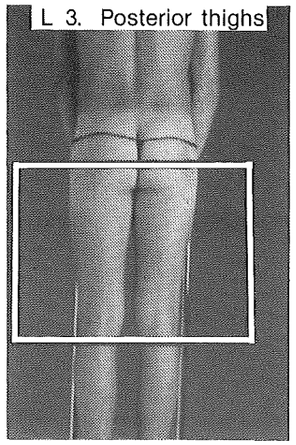
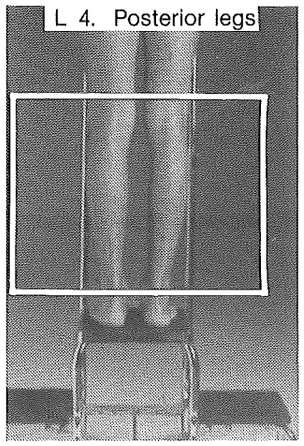


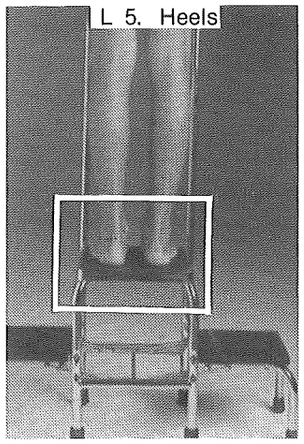
Fig. 5-C. Lumbar Examination

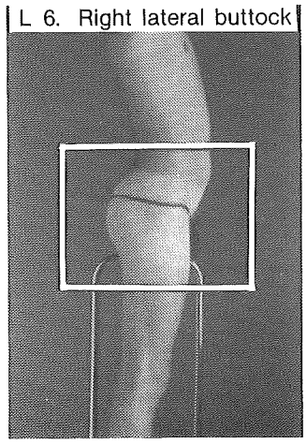


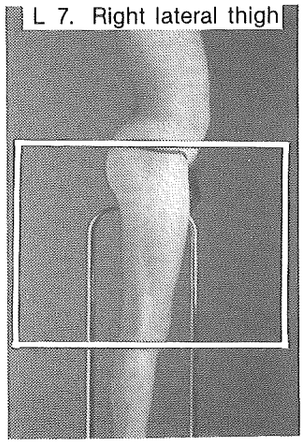


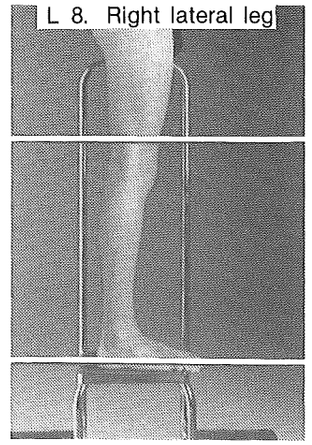


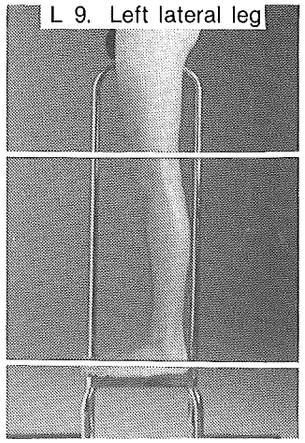


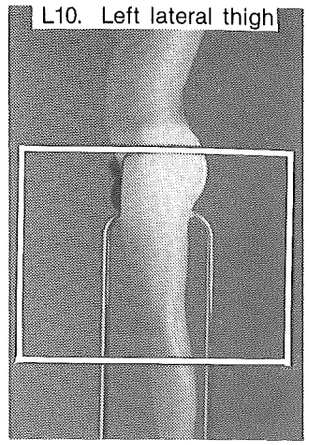


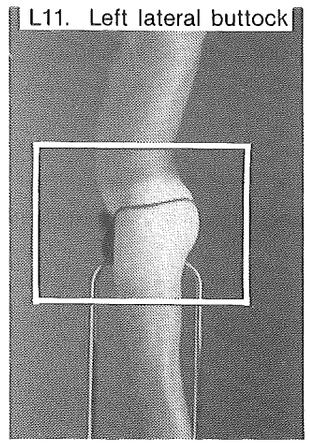


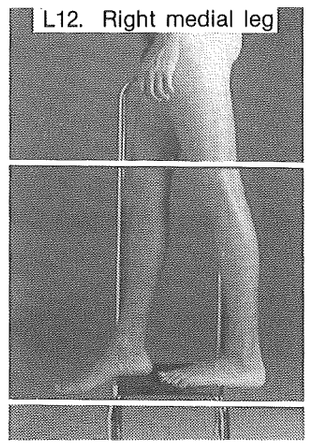


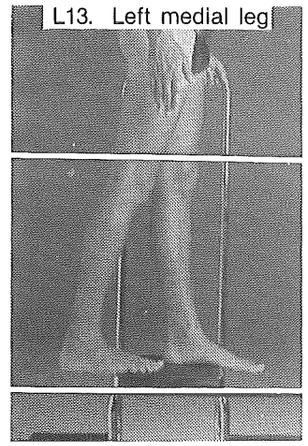


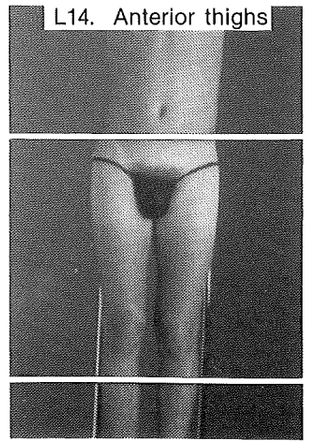


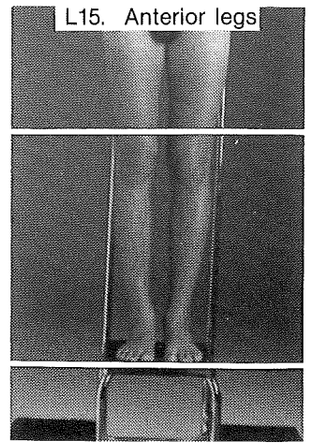


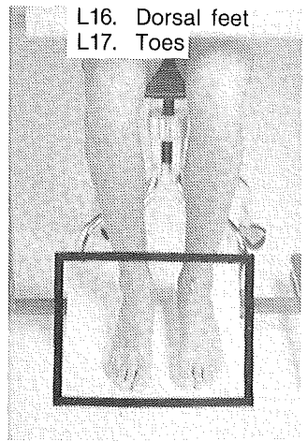








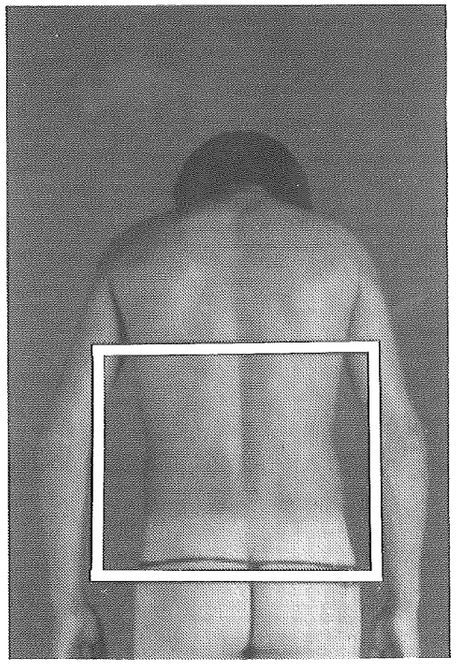




Lumbar Examination

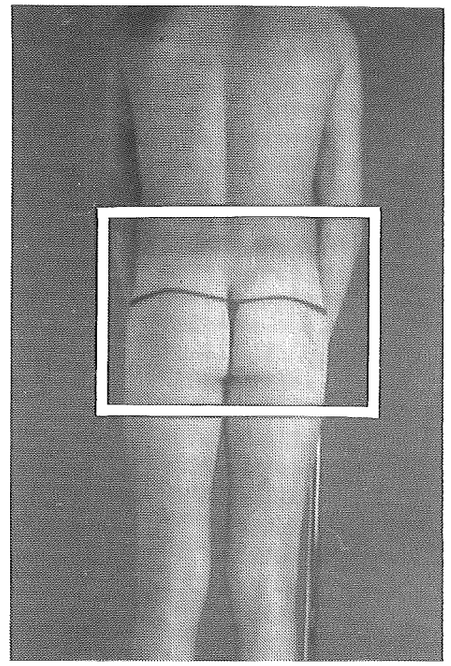
Fig. 5C shows each lumbar examination position with the area of interest outlined.

L 1. *Back:* Have the patient stand on the floor with his or her back to the scanner, and bending forward just enough to eliminate any skin folds. The top of the intergluteal cleft must be in the bottom of the picture. Make sure the entire lumbar area is in the picture. Include the break in the waist near the top of the frame as an upper marker or landmark, and the intergluteal cleft as a lower landmark. These landmarks are for orientation, and the relationship in the framing is important. If the patient is too close to the infrared scanner, the break in the waist will not be seen. If too far, the break in the waist will be in the middle of the frame. Since the patient is bending forward slightly, the scanner will have to be raised so that it is perpendicular to the back. Focus, set the technique, and make the exposure.

