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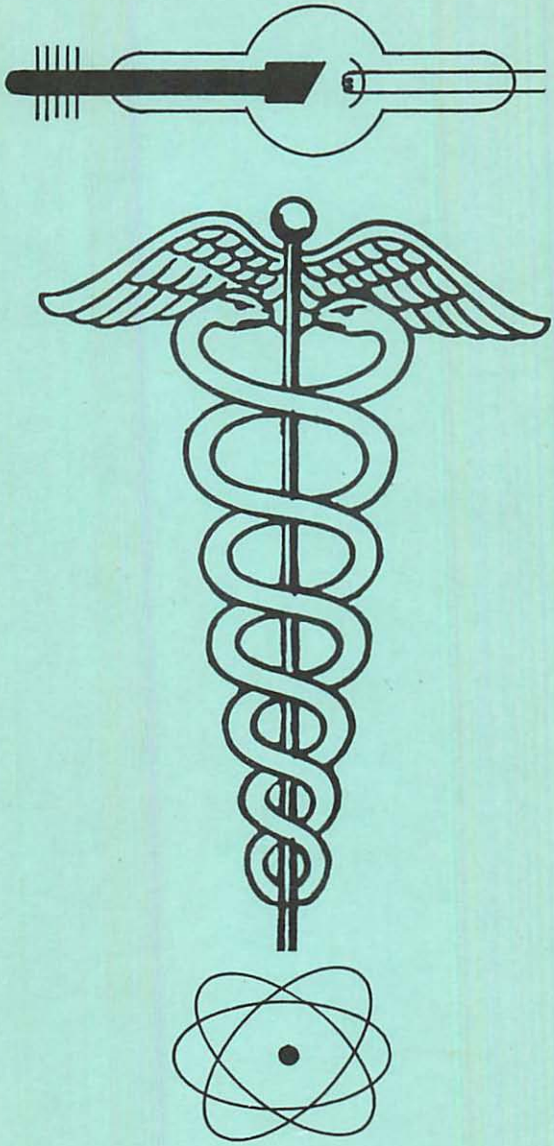
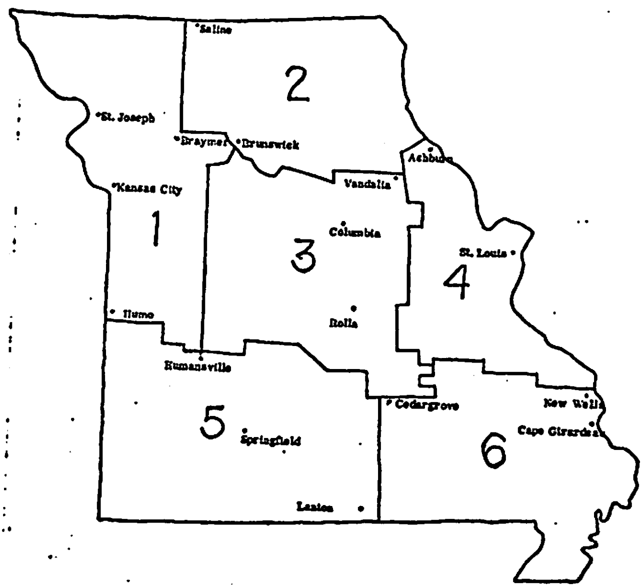


MISSOURI MINUTES

MSRT
DISTRICT DIVISIONS



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"Opinions expressed in this journal are those of the writers and do not reflect offical opinions of the Missouri Society of Radiologic Technologists unless so stated. Originial articles are accepted only with the understanding that they are contributed solely to the "Missouri Minutes". If and when the manuscript is published, it will become the sole property of the Journal."

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Contributing Editors

Sr. Francita Barringhous, R. T.
Ulysses Murray, R. T.

TABLE OF CONTENTS

May, 1972

COMMITTEE CHAIRMEN

Nominating:	Glenda Shipman, R. T.
General Convention Chairman:	Merlin Heinselman, R. T.
Licensure:	Gerald Casey, R. T.
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Resolutions and Bylaws:	Richard Hammer, R. T.
Professional Affairs:	Jack Manglos, R. T.
Membership:	H. P. Fritz, R. T.

PRESIDENT'S MESSAGE

Your Board of Directors and officers have been working very hard for the past several months to implement the changes that you the Society requested at our last annual meeting. I am pleased that our membership asked for these changes in organization as it will allow our professional society to continue to grow in the years ahead. The first change is a new organizational structure providing for a 13 man board starting next year. This will include six district directors elected by the active members within each district, four elected officers, and three past presidents. This new board of directors will certainly be a more representative governing body, for each district of the state will now be actively represented. This enlarged board will allow the society to move forward as swiftly and as efficiently as is necessary to meet the new changes that lay ahead.

