PHOTOSCAN REVERSAL—A VALUABLE AID IN PHOTOSCAN INTERPRETATION

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Photoscan reversal is a technique that has been devised to help interpret diagnostic photoscans. By reversing the image pattern using graded exposure, one can vary background suppression with contrast enhancement. This method has aided the study of dense scans—most notably liver, renal and lung. The method we have used to produce photoscan reversals is described below. Representative examples and a paired series of conventional scans with photoscan reversals are presented.

MATERIALS AND METHODS

Conventional scans were first obtained using a Picker Magnascanner with a 3-in. NaI(Tl) crystal and a 19-hole collimator. The film used was 14 × 17-in. Ansco High Speed (Supreme) developed in Hunt's chemicals at 28.9°C for 3½ min, fixed at 23.9°C and dried.

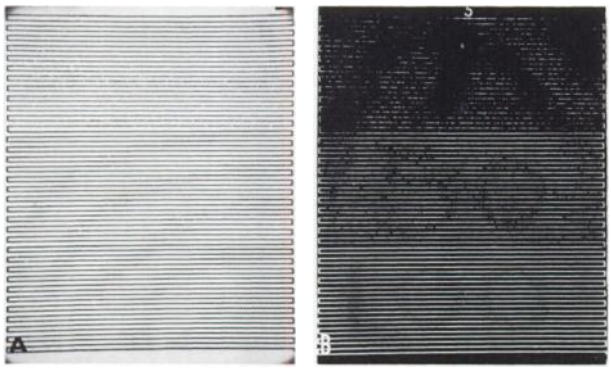

FIG. 1. A shows scan made with Picker Magnascanner by mechanically reducing voltage applied to cathode-ray tube to introduce numbers into pattern. Top third has number "25", "50" is in center and "100" is at bottom. Number in each case represents voltage change used to form figure. Numbers are not discernible in original scan. B is photoscan reversal made with 5-sec exposure. It illustrates that contrast enhancement is sufficient to bring out numbers "50" and "100."

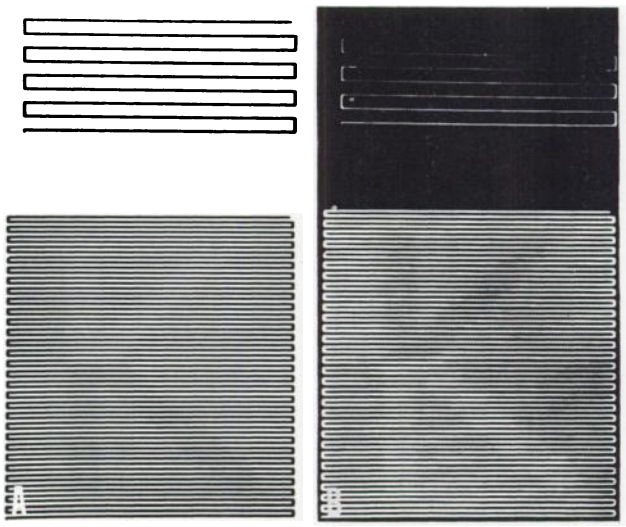

FIG. 2. A is scan made by same method as Fig. 1A. Top half of "K" was formed by reducing voltage by 100 volts; bottom half was made by an increase of 100 volts. B is photoscan reversal of Fig. 2A (15-sec exposure).

Reversed films were produced by a contact printing method adapted from the Ben-Porath, Imperato and Kaplan procedure (*1*). Unexposed x-ray film of the same type is placed behind the conventional scan between 18 × 27 × ¼-in. glass plates. The films are then placed on a nonreflective table 5 ft below a flashlight bulb (WPR-9). The flashlight bulb is powered at 3 volts by dry-cell batteries. A timing switch is connected into the circuit for graded exposures. We found that three exposures, 2, 4 and

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6 sec, gave optimal results. The three exposed films are then placed in cassettes and developed in the same way as the original scan.