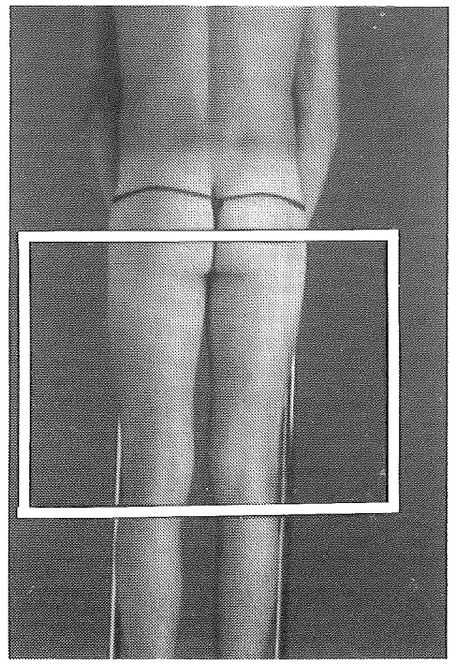


From this point on, until imaging the dorsal aspect of the feet, the patient should be standing on a step stool (views L2 through L15). This brings the patient up to the level of the infrared scanner and aids in maintaining the perpendicular relationship between the infrared scanner and the area being thermographed.

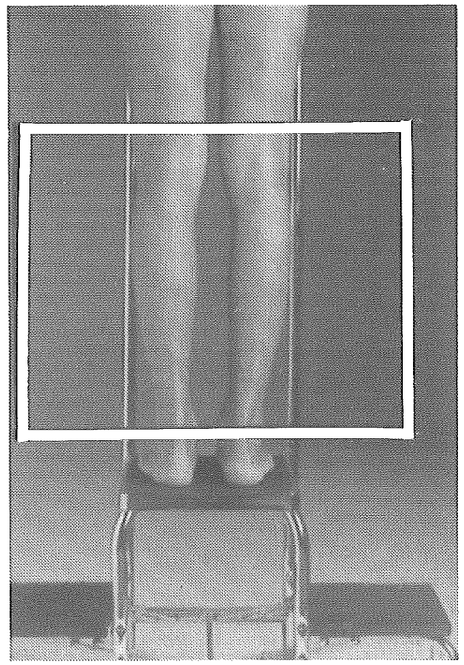
The next four views (L2 through L5) will be posterior views (the patient's back to the scanner) with the feet slightly apart and parallel. Once the scanner is at the appropriate distance from the patient, it should not have to be moved except up and down so that it is level with the appropriate area to be thermographed.



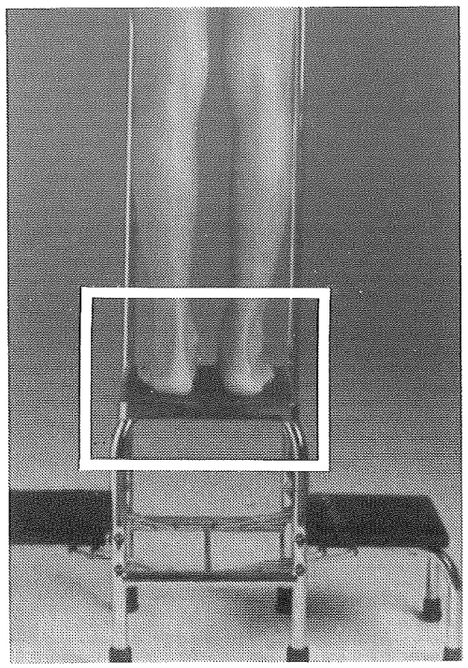
L 2. *Buttock:* Raise the scanner so that it is level with the buttock area. Focus the scanner, set the technique, and make the exposure.



L 3. *Posterior thighs:* Lower the scanner to the mid-thigh, and encompass the bottom of the buttock to the popliteal fossae (back of the knees). Check the focus, set the technique, and make the exposure.

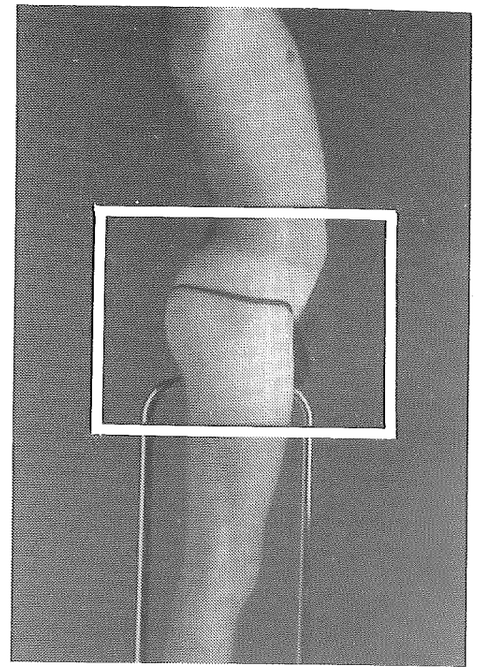


L 4. *Posterior legs:* Lower the scanner and encompass the popliteal fossae to the ankles. Don't worry about the heels. They will be imaged separately on the next frame. Check the focus, set the technique, and make the exposure.