The second change is the voting system. This new procedure, balloting by mail, will give every active member a vote in the selection of officers for the society. However, the success of the new voting system will depend on the prompt marking and return of the ballot. A cover letter for the handling and marking of the ballots will be included with the ballot. I sincerely hope that every active member will take this new responsibility and vote for the candidates of their choice.

Along with the above changes it is time for each of us to cooperate with every other member at local and state levels to help effect the many programs we want for our professional welfare. It is time for each member to join with his colleagues in making our profession a strong, single organization that speaks everywhere with one voice - the voice of radiologic technology.

Robert Rein, President
MSRT

JACK PRANCE

Kodak

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OFFICERS TO BE ELECTED BY MAIL BALLOT

The membership of the Society voted at its last annual meeting to elect officers, except counselors, by mail ballot. This method will give all members a chance to vote for those persons who will serve them as officers of the Society. Ballots will be mailed to all active members (members of ASRT and MSRT). The membership will be advised to read, carefully, the instructions that will accompany the ballot. The instructions will also specify a deadline date for mailing the ballot; however, the wise and interested member will vote immediately and get the ballot in the mail. Ballots will be counted at the annual meeting and the results will be announced to those members who are present and will be published in the next issue of the Missouri Minutes.

JOB OPPORTUNITY FILM AVAILABLE

The U. S. Department of Labor, Manpower Administration, has prepared a film entitled "Jobs in the Health Field". It is an 11 minute, 16mm, color-sound film which portrays the wide variety of career job opportunities available in health services including laboratory technicians, x-ray technologists, therapist assistants, and other key health service personnel.

Further information can be obtained from the National Audiovisual Center (GSA), Washington, D. C., 20409.

THE AMERICAN SOCIETY OF RADIOLOGIC TECHNOLOGISTS
645 NORTH MICHIGAN AVENUE / CHICAGO, ILLINOIS 60611 / (312) 944-3410

May 19,1972

TO: ASRT Counselors, Affiliate Society Officers, Editors and Representatives

FROM: George F. Koenig, R.T.,FASRT

SUBJECT: Regional Meetings at 1972 Annual Meetings

The ASRT Board of Directors, at the 1971 board meeting following the annual meeting, approved a motion to hold ten separate regional meetings replacing what was formerly called "Meeting of Counselors, Affiliate Society Officers, and Representatives".

These meetings will be chaired by the Regional Directors. In addition to yourselves, all members of your region present at the Annual Meeting are invited to attend. The Board of Directors feels that these meetings will be more beneficial and effective in communicating the Board's actions, and more responsive to the needs and questions of the membership.

Locations of the meeting rooms will be listed in the program. We look forward to talking with you and others from your region.

cc: ASRT Board of Directors

THE AMERICAN SOCIETY OF RADIOLOGIC TECHNOLOGISTS
645 NORTH MICHIGAN AVENUE / CHICAGO, ILLINOIS 60611 / (312) 944-3410

The ASRT Licensure Committee has recently completed a study designed to summarize the state licensure activities throughout the United States. Some of the highlights of this report are listed below:

1. Among the 49 states which replied, there were 26 which had committees responsible for drafting legislation, or drafting it if need be.

2. 16 states have completed bills
   3 are rewriting their bills
   11 are drafting legislation
   10 are not drafting legislation
   9 are without a legislative committee

3. Fourteen states have had bills in state legislatures - of these:

   3 states have enacted acts
   6 have bills pending
   5 have had bills defeated

MALLINCKRODT PHARMACEUTICALS

CONTRAST MEDIA

RADIOPHARMACEUTICALS

Representatives:

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Kansas City	Monte Schaufler

INTRAVENOUS PYELOGRAPHY OF THE ADULT

Written by Anthony M. Raia
Student Technologist
Mallinckrodt Institute of Radiology
Washington University School of Medicine
St. Louis, Missouri

This paper is a report on intravenous pyelography (IVP) of the adult. Intravenous pyelography is the radiographic examination of the kidneys, ureters, and bladder with the contrast medium being injected intravenously. The examination procedure used in this paper is in accordance to the examination procedure used at the Mallinckrodt Institute of Radiology, Washington University School of Medicine.

