Decreasing Radiation In Photofluorography

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DURING the last several years, considerable attention has been given to reducing the amount of diagnostic X-radiation that medical and dental patients receive. With this objective, research has concentrated on the radiographic process, making improvements in intensifying screens and film emulsions, to reduce exposure of both film and patient without loss of detail of the diagnostic picture.

A major consideration is that up to 98 percent of the density of a radiograph, except for the nonscreen type of film, may result from the actinic rays given off a fluorescent screen under the influence of X-ray energy. The remaining density is a consequence of X-rays directly. In photofluorographic work, the radiograph is obtained by a purely photographic process. A camera records on photographic film the image appearing on a chemically treated surface that fluoresces under the influence of X-radiation.

The period of film exposure required to obtain an image by this photographic procedure determines the necessary period of X-ray production. Therefore, shortening the necessary photographic exposure time, by use of a "brighter" fluorescent screen or a more sensitive film emulsion to record the image, permits corresponding reductions in X-ray exposure time for the patient and in the amount of scattered radiation the technician and others in the vicinity of the X-ray machine will absorb.

Faster Film Emulsions

Within the last few months, a new green-sensitive photofluorographic film (*A*), type PFG–470, which has a faster emulsion than film produced previously (*A*), type PF–470, has been put on the market. This new film was tested in the Electronics and Technical Service Laboratory, Tuberculosis Program, Public Health Service, to compare its emulsion speed with that of the earlier type.

Both types of film were exposed on a 70-mm. photofluorographic X-ray machine, using a safety-timer instead of a phototimer. An impulse counter (one impulse being equal to $\frac{1}{120}$ second) was connected across the field coil of the main contactor to measure the time of each exposure. A Presdwood phantom, representing the patient, was used in front of the hood. The grid in front of the fluorescent screen was removed so that grid lines would not interfere in making density readings. The X-ray machine was operated at 100 kilovolts peak and 175 milliamperes. All factors, except time, were kept constant, and exposures were made on both types of film.

The two strips of film were processed simultaneously by the temperature-time technique in open tanks containing regular X-ray processing solutions. After the film was washed and dried, the density in the same area of each frame of film was measured by a densitometer. The base plus fog level density was measured in the clear area between each two frames and subtracted from the density reading in the frame to obtain the density of the emulsion. The emulsion density readings and the film density readings were then plotted against time periods in impulses, and smooth curves were drawn through the points for both types of film (fig. 1). By choosing a density reading and noting the corresponding exposure time on each curve, the comparative speeds of the two films were obtained.

It is noteworthy that the new film emulsion is twice as fast at the density of 1 as the older type. The older type has a colorless base in contrast to the light purple base of the new. This, of course, affects the overall apparent density and makes the new type of film 2.8 times faster than the old at the density of 1.

Less Radiation

Another study carried out in this laboratory determined the effect of added filtration on:

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1. Skin dose received by a patient from a 70-mm. chest photofluorogram.

2. Exposure time.

The work was done in a bus unit containing a 70-mm. photofluorographic machine. All exposures were phototimed, and an impulse counter was connected across the field coil of the main contactor to measure the time in multiples of $\frac{1}{120}$ of a second. Again a Presdwood phantom was used. A condenser R meter with a 25-roentgen chamber was used to measure the radiation at the surface of the phantom, which represents the skin dose received by the patient. Pieces of half-hard-rolled aluminum sheet, 0.025 inches thick, were used for the added filtration.

X-rays were produced at 100 kilovolts peak and 175 milliamperes, first with no added filtration, then with added filtration, in steps of 0.025 inch. The observed data are graphed in figure 2. An increase in the period of exposure is required with increased filtration to obtain a given density; radiation experienced by the phantom in the direct beam decreases, nevertheless. With 3 mm. of added aluminum filtration, the phantom received only 55 percent of the dose received without such filtration even though the length of exposure increased 30 percent. The aluminum filters out those X-rays of longer wave length which are absorbed by the patient and do not contribute to the brightness of the fluorescent screen.

Figure 1. Comparison of speed of two types of photofluorographic film (100 kilovolts peak, 175 milliamperes).