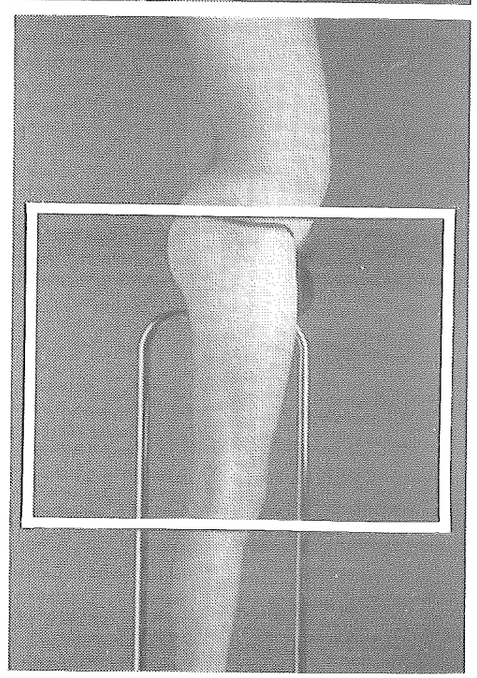
L 5. *Heels:* It may be necessary to angle down on this view. Have the heels in the center of the frame. Check the focus, set the technique for the heels only, and make the exposure.

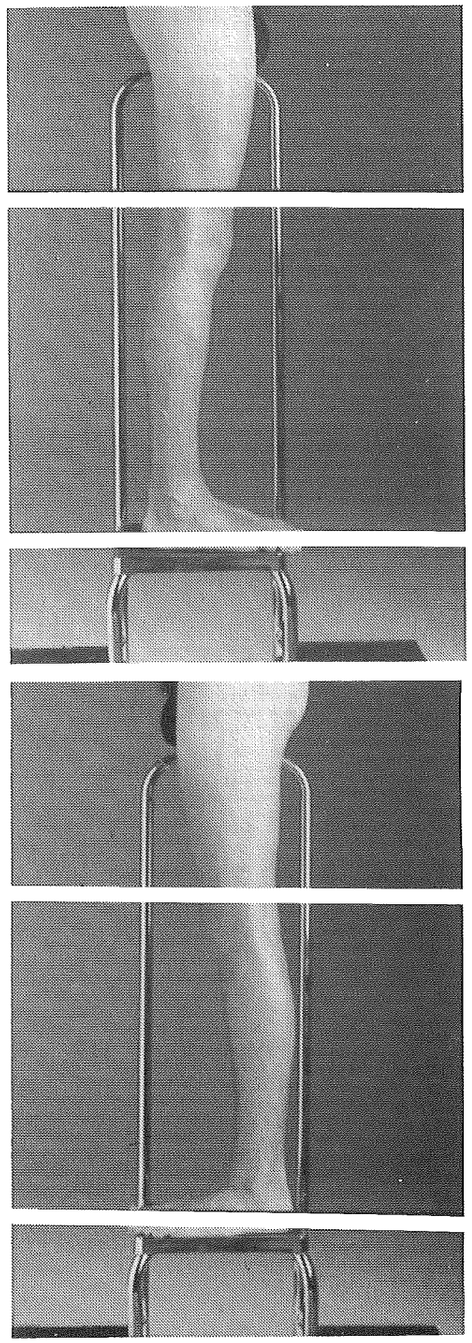
Laterals (L6 through L11): Instruct the patient to stand with his or her right side toward the scanner and arms bent at the elbows so that they are out of the picture. Next, set a technique for the thigh. Do not take a picture. The technique is not to be adjusted for the next 6 views. The color range will be appropriate for all six projections. Be sure the feet are parallel and the scanner is perpendicular so that the legs are completely superimposed.



L 6. *Right lateral buttock:* With the patient's right side toward the scanner, adjust the height of the scanner to the level of the right lateral aspect of the buttock. Check the focus, do not change the technique. Make the exposure.

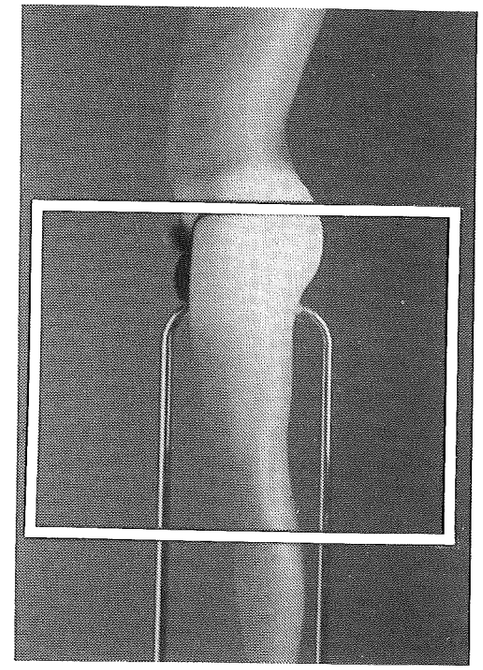
L 7. *Right lateral thigh:* Lower the scanner so that it is level with mid-thigh. Include the lower portion of the buttock and the knee. Check the focus, do not change the technique. Make the exposure.



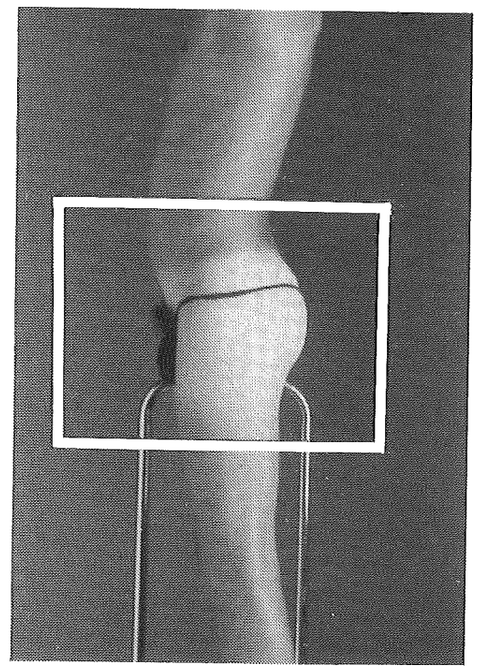


L 8. *Right lateral leg:* Lower the scanner to the level of the mid-lower leg and include the knee and the ankle. Don't worry about the feet. They are often much colder and will be thermographed separately (L12 and L13). Do not change the technique. Make the exposure.

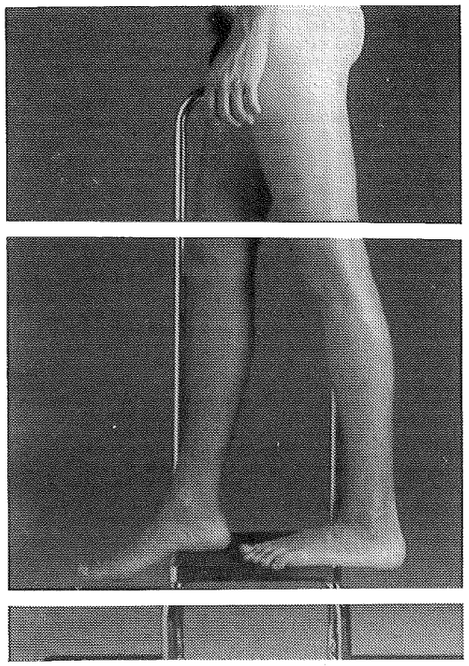
L 9. *Left lateral leg:* Next, have the patient face the opposite direction so that his or her left side is facing the scanner. The height of the scanner will already be set from the last projection. However, be sure the feet are parallel and the scanner is perpendicular to the legs so that the legs are completely superimposed. (Include the same information as in the right lateral leg). Check the focus; do not change the technique since this is a right-to-left comparison. Make the exposure.