Very shortly after the discovery of x-rays it was observed that the outline of the kidney is visible on radiograms. It was found that the shadow was not due to greater density of the kidney but to the presence of fat in the capsule, which allows the x-rays to pass through more readily and thus casts a halo about the kidney itself. This accounts for the well-outlined shadow so often seen in stout individuals. Early workers in this field were handicapped by the large amount of scattered radiation which markedly diminished the sharpness of the outlines, but the Potter-Bucky diaphragm eliminated that disturbing element to a very great extent.

In 1923, L. G. Rowntree and his co-workers at the Mayo Clinic attempted to visualize the urinary tract by means of the intravenous injection of sodium iodide, but although significant shadows were obtained, this salt was not excreted and was not concentrated sufficiently in the urinary tract for general practical use in clinical urography. A drug which could be excreted by the kidneys in sufficient density for radiologic use was needed. During the 1930's Professor Arthur Binz, of the Kaiser Wilhelm Institute in Berlin, studied a selected group of drugs rather exhaustively, reporting the use of over seventy preparations. It was found that some of the drugs in this group had distinct renal affinity and these were studied further from a radiologic viewpoint to ascertain their possible use in urography. Binz and his colleagues then chose eleven of these drugs which seemed to promise results in urography. They then undertook the study of the clinical properties of these drugs, and were able by alteration of number 9 in the group to obtain the desired result. Uroselection was chosen as a compound of sufficient concentration and nontoxicity to be of practical value. This event constituted the birth of intravenous pyelography.

The most commonly used medium today are the diatrizoates and iothalamates which contain three iodine atoms per molecule. These contrast agents have a low toxicity and relatively few side reactions. They are well tolerated by most individuals and provide a wide margin of safety when used in the general population. The use of any contrast medium must be accompanied, however, by a judicious interpretation of each individual's history of allergic reactions.

The route of excretion of the intravenously administered diatrizoates and iothalamates is largely glomerular. Opacity is achieved through tubular reabsorption of excreted water and a relatively increased concentration of the contrast medium in the urine by the time it has made its way to the collecting tubules. The contrast medium produces some diuresis and in the presence of a dehydrated state the water absorption is enhanced resulting in a higher concentration of the medium in the urine than would be possible in the hydrated state.

The larger the dose of contrast medium administered, the greater the opacity achieved. A large dose will result in enhanced visualization of the urinary tract up to a point. Large doses have proven to be safe and would be more except for several factors. Improved visualization contributes only so much additional information. A renal pelvis which is made too opaque may conceal small lesions. The cost of the examination is increased when using large doses and there continues a fear that reactions to the injections are dose related. Conflicting views on this last objection exist and a decision must be made individually in each radiographic department. The average adult dose at MIR is 50cc of Conray 400.

Other factors which influence the excellence of visualization are as follows: The condition of the kidney and its capacity to provide an adequate glomerular filtration; the maintenance of a normal blood pressure (the patient in shock is not a suitable candidate for intravenous pyelography); the presence of stasis in the urinary tract, and the diameter of the structures under scrutiny. A large renal pelvis, in the absence of the stasis, will appear more opaque because it contains more iodine atoms than a smaller pelvis. With adequate ureteric pressure, a large number of atoms will be contained in the pelvis and an observable mild dilatation of the pelvis and calyces will result.

For a successful examination, the colon, which lies in front of the area to be viewed, needs to be as free as possible of feces and gas. This, together with dehydration of the patient, so that the dye is more concentrated at one given time, allows the film to be of greater diagnostic quality. The patient is usually given 2 ounces of castor oil or milk of magnesia between 4 pm and 6 pm the day prior to the examination. A light supper may be eaten but no food or liquid is allowed until the examination is completed the following day.

The request for an intravenous pyelogram by the referring physician or attending physician should include the usual diagnostic possibilities and a statement by him, too, as to whether or not there are any contraindications for the use of Pitressin. If the patient has a history of high blood pressure, heart disease, jaundice, or some other conditions, Pitressin is not administered. Pitressin is not used routinely in all examinations but is especially necessary where the patient has been poorly prepared physically. Acting as a smooth-muscle stimulant, it causes the patient to expell flatus and fecal material, and empty his bladder within a few minutes after it is administered.

