USE OF HIGH-DEFINITION FILMS AND IMMERSION TECHNIC IN EARLY DIAGNOSIS OF METABOLIC AND SYSTEMIC DISORDERS

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FOR many years there has been periodic interest in radiology of the soft tissues to further the understanding of their pathology and of dermatologic disorders.[1-5] There is general agreement that exposure to low kilovoltage and high milliampere-seconds is necessary to accentuate the contrast of skin and underlying soft-tissue components. Water and other immersion mediums have been utilized to enhance this contrast.[6,7] Injection of contrast mediums and gases into the subcutaneous layers has also been utilized to demonstrate injury and pathologic lesions in these tissues.[8]

In the past the immersion technic has been applied to evaluate bone atrophy and to obtain greater detail of small vessels and organs injected with contrast medium. Recently a report[7] discussed immersion of the forearm in water or alcohol for roentgenographic evaluation of skin thickness in control subjects and in acromegalics. During the last year, the author has applied an immersion technic in the examination of more than 100 patients. The purpose of this paper is to state briefly some preliminary observations of application of this technic to various pathologic disorders of the hand.

Method

For the immersion technic, a pliable plastic cassette is placed beneath a thin plastic basin, and the patient's hand or foot is placed flush with the bottom of the basin. Just enough water is added to immerse the hand or foot. Exposure to roentgen rays from 30 to 34 kv. for 1.5 to 3 seconds at 100 ma. was used in all cases reported in this study. Focal spot size was 1.2 mm., and all exposures were taken at a distance of 28 in. No filters or intensifying screens were used. DuPont Industrial AA film was used and was developed for 2.5 minutes in the X-OMAT developer, after which it was placed in fixing solution for 8 minutes.

Observations and Results

The immersion technic improves the diagnostic quality of roentgenograms in four ways by: (1) giving a clear outline of the inner and outer borders of the skin; (2) accentuating the contrast of the subcutaneous fat layer to the adjacent skin and deeper tissues, and outlining clearly its distribution and contents; (3) outlining the capsular structure of the joints, especially of the metacarpophalangeal joints and proximal interphalangeal joints; and (4) providing a relatively homogeneous penetration of bone of various thicknesses. The major disadvantage of

this technic appears to be a slight loss of definition because of greater scattering of the roentgen-ray beam.

The skin of the fingers of a normal adult is not of uniform thickness. On the radial sides of the distal index and third fingers the skin is usually double the thickness of that of the ulnar sides of these fingers. The skin of the thumb is thickest and is evenly distributed. Skin of the fourth finger is thinnest and is evenly distributed. On the ulnar side of the fifth finger the skin is thicker than on the radial side. On each finger the skin is thickest distally and thinnest at the base. Laborers' hands showed somewhat thicker skin distally than those of men of similar ages who have sedentary jobs. The average skin thickness at the base of the fingers is 0.5 mm. in women and 1 mm. in men. The normal adult range of skin thickness at the base of the fingers appears to be from 0.5 to 1.5 mm. Age, as well as occupation, may also be a factor affecting skin thickness in hands, as skin of elderly men and women is thinner than that of young adults.

Roentgenographic Findings in Metabolic and Systemic Disorders

Three young acromegalic men had generalized increased thickness of the skin of the hands, up to three times the normal thickness. (*Fig. 1.*) These skin changes were associated with typical bone changes of ungual tufting, cortical thickening and broadening of the phalangeal end plates. However, a 70-year-old acromegalic man showed no skin thickening of the hands or typical bone changes, suggesting either that his skin and bone were unable to respond to certain endocrine stimuli, or that his endocrine elaboration was different from that in the younger acromegalics. This patient was known to have had acromegaly for a considerably longer time than did the three young patients. Conventional roentgenograms of the hand of a 74-year-old man showed heavy bone structure not unlike that of an acromegalic hand, but high-definition films and the immersion technic revealed his skin to be thinner than normal. In his youth the patient was a professional bare-knuckle fighter, which could possibly account for the bony changes seen. The roentgenograms of the hands of a 46-year-old woman with an enlarged sella turcica and visual field changes showed no skin or bone changes to suggest acromegaly. Although further studies confirmed the presence of a pituitary tumor, it was not of the eosinophilic type and growth hormone assay was normal.

The immersion technic is particularly valuable in demonstrating early arthritic manifestations, especially capsular distention. Standard roentgenograms often fail to reveal this change clearly because of redundant superimposed skin folds. Immersion films show especially well the joint capsule surrounded by a thin layer of fatty tissue. Local edema and inflammation are manifested by distention of the fatty tissue and an accentuated reticular pattern. Loss of the usually sharp capsular outline is also noted. Palmar and digital artery visualization is often obtained with the immersion technic which provides sufficient detail so that the arterial diameter

Fig. 1. Roentgenogram of the hand of a 33-year-old acromegalic man showing massive skin thickening, by immersion technic. Picture is enhanced by logitronic reproduction.

can be determined. Vascular dilatation in the involved hands has been observed in several patients with acute arthritides; palmar vessels with small diameters were seen in those with scleroderma.

Conclusion

The immersion technic is a useful new radiologic method of detecting early changes in certain metabolic and arthritic disorders. Further studies are in progress with the immersion technic in a wide variety of diseases.

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