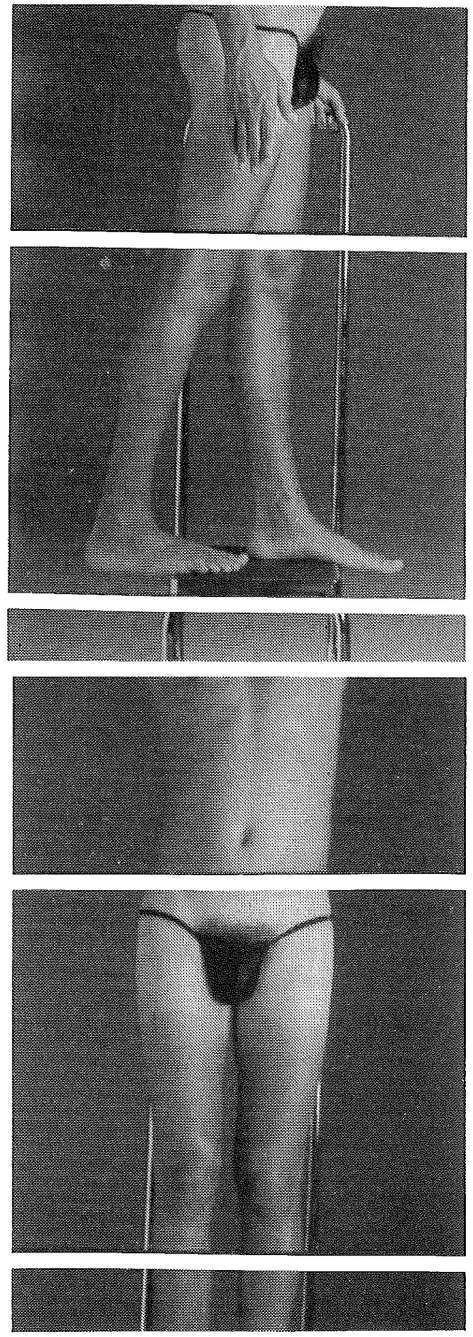
L10. *Left lateral thigh:* Raise and center the scanner height to the mid-thigh. Include the lower portion of the buttock and the knee. Check the focus, do not change the technique. Make the exposure.



L11. *Left lateral buttock:* Raise the scanner so that it is level with the mid-buttock. Check the focus, do not change the technique. Make the exposure.

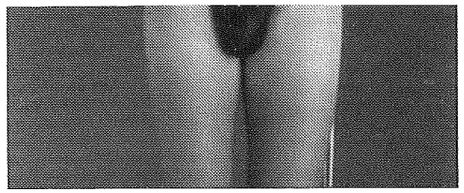


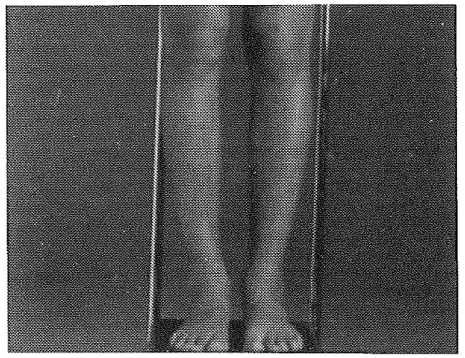
L12. *Right medial leg:* With the patient still facing the same direction, place the right foot forward and the left foot back so the medial (inner) aspect of the right lower leg can be seen. The scanner should be lowered to encompass the area from the knee down. Make sure the feet are in the frame. Set the technique on the inner leg and feet. Since the feet are usually much colder than the leg, it may be necessary to thermograph the lower legs and feet separately. However, if a technique is set on the feet in a middle range color, the lower leg may be within the color parameters. Be sure the legs are not off the scale (white or black). If it is necessary to thermograph the inner legs and lateral feet separately, the patient will have to be turned around twice in the walking position. The setting should not be changed between comparison views (i.e., legs-to-legs, feet-to-feet). Check the focus, set the technique, and make the exposure.

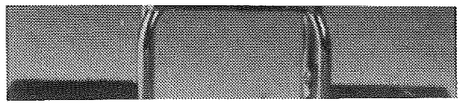


L13. *Left medial leg:* The patient will make an about face, with the left leg forward and the right leg back. Do not change the level control since this is a right-to-left comparison. Make the exposure.

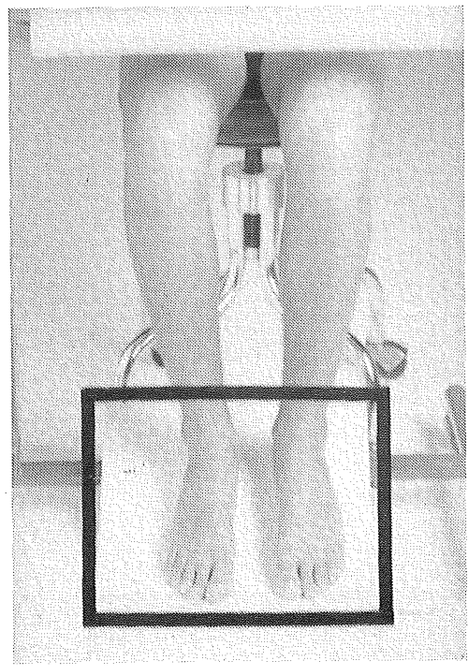
L14. *Anterior thighs:* Have the patient face the scanner with feet parallel. The scanner should be level with the mid-thighs. Encompass the hips and the knees. Check the focus, set the technique, and make the exposure.







L15. *Anterior legs:* Lower the scanner to the level of the lower legs to encompass the knees and ankles. Don't worry about the feet. They are often colder and will be thermographed in the next view (L16). Check the focus, set the technique, and make the exposure.



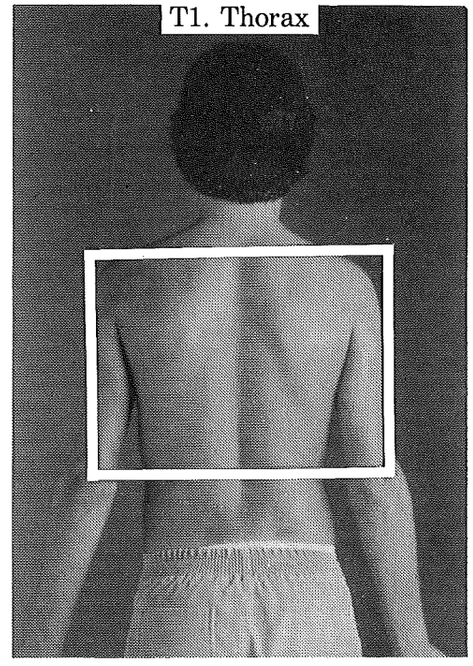
L16. *Dorsal feet:* With the patient seated, position his/her heels on a platform with the feet angled down. This will make it easier to achieve the perpendicular relationship. The feet should be parallel and the knees together. Angle the scanner appropriately. Focus the scanner, set the technique, and make the exposure.