Prior to injection of any contrast medium, the patient should be questioned to obtain a history of allergy. A positive history of allergy implies a greater than usual risk to the patient, but does not arbitrarily contraindicate the use of the agent. When a diagnostic procedure is thought essential in such patients, premedications for the purpose of avoiding or minimizing possible allergic reactions should be considered. An intravenous injection of 1 to 2 cc of the medium about 10 minutes prior to the procedure is frequently used in an effort to screen patients. Any significant reaction should be evident within about 10 minutes. However, the absence of a reaction to the test dose is not entirely reliable for predicting the patient's response to a large dose.

In patients with advanced renal disease, iodinated contrast media should be used with caution, when the need for the examination dictates, since excretion of the medium may be severely impaired.

General reactions to contrast media fall into two groups, namely those due mainly to hypertonicity and specific toxicity of the contrast medium and reactions caused by hypersensitivity to the media. The severity of the latter varies from very slight to fatal.

The injection of the contrast medium is sometimes followed by a feeling of burning, reddening, nausea or vomiting, but the reaction is usually transient. Sometimes reactions of another type appear, namely urticaria in the form of single wheals or more widespread changes coalescing to form large regions of edema. Such edema may be serious if it involves the larynx and causes respiratory difficulties. A special type of reaction has been described by Sussman and Miller (1956). It is iodine mumps and consists of a swelling of the salivary glands occuring some days after the injection of contrast medium.

Occasionally shock develops with the usual signs: imperceptible pulse, pallor and severe drop in blood pressure. Such shock may, though rarely, be fatal. Owing to the risk of severe reactions to the injection of contrast medium the examination room or nearby room should always be equipped with an emergency cart with analeptics and antihistaminics and with instruments for artifical respiration, thoracotomy, and heart massage.

Adrenaline should not be used because it may cause ventricular fibrillation.

Prior to injection of the contrast medium a preliminary or scout film is taken on a 14" x 17" film. The patient is placed in the supine position with the median line of the body over the center line of the table. The film holder is centered to the crest of the ilium. If a second film is needed, center the second film holder 3 inches above the crest of the ilium. The central ray is directed perpendicularly to the center of the film holder for each film. In the case of a suspected kidney stone a right posterior oblique (RPO) or a left posterior oblique (LPO), or both, may be requested by the radiologist before injecting the contrast medium.

Routine IVP Radiographs

1. Four minutes after injection a radiograph is taken of the kidneys on a 10" x 12" film. The patient is in the supine position and with the median line of the body over the center line of the table, the film holder is centered midway between the xiphoid process and the eleventh rib. The central ray is directed perpendicularly to the center of the film holder.

Immediately following the 4 minute film, a compression device made of balsa wood or plastic, is placed on and strapped across the patient's lower abdomen. If the patient is extremely sensitive in this area the x-ray table may be tilted about 35°, if possible, putting the patient into the Trendelenburg position - a recumbent position with the pelvis above the head.

2. Eight minutes after injection an anterior-

posterior (AP) radiograph is taken on a 14" x 17" film. The patient is in the supine position and with the median line of the body over the center line of the table the film holder is centered to the crest of the ilium. The central ray is directed perpendicularly to the center of the film holder. Compression blocks are used for this radiograph.

3. Twelve minutes after injection a right posterior oblique (RPO) and left posterior oblique (LPO) are taken on two 14" x 17" films. The patient is placed in right and left posterior oblique positions with the body angled 45° more or less to the right and left. A hypersthenic patient would need to be obliqued more than an asthenic patient. The central ray is directed horizontally four inches to the inside of the anterior superior spine, and perpendicularly to the center of the film holder. If possible, compression blocks are used for these radiographs. The compression blocks are removed before the fifteen minute film if they have not been removed already.

4. Fifteen minutes after injection a full posterior-anterior radiograph is taken on a 14" x 17" film. The patient is in the prone position with the median line of the body over the center line of the table. The film holder is centered to the crest of the ilium. The central ray is directed to the center of the film holder.

5. Following the 15 minute film a bladder film is taken on a 10" x 12" film. The patient is in the supine position with the median line of the body over the center line of the table. The film holder is centered midway between the anterior superior spine and the symphysis pubis. The central ray is directed to the center of the film holder.

Frequently, following the bladder film the radiologist may request a post void film. The patient will then be given a chance to void, after which the technician takes the post void film using the same method as the bladder film.

All IVP films are taken on expiration. All IVP films utilize a 40" focal film distance. The techniques differ according to the different densities and positions of the patient, and the different examination rooms.

A well done IVP will enable the radiologist to diagnose any stones, calcifications, abnormalities, malfunctions, and diseases that may be present in the kidneys, ureters, and bladder. The IVP is but one of many types of examinations of the urinary system. They all help to make up the extensive field of diagnostic radiology.