DISCUSSION

It is possible to vary contrast with photoscan reversals using graded exposures. This amounts to a technique for altering the scan image in densely exposed areas to highlight subtle changes. The reversed scans provide a positive image with background and unexposed areas darkened—just the reverse of the usual photoscans. Figures 1A and 2A are photoscans. Their respective reversed photoscans are seen in Figs. 1B and 2B. We feel the latter scans highlight information obscured in the original scans due to decreased background with contrast enhancement in the reversals. When viewed on a viewbox, the light penetrates the films in a graded photolucent instead of a photodense pattern which aids interpretation of line and dot differences. Figure 3A shows a liver scan originally considered normal. There is an area of decreased density in the center of the photoscan which is better seen on the reversals (Fig. 3B and C). A followup study 2 months later clearly shows the defect with both techniques (Fig. 4A and B). The scan of another patient's liver showed several defects (Fig. 5A). The reversal study shows an even more extensive disease pattern. Figure 6A and B, 1 month later, showed progressive changes.

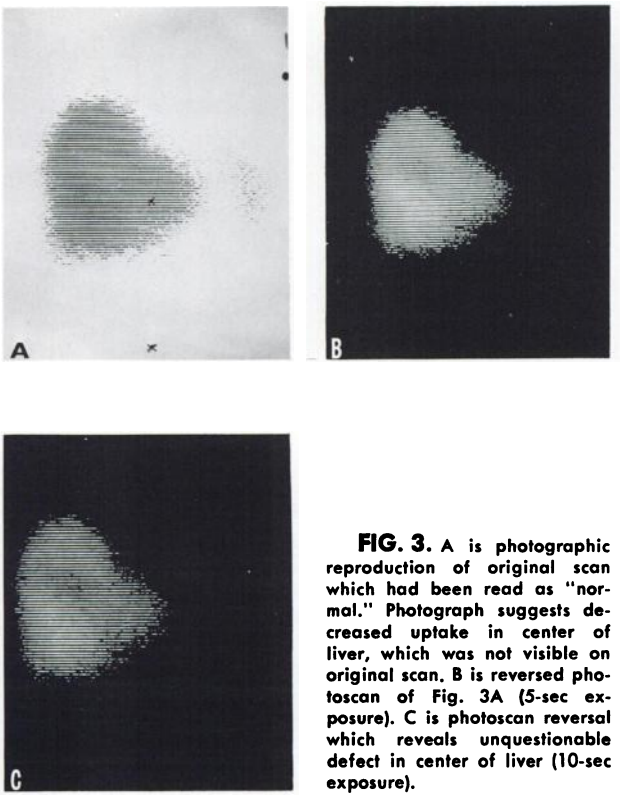

FIG. 3. A is photographic reproduction of original scan which had been read as "normal." Photograph suggests decreased uptake in center of liver, which was not visible on original scan. B is reversed photoscan of Fig. 3A (5-sec exposure). C is photoscan reversal which reveals unquestionable defect in center of liver (10-sec exposure).

Photoscan reversals are not advocated for brain, bone and joint scans where abnormalities in the photoscans are seen as areas of increased density. It is possible that valid information in diseased areas could be lost because they appear normal in the reversal study.

The possibility of finding defects that do not in fact exist was considered. Ten "normal" liver scans were compared with reversal studies using three or more graded exposures. Exposures up to 15 sec

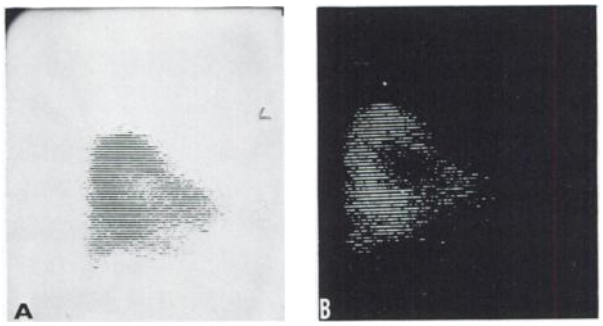

FIG. 4. A is followup scan made 2 months after that shown in Fig. 3A. Defect is now obvious in standard scan. B is reversal of followup scan which shows extension of defect seen in Fig. 3C (5-sec exposure).