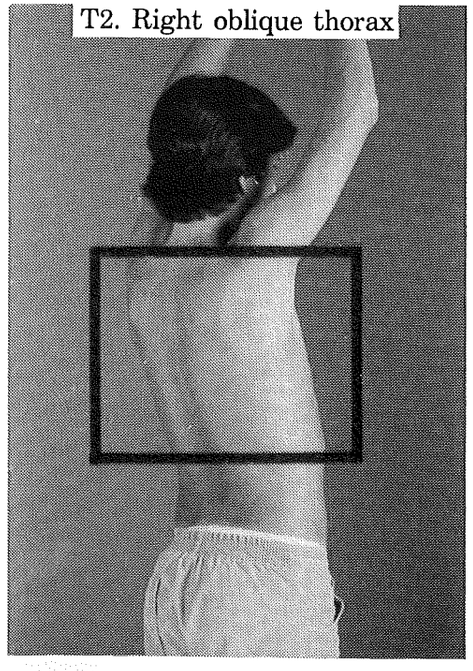
L17. *Toes:* Use the same positioning as in dorsal feet. Adjust the technique to isolate the toes, and make the exposure.

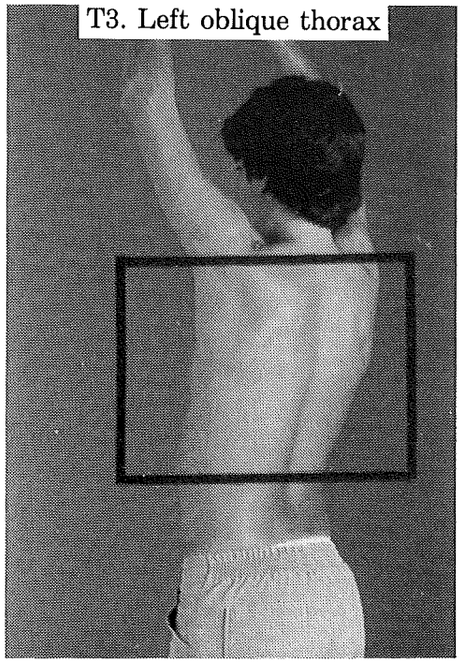
Thoracic Exam

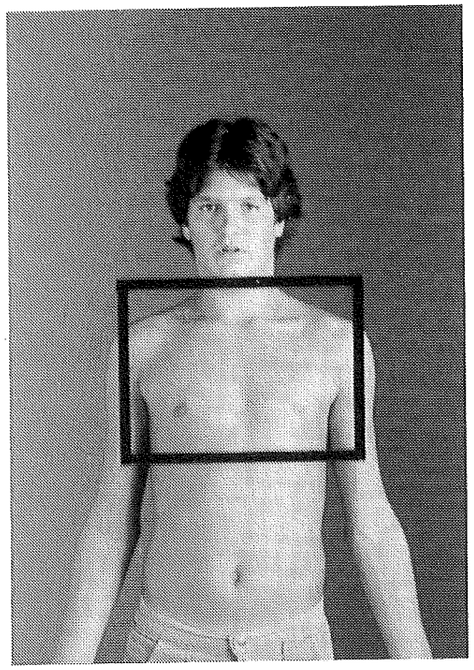
T1. *Thorax:* The patient should be standing up straight with his or her back to the scanner and arms to the sides. The scanner should be level with the mid-scapular region. Encompass the area from the shoulders to the upper lumbar area.

T2, T3. *Obliques and/or laterals:* These should be taken if the patient has a complaint in the lateral aspect of the thoracic area. Obliques and laterals are taken with the arms up.



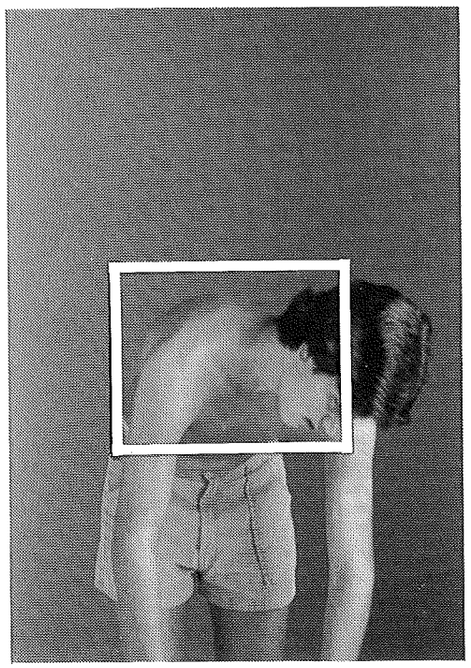




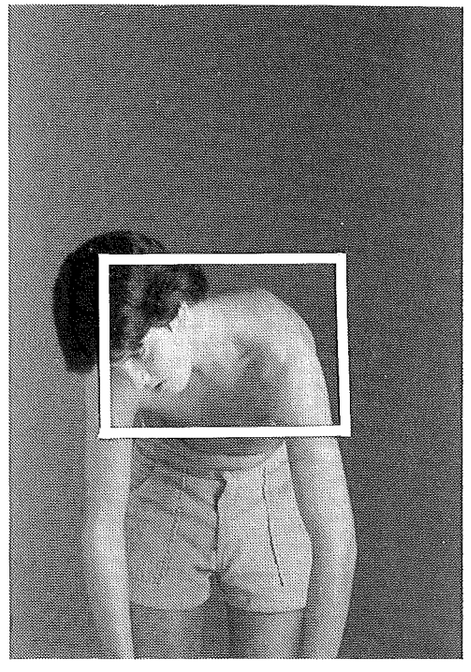


Optional Views

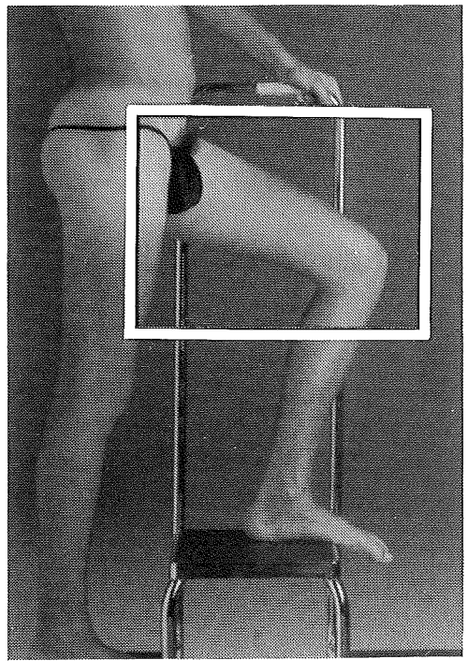
V1. *Anterior shoulders:* Have the patient face the scanner with the arms by his or her sides. Encompass both shoulders.



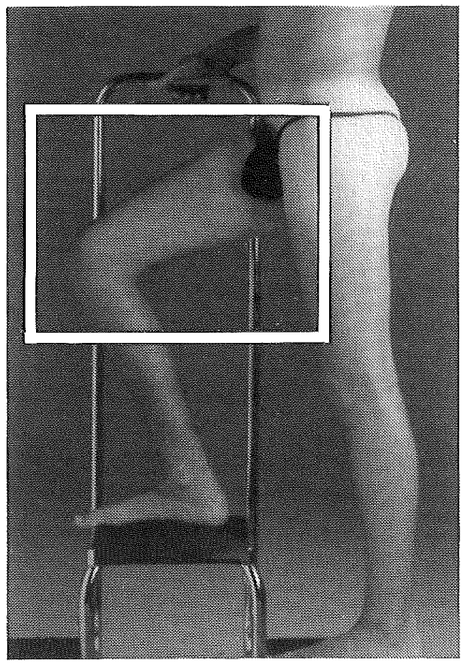
V2. *Top of right shoulder:* Have the patient face forward, bending at the waist, with the head down so the top of the shoulders are facing the camera. Tilt the head to the left, away from the side being imaged. Focus, set the technique, and make the exposure.