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THE MSRT STATE CONVENTION

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First District

The membership committee of the First District has recently completed a statistical survey in order to tabulate certain kinds of data about the registered technologists in its district. The committee, led by H. P. Fritz, R. T., Chairman, managed to personally contact 300 of the 412 registered technologists listed as residing in their district. The following information was compiled by the committee:

Total R. T.'s in District 1	412
Total reached for questioning	300

Of those R. T.'s who were questioned, the results were as follows:

Total full time R. T.'s	212
Total part-time R. T.'s	30
Total unemployed as R. T.'s	58
Total working R. T.'s	242
Total members of ASRT	108

This leaves a total of 124 to convince that they should be members of the ASRT.

Total members of MSRT 79

This leaves a total of 173 to convince that they should be a member of their state society.

Total members of District 1 56

This leaves a total of 186 potential members

Total members of all three societies 241

Gathering statistics such as these, reported Mr. Fritz, can prove to be very beneficial to the members of the MSRT, since it is precisely this kind of information which can help provide the leverage our society needs when we meet with other influential and controlling groups to discuss professional affairs and socioeconomics.

The First District also wishes to announce the results of their election of officers for the 1972-1973 year:

President	James Roach, R. T.
Vice-President	Jack Manglos, R. T.
Secretary	Joan Nastasio, R. T.
Treasurer	Donald Blancett, R. T.

Second District

Sister Armella, a charter member of the Missouri Society of Radiologic Technologists, has recently retired from her position as Chief Technologist at St. Elizabeth's Hospital in Hannibal, Missouri. Sister became a registered technologist in 1927, and she has been working at St. Elizabeth's since that time. She has been interested and active in her profession and is known to many technologists through her attendance at state and national meetings. In the future, Sister will be engaged in Patient Relations at St. Elizabeth's where she will be able to move at a more leisurely pace. We wish to join with Sister Armella's many friends in radiologic technology in saying that we will miss her and we wish her much satisfaction in her new activity.

Charles Sandlin, R. T. has been appointed Chief Radiologic Technologist at St. Elizabeth's Hospital in Hannibal, Mo. Mr. Sandlin has been working at the

University of Missouri Medical Center. He has held previous positions at the University Hospital in Augusta, Georgia and at the University of Oklahoma Medical Center. Mr. Sandlin has been active in the radiologic technology societies of Georgia and Oklahoma before moving to Missouri.

Fourth District

In the February meeting of the 4th District it was unanimously agreed upon by the membership that because there was indication that certain members of the Missouri Radiological Society and the Missouri Medical Association were of the opinion that the technologists of Missouri were supporting the licensure bill introduced by the chiropractors, a letter should be drafted by the 4th District and sent to each of these two organizations, officially declaring the District's opposition to this bill. It was also suggested that the State Society (MSRT) be contacted regarding this issue, so that it too could take similar action in order to prevent any further misconceptions about the technologist's opinion of the chiropractor-introduced licensure bill.*

The Fourth District also announces that its offer to sponsor a luncheon at the 1972 Annual MSRT Meeting has been accepted, and that the tentative date of the luncheon is to be Friday, October 6.

At the April meeting, Stan Eisen, President, read a letter from Miss Phyllis McEnerney, notifying the

* The MSRT did draft a similar pronouncement and subsequently sent a letter to each organization declaring opposition to the bill by the MSRT members.

membership of her resignation as a member of the District's Board of Directors. It has been decided by the Board that filling the vacancy is a job which should be left up to the 1972-1973 Board of Directors, therefore, to date, there has been no announcement of a replacement member.

The results of balloting for the 1972-1973 officers and representative to the State Board of Directors are listed below:

District Representative to the State Board of Directors	Marty Strussion, RT
President-Elect	Gary Brink, RT
Vice-President	Joseph Stojeba, RT
Treasurer	Judy Cortner, RT
Secretary	Julie Blanton, RT
District Board Member	Ronnie Schaller, RT

One of the first duties given to the District Representative to the State Board of Directors was to request that an agenda of all State Board Meetings be mailed to the Districts early enough to allow each district to discuss the agenda at their monthly meetings prior to the State Board Meeting. The purpose for this is to be able to arrive at a concensus opinion of the district members on all "agenda" items, and thus, be able to send the District Representative to the State Board Meeting as a "true" representative of the District which he represents.