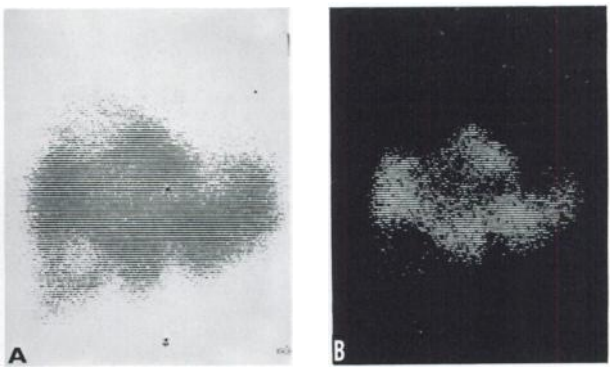

FIG. 5. A is original scan showing severely diseased liver. B is photoscan reversal which enhances areas of wipeout (5-sec exposure).

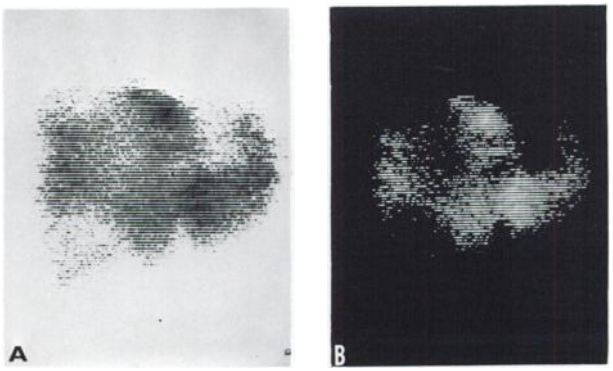

FIG. 6. A is followup scan performed 1 month after that shown in Fig. 5A. B is reversal of followup scan (5-sec exposure).

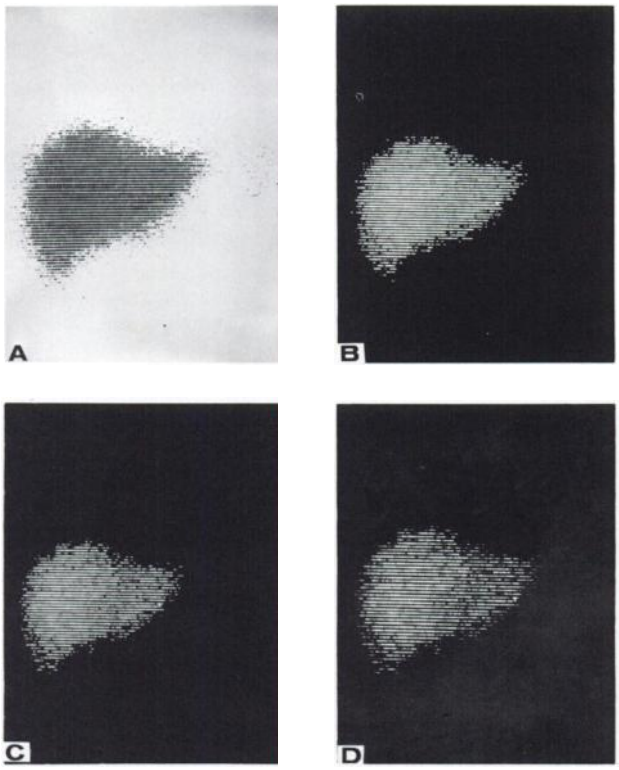

FIG. 7. A is normal liver scan. B is reversal of normal scan showing minor background suppression and no localized wipeout (5-sec exposure). C is reversal of normal scan showing considerable background suppression but no localized wipeout (7-sec exposure). D is reversed scan showing patchiness. No unexpected areas of localized wipeout were created by overexposure of normal liver scan (15-sec exposure).

were included. Typical results are shown in Fig. 7A–D. No questionable areas of decreased density were found in the reversal study except where the tissues are thin and the counts therefore decreased, i.e., left lobe and hepatic notch. A general patchiness does appear with overexposures of the reversal photoscans, however. We found the best clinical correlation when exposure times in the reversal study was 2, 4 and 6 sec.

SUMMARY

The method of producing reversal photoscans described in this paper has the advantage of suppressing background with enhanced contrast. Representative photoscans are presented together with reversal photoscans. Subtle differences in dense scans (liver, kidney and lung) can be highlighted with this technique. Examples where this has been helpful are presented to demonstrate areas of possible usefulness for the reversed photoscan. Limitations of applicability and interpretation are discussed.

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REFERENCE

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