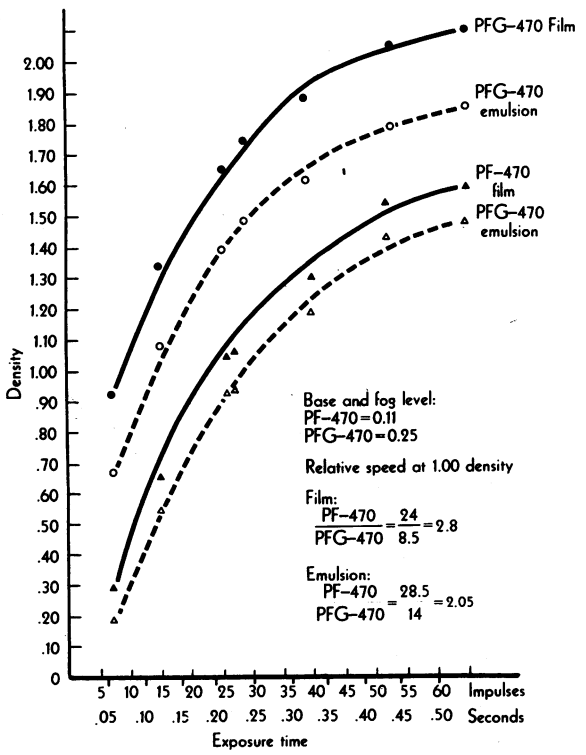
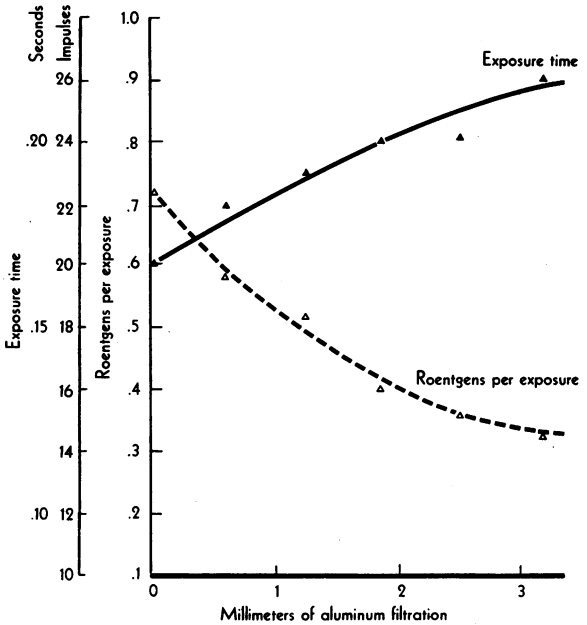


Figure 2. Effect of aluminum filtration on exposure time and radiation dose.



Summary

A new type of photofluorographic film (PFG–470) requires an exposure period only half as long as the earlier type (PF–470) to obtain a radiograph of the same density. Thus, the patient receives only one-half the radiation. If 3 mm. of aluminum filtration is added, the patient will receive approximately half the radiation dose he would receive without it, with either type of film, even though the exposure time must be increased a third to obtain an image of a given density.

To illustrate these reductions, for a fluorogram of a patient of average size made with the earlier type of film and no added filtration (100 kilovolts peak and 175 milliamperes), the exposure time may be 18 impulses, or 0.15 seconds. If 3 mm. of aluminum filtration is added

with this type of film, the patient will receive only half as large a dose of radiation although the exposure time will be increased to 24 impulses, or 0.20 seconds. If the new film is used, which simultaneously halves both the exposure time and the dose, an exposure of 12 impulses, or 0.10 seconds, will suffice, and the radiation dose will be only one-fourth of that received with the older type of film without the added filtration.

MATERIALS

(*A*) Type PFG–470 and type PF–470 film, Eastman Kodak Co., Rochester, N. Y.

Health Survey in Nepal

Our bureau of local health services has finished its first health survey, reporting on 157 persons in Hitaura, Nepal, in territory described as "Paradise" in a recent travel movie. In the last 5 years, deaths occurred in 20 of the 30 families surveyed; 7 of the deaths came before 1 year of age and 13 before the age of 20.

The 34 women questioned in the survey had had 9 abortions or stillbirths and 142 deliveries of live babies; but 18 of these infants died before the age of 1 year. These figures mean an annual mortality rate of more than 4,000 per 100,000 or 4 per 100 population. This rate cannot be projected because of the small sample, but Hitaura's mortality rate may possibly represent all of rural Nepal.

—RAYMOND E. STANNARD, M.D., *public health adviser, U. S. Operations Mission, Nepal.*

First Conference

Thailand's first national conference of public health workers was held at Cholburi in March 1957. From all parts of the country, 200 health officers, nurses, sanitary engineers, health educators, and other workers gathered to confer, review, and plan for the nationwide public health program.

—ANDREW P. HAYNAL, *deputy chief, public health adviser, U. S. Operations Mission, Thailand.*

Cochabamba's Boycott

The 100,000 people of Cochabamba were vaccinated in 7 days when smallpox broke out in this Bolivian city. Health servicio workers found 218 cases, but it is assumed that many others were hidden and that some infected persons left to escape isolation.

In a mass campaign 24 teams of medical students vaccinated house by house, 5 teams of nurses vaccinated at schools and factories, and 16 vaccination clinics were set up at government and private agencies and in industrial plants. Cochabamba's 29 pharmacies were given instructions and equipment for inoculations.

Local authorities and the public joined in a voluntary boycott which was decisive in the campaign's success. Banks, restaurants, buses, cinemas, and public offices refused to serve unvaccinated persons.

Glycerinated smallpox vaccine previously used in Bolivia proved to be of doubtful potency; several persons vaccinated a month before developed the disease during the outbreak. Lyophilized vaccine was imported from France and Peru for the mass vaccinations.

At the close of the campaign, 105,548 people—including both the resident and floating population—had been vaccinated. These were identified by indelible ink marks on the finger tip, which helped to establish the number inoculated.

As the campaign extends to rural areas of Cochabamba Department and later to the rest of the nation, it is expected that smallpox will be wiped out in Bolivia.

—HARALD S. FREDERIKSEN, M.D., *chief, health, housing, and welfare field party, U. S. Operations Mission, Bolivia.*