The winners of the annual film exhibit competition are:

Technology Category

1st Place	"Catheterization", by Coretta Schroer and Obie Knudtson

Student Category

1st Place	"Air Absorption: Oxygen Therapy" by Terry Karch and Kerry Shipley
2nd Place	"Effects of Angulation in Cerebral Angiography" by Mike Albertina
3rd Place	"Increased Radiographic Contrast Through Decreased Secondary Radiation" by Diane Lloyd

A $50 cash prize was awarded to Miss Theresa Howard, a student at the Forest Park Community College as the winner of a membership drive sponsored by the Fourth District. Miss Howard received the cash prize at the District's May Meeting for having recruited ten new members into both the Fourth District and the MSRT.

<u>Fifth District</u>

At the monthly meeting of the 5th District, held at St. John's Hospital in Springfield, the membership adopted a recommendation that membership renewal forms be mailed along with invitations during the month preceeding the due date.

The Student Affairs Committee was instructed to work on a set of recommendations to be presented to the MSRT which would improve the student benefits in the State Society.

The election of officers for the 1972 fiscal year resulted in the following:

President	Sister Joyce Marie Smith, RT
Vice-President	Guy Hawkins, RT
Secretary	Opal Housh, RT
Treasurer	Dale Crouch, RT

The scientific program for the evening was presented by Robert Rein, President, MSRT, and was concentrated on the functions and goals of the MSRT and ASRT. It was followed by a provocative question and answer period which was felt to be of "great value and interest" to the members.

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TECHNICAL TALK

The important role that image sharpness plays in contributing to radiographic quality necessarily makes it the subject of frequent, if not continuous, discussion in the day-to-day activities of a technologist. Careful scrutinization of each and every radiograph for adequate positioning, technique, and sharpness requires constant mental review of each of the myriad factors which can ultimately affect the final radiographic quality. Most of these factors have been learned by the technologist in the classroom, while others have been gleaned from his experience over the years. Thus, the technologist routinely finds himself making "value judgements" in the process of critiquing a poorly executed radiograph. Decisions on how to alter the radiographic set-up in order to "correct", and thereby improve, the radiographic image are based upon the technologist's knowledge and thorough understanding of the technical factors which can make or break a radiograph.

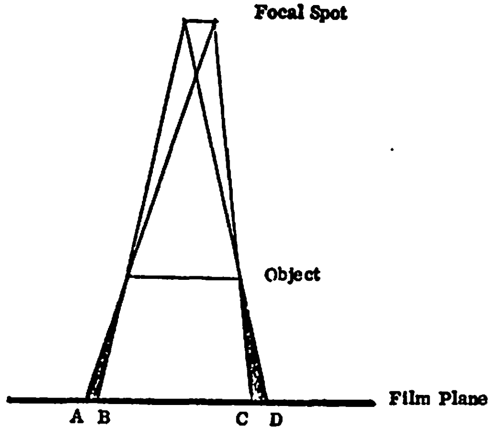
This leads to a point at which a declaration of a theme of this article is appropriate. If, for the sake of brevity, technique and positioning are excluded from the discussion of quality controlling factors, then the only remaining factor influencing radiographic quality is one of detail sharpness. It is, therefore, the purpose of this article to briefly discuss some of the factors which have a direct influence on radiographic sharpness, to explain a phenomenon, often overlooked, which contributes to the overall loss of radiographic clarity and sharpness, and to show by means of a simple equation how the geometric area of unsharpness (penumbra) is directly related to the size of the focal spot, the object-film distance (OFD), and the focal-object distance (FOD).

To establish a "common ground" for terminology usage in the remaining portion of this article, a short preview of the concept of geometric unsharpness (penumbra) follows:

Penumbra

The area of unsharpness which extends beyond the lateral edge of an object being imaged on a radiographic film is called penumbra. Figure 1 demonstrates a penumbral area equal to A-B and C-D, and an actual image (umbra) represented by B-C.

FIGURE 1

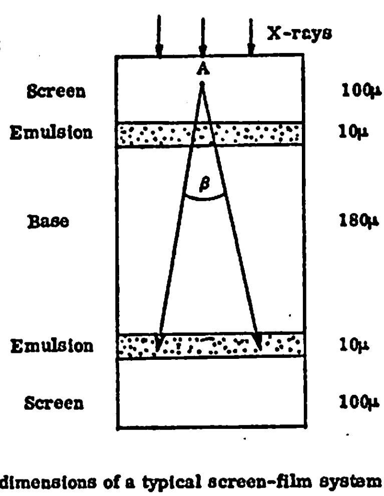


The ultimate sharpness of a radiograph is dependent upon the size of the penumbra in relation to the size of the object being examined. If the area of penumbra is large in relation to the object of interest, the radiograph will be judged unsharp, thus making it necessary to repeat the examination in order to reduce this zone of unsharpness. The technologist, in order to "diagnose" the cause or causes of excessive penumbra, must be able to sort out those factors which he knows can have an effect on sharpness, and decide which ones he will alter in order to improve the radiographic quality.