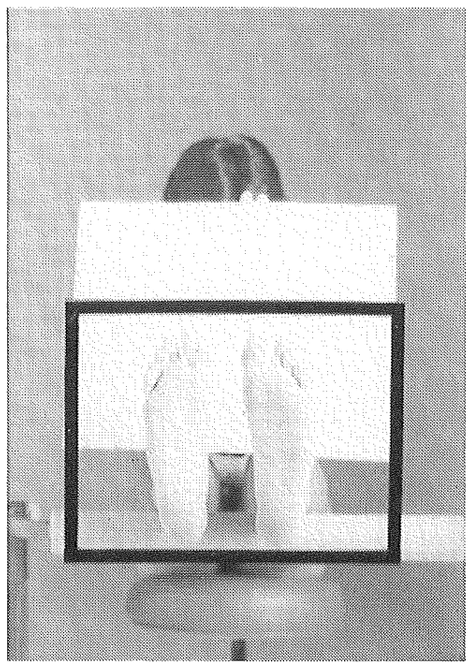
V3. *Top of left shoulder:* Opposite of V2, the head tilting to the right so the left side can be imaged. Do not change the technique as this is a right-to-left comparison.



V4. *Left medial thigh:* With the patient's right side facing the scanner, have him or her step the left foot up onto a step stool, positioned so that the medial aspect of the left thigh is clearly visualized. Focus, set the technique and make the exposure.



V5. *Right medial thigh:* With the patient's left side facing the scanner, have him or her step the right foot up onto the step stool, positioned so that the medial aspect of the right thigh is clearly visualized. Do not change the technique as this is a right-to-left comparison.



V6. *Plantar feet:* The patient should be sitting and facing the scanner. Prop the patient's feet up so the legs are parallel to the floor, with the toes pointing upward. Have the patient hold a cardboard behind his or her feet. Encompass the bottoms of the feet.

Black & White Imaging

Everything discussed up to this point has pertained to color thermograms. We will now discuss black & white thermography.

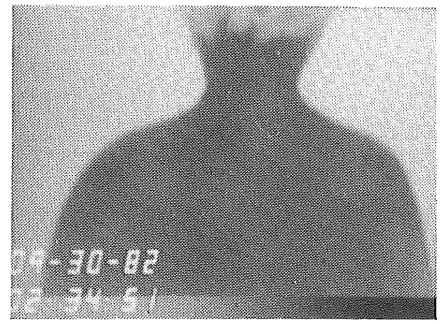
Black & white thermograms are taken at the end of every exam, following the completion of the final color set.

The polarity (white hot or black hot) should be set so that the end result will be black hot. This depends on whether positive (transparency) or negative (print) film is utilized.

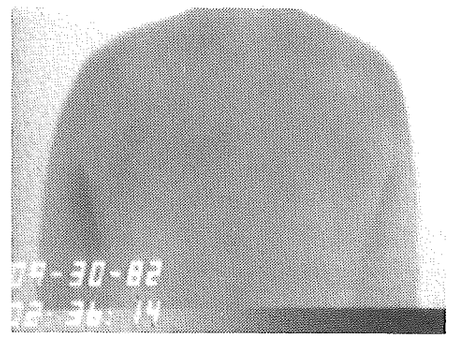
	Polarity
Positive film:	black hot
Negative film:	white hot

Standard black & white thermograms are as follows:

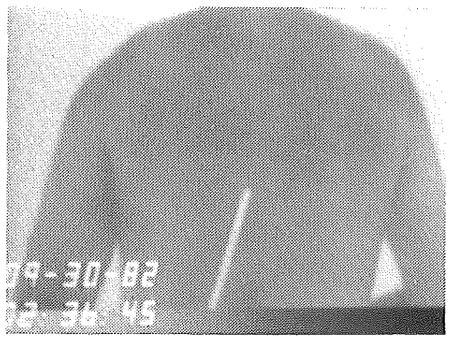
1. *Cervical exam:* One view of the neck and shoulders.
2. *Thoracic exam:* One or more views of the thorax. To facilitate the interpretation of the exam, it is helpful to obtain additional views with the patient pointing to the area of complaint.
3. *Lumbar exam:* Pre-and post-alcohol thermograms of the lumbar region (see chapter 8, *Thermal Focusing).*



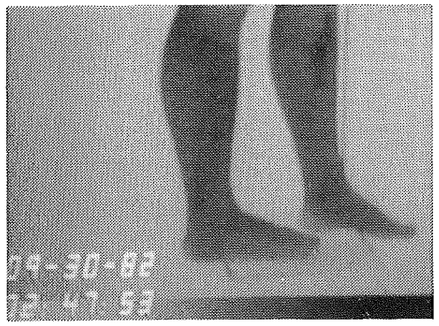
1. Cervical exam



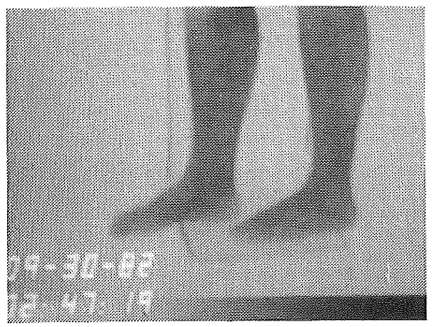
2a. Thoracic exam



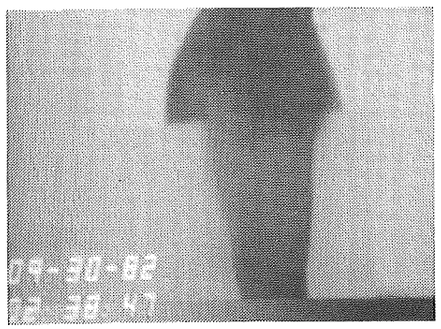
2b. Thoracic exam with pointer



1a. Varicosities



1b. Varicosities

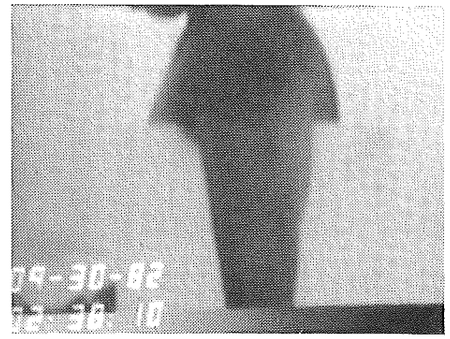


2a. Hot spots

Additional Black & White Images

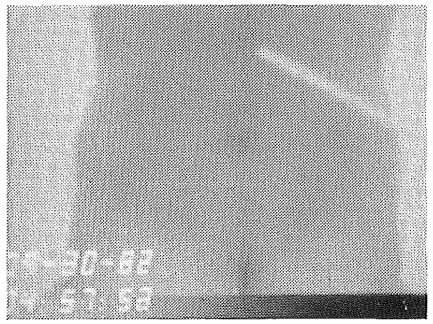
1. Varicosities - Varicosities must always be recorded. If a varicosity is present in only one leg, and not the other, both legs must be recorded for comparison.