Intensifying Screens

The effect that intensifying screens have on image sharpness is one of degradation of clarity, compared to a directly exposed radiograph in which the x-rays themselves are directly responsible for image formation. The inherent unsharpness caused by intensifying screens is principally the result of light diffusion which occurs within the phosphor layer of the screens. Figure 2 shows the process of this diffusion and how it relates to the geometry of the image forming system.

FIGURE 2



Physical dimensions of a typical screen-film system and light diffusion in the system.

An x-ray impinging upon a crystal (A) within the intensifying screen causes that crystal to fluoresce with a bluish light. This light is emitted in all directions, and depending upon its location within the intensifying screen, will leave the screen within a certain solid angle (β) and expose the adjacent x-ray film. From the illustration it can be seen that the light emitted by a very small crystal within the phosphor layer of the screen will actually expose a much larger area on the x-ray film. This inaccurate imaging of the original crystal results in the loss of radiographic sharpness and is thus one of the factors which the technologist must contend with when trying to maintain radiographic image sharpness. From a pure geometrical standpoint it should be apparent that the degree of unsharpness will depend upon the location of the crystal within the screen. Since crystals far from the film will be imaged less sharply, it can be concluded that thin phosphor layers (slow-speed screens) will be sharper than thick phosphor layers (high-speed screens).

Film

When radiographic film is employed with intensifying screens, the inherent unsharpness of the combination is principally caused by the diffusion which takes place within the intensifying screens. There is, however, an additional component contributing to radiographic unsharpness which has its origin in the x-ray film itself.

Unlike intensifying screens, the thickness of the film's emulsion layer has a negligible effect on image sharpness: but, what is significant about the x-ray film and its contribution to loss of resolution, is the double emulsion coating found on virtually all film used with intensifying screens. In figure 2, a cross-section of a screen film combination shows the film's emulsion layers being typically separated by a transparent base considerably thicker than the film's emulsion layers. This "double emulsion" system results in a phenomenon known as "crossover". Some of the light originating in the front screen is not absorbed by the first layer of film emulsion in contact with the screen. This light penetrates the film base and is then partially absorbed within the second layer of film emulsion. Once again, for geometric reasons, this second image (crossover image) is even less sharp than the image formed in the first emulsion. The "crossover" phenomenon is often neglected when considering factors affecting radiographic sharpness. However, because it accounts for about 30% of the total exposure on the film with calcium tungstate screens,[2] its existence should be recognized as one of the factors which affects radiographic image sharpness.

Motion

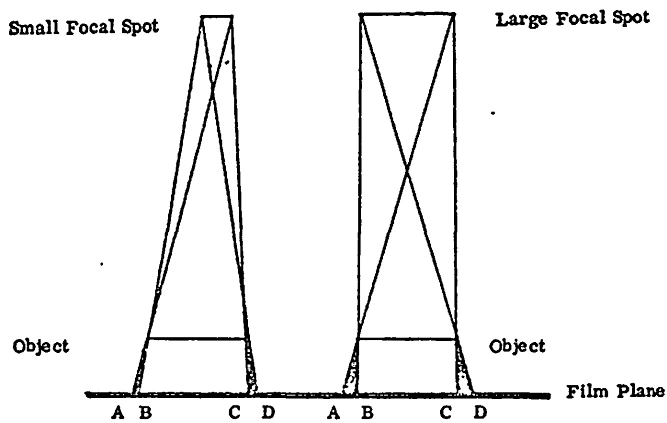
When referencing detail sharpness to motion, consideration must be given to the two types of motion commonly encountered in a radiographic set-up. The first, and most common type of motion occurs when the part being radiographed is moving during the exposure time. Object motion results in the generation of a rather large penumbral area, and consequently, even the smallest object motion is responsible for a drastic reduction in image sharpness.

The second type of motion which influences radiographic quality occurs when a poorly supported x-ray tube swings during an exposure. Although the motion unsharpness which results from having the focal spot move during the exposure is about 1/6[1] as large as would be produced by an equal amount of object motion, its effect on the final radiograph is not negligible, and thus, must be considered as a potential source of excessive penumbra.

Focal Spot Size

One of the most influential factors regulating radiographic sharpness is the size of the focal spot. The penumbral area produced by a focal spot with finite dimensions is directly proportional to the size of the focal spot. Thus, if two radiographs are taken using identical conditions, the only variable being the size of the focal spot, the penumbra produced by a 2 mm. focal spot will be twice as large as that produced by a 1 mm. focal spot. This point is demonstrated by illustration number 3.

FIGURE 3

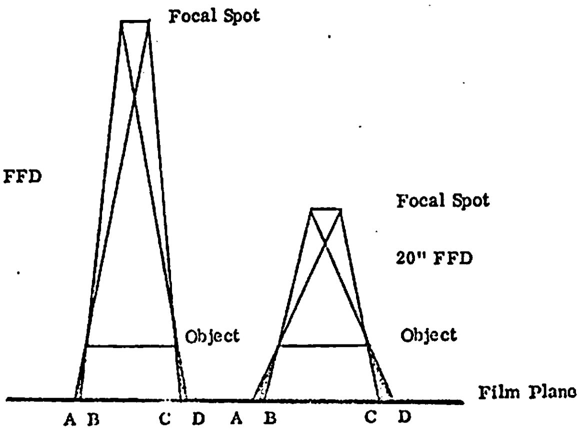


The effect of focal spot size on penumbral area (AB, CD).

Focal-Film Distance

The effect that FFD has on geometric unsharpness can be considerable depending upon the magnitude of the FFD used in radiographing an object. Radiographs taken with a large FFD exhibit less penumbra than those employing a short FFD. There exists an inverse proportionality between the size of the focal film distance and the zone of unsharpness (penumbra) on a radiograph. Figure 4 depicts two radiographic set-ups in which only the FFD has been varied. Note that a FFD of 40 inches results in exactly 1/2 of the penumbral area compared to that generated when a 20-inch FFD is used.

FIGURE 4



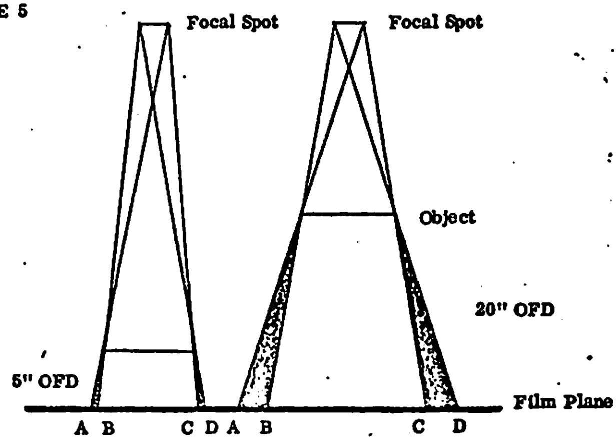
The effect of FFD on penumbral area (AB, CD).

Object-Film Distance

The last factor which has a direct bearing on radiographic sharpness is the object film distance (OFD).

Once again, as with the other factors which affect geometric unsharpness, there is a proportionality between OFD and penumbra. In this case there is a direct proportionality between the two, consequently, as OFD is reduced, so also is the penumbral area. In figure 5 the OFD has been varied to illustrate its effect on penumbra.

FIGURE 5



The effect of OFD on penumbral area (AB, CD).

Up to this point the effect that each of certain factors had on detail sharpness has been discussed independently of one another. At certain times it has been demonstrated that penumbra is directly proportional to one of the controlling factors (FS, OFD, FFD) while at other times, an inverse proportionality has been shown to exist. For the quality conscious technologist it is important to establish a simple, yet comprehensive method of relating these three factors so that a quantitative prediction of detail sharpness is possible. To do this easily, but effectively, requires only that the technologist be familiar with the following formula:

$$\text{Penumbra} = (\text{FS size}) \times \frac{(\text{OFD})}{(\text{FOD})},$$

where penumbra is the size of the zone of unsharpness, FS is the size of the focal spot; OFD is the object-film distance; and FOD is the focal-object distance. If the actual dimensions are "plugged-in" to this formula, remembering to convert all dimensions into one standard such as inches or millimeters, it is but a simple matter to determine the quantitative effect that a change in one of the variable factors will have on the final radiograph, and thus, the technologist has a simple yet profound method of correlating some of the variable factors which have considerable effect on radiographic quality.

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