2. Hot spots and "leopard-like" patterns should be recorded. Again, always record both sides for comparison.



2b. Hot spots

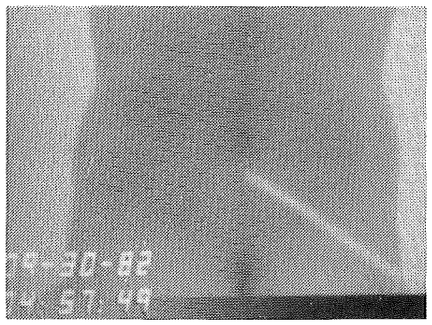
3. All scars and skin markings must be recorded. When elongated scars (such as laminectomy scars) are present, take two pictures. Using a pointer, point to the top of the scar on one exposure, and point to the bottom of the scar on the second exposure.



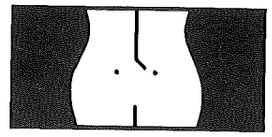
3a. Scar (pointer at top of scar)

4. Hands that are too cold to image in color require *Step Isotherms* (see chapter 9).

5. If there are any doubts about a particular finding, record it in black & white.



3b. Scar (pointer at bottom of scar)



Thermal Focusing

Diagnostically, the most important portions on a lumbar exam are those adjacent to the midline, both next to and below the lumbar stripe. Information in the lumbar area is acquired in black & white; it cannot be visualized in color. The lumbar patterns are either normal or abnormal; in an all or none sense, one or the other. This is a qualitative thought process. The color pictures of the extremities have different criteria for abnormality, and demonstrate quantitative information. Dr. Wexler has found that in 10-15% of more than 8,000 cases, the diagnosis is made via the black & white pictures alone. This is because the irritated nerve does not always manifest itself into the extremities, and is therefore seen only in the lumbar area.

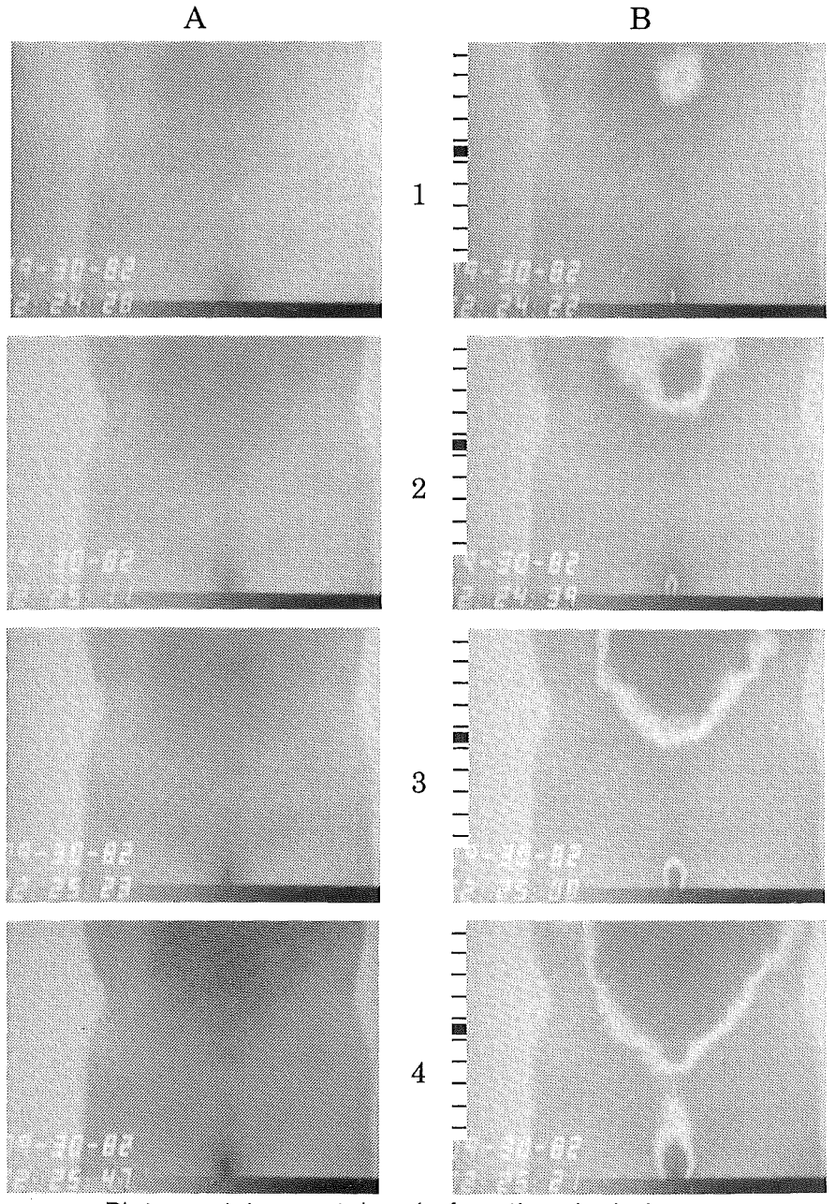
Thermal focusing is a procedure that involves concentrating the location of the most optimally visualized portion of the grey scale (middle grey) at different positions, producing a composite of pictures yielding a maximum amount of diagnostic information. Some will appear lighter and others darker. If an abnormality shows on any one thermogram, it is valid.

Following the last color set of a lumbar exam, a series of thermal focusing pictures is taken. The back is then sprayed with alcohol, and the procedure is repeated immediately.

At arms length, spray the lumbar area only with alcohol 4 or 5 times. For a smooth, even coverage of the back, be sure the spray nozzle is turned to maximum dispersement. The alcohol spray is always done last.

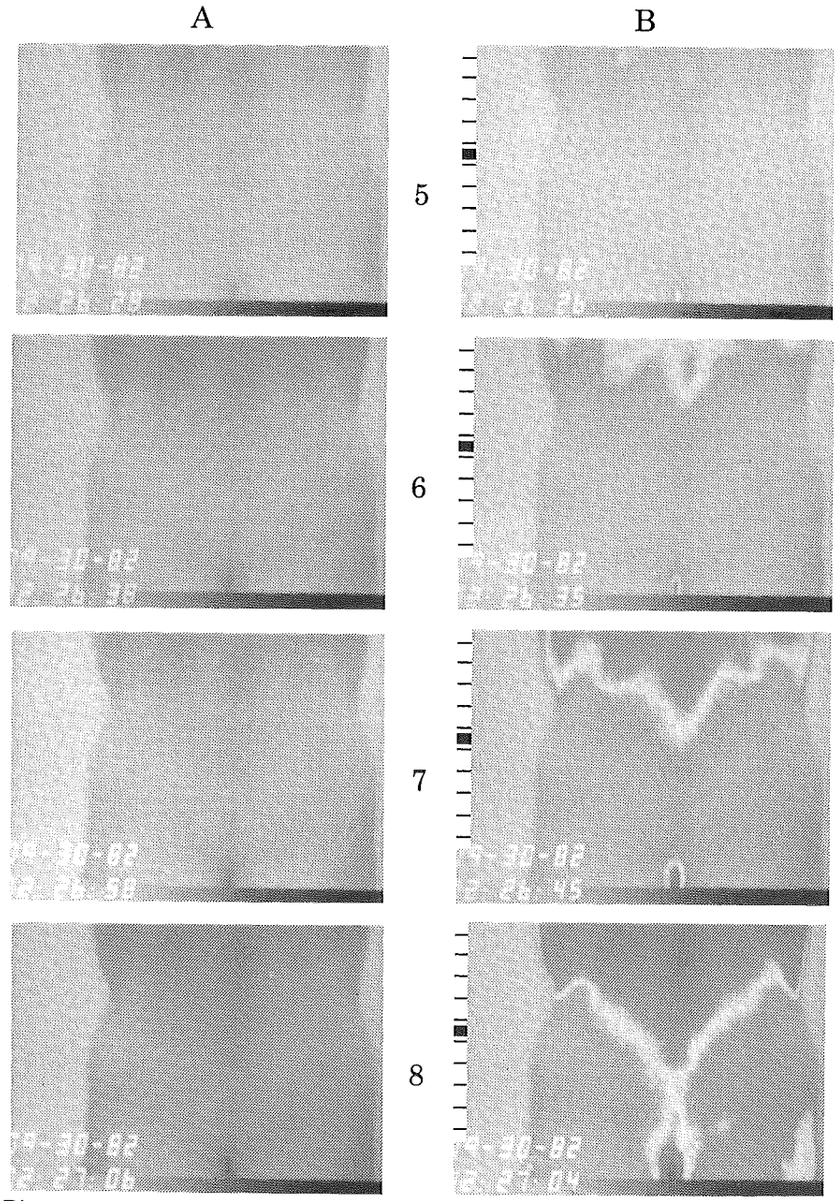
The thermal focusing procedure is demonstrated on pages 7-2 and 7-3. There are four settings (1-4) before the alcohol spray, and four settings (5-8) after the alcohol spray. An actual exam, however, should include a minimum of 7-10 thermal focusing settings before the alcohol spray, and a minimum of 7-10 settings after the alcohol spray. The more thermal focusing pictures obtained, the easier it will be for the physician to find an abnormality, if one exists.

Columns A show the thermograms to be recorded. Columns B show the isotherm settings corresponding to the thermograms in columns A. The thermograms should be recorded without the isotherm lines present.

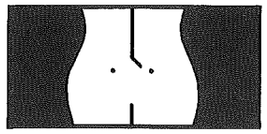


Pictures 1-4 were taken before the alcohol spray.

The isotherm is used only to set-up the picture, and is shown here only to demonstrate the thermal focusing procedure.



Pictures 5-8 were taken immediately following the alcohol spray.



Positioning for Thermal Focusing

1. Have the patient bend slightly forward to eliminate any skin folds.
2. Center the image so the top of the intergluteal cleft is at the bottom of the picture.
3. Make sure the entire lumbar stripe is in the picture.
4. Include the break in the waist at the top of the frame as an upper marker or landmark.
5. Make sure the infrared scanner is perpendicular to the back.

(See page 5-14, Fig. L-1, for proper positioning).

Procedure for Thermal Focusing

There are two control knobs to be used for this procedure, the Isotherm control and the Level control.

1. Turn on the Isotherm. Once the Isotherm is turned on, a cursor is displayed on the left side of the screen, which can be moved up or down the Isotherm scale. Set the cursor at the middle of the scale (Fig. 1B, page 7-2).
2. Adjust the level control to make a small spot at the hottest area of the lumbar stripe (Fig. 1B, page 7-2).
3. Turn off the Isotherm.
4. Make the exposure (Fig. 1A, page 7-2).
5. Turn on the Isotherm and again, set the cursor at the middle of the scale. (Fig. 2B, page 7-2).
6. Adjust the level control so that the Isotherm surrounds a slightly larger area along the lumbar stripe (Fig. 2B, page 7-2).
7. Turn off the Isotherm.
8. Make the exposure (Fig. 2A, page 7-2).
9. Turn on the Isotherm and set the cursor at the middle of the Isotherm scale (Fig. 3B, page 7-2).
10. Adjust the level control so that the Isotherm surrounds a slightly larger area than in the previous setting (Fig. 3B, page 7-2).
11. Turn off the Isotherm.
12. Make the exposure (Fig. 3A, page 7-2).
13. Repeat the procedure and gradually continue to widen the Isotherm pattern along the lumbar stripe. Take pictures at each setting until the entire back is surrounded by isotherm lines. The procedure is then repeated immediately following the alcohol spray (Figs. 5-8, page 7-3). Notice how the actual thermograms become darker as the Isotherm pattern is widened on the lumbar stripe.

Stress Testing

A patient who is having a lumbar thermogram and has had previous back surgery must have a stress test. This is simply a 4th set following exercise.

At the end of the 3rd set, have the patient do approximately 12 toe-touches and follow immediately with a 4th complete set.

Please note: The patient should not be stressed beyond tolerance.

A stress test might also be indicated when a patient only experiences pain following exercise, by lifting an object, or by moving in a particular way.

Once again, following the 3rd set, have the patient try to recreate the symptoms. Do a 4th set immediately, followed by thermal focusing black & white thermograms. The black & white imaging is always done last.

The Patient

A thermographic examination might seem to be a somewhat tedious process. As the technologist becomes more proficient, the exam will become less complicated. It takes a well-trained thermographer approximately 4 minutes to complete one set of a lumbar thermogram. Some cases, however, may take up to 15 minutes. This time variation can be attributed to the patient's physical condition, ability to follow directions, anxiety level, and general attitude.

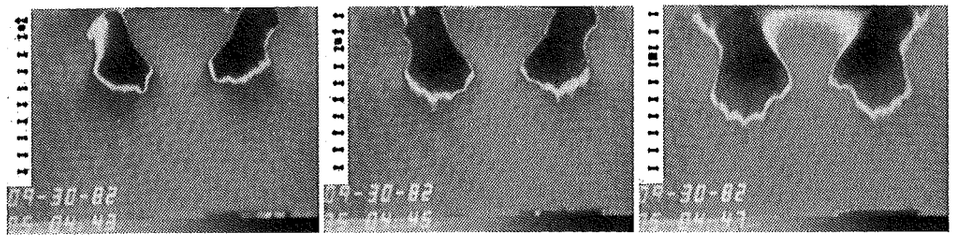
It is very important to consider the conditions under which the patient is having the exam, the fact that he or she is disrobed for an hour or longer (a male may wear a G-string and a female wears a towel covering her breasts and genitalia), and the criteria for having the thermogram.

It must be stressed how important it is to make the patient feel as comfortable as possible. The thermographer might know the positioning, technique, and thermal focusing, but this means nothing if the patient refuses the exam.

In other words, as a professional, the technologist must be able to adjust accordingly to individual personalities. The technologist's attitude can directly affect the attitude of the patient.

Remember, the patient is there for one reason: to have a thermographic examination.

Step Isotherm



A B C

D E F

Occasionally the patient's fingers are so cold that they are not distinguishable on color thermograms. A procedure called *step isotherm* must then be performed at the end of the exam. This is done in black & white.

1. Position the hands as in the color thermograms (both dorsal and ventral surfaces).
2. Turn the isotherm on, set the cursor at the top of the scale.
3. Turn the level control to the point where the isotherm line becomes visible and surrounds the wrists. Once set, the level control should not be changed for the remainder of the step isotherm procedure.
4. With the isotherm still on, take a picture (Fig. A).
5. Turn the isotherm control moving the cursor progressively down, step by step, taking a picture at each step with the isotherm on (Figs. B-E), until the isotherm lines are completely off the fingers (Fig. F).

This procedure breaks down the isotherm scale into 1°C increments. Each step represents one color of the color scale. Before color came onto the scene, every view in black & white was done via *step isotherm.*