

HARALD BRODIN: Longitudinal Bone Growth The Nutrition of the Epiphyseal cartilages and the Local Blood Supply

Experimental Study

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(Author's Abstract)

The main purpose of the investigation was to determine the correlation, if any, between the change in longitudinal growth and the blood supply to the surroundings of the epiphyseal cartilage of the long bones.

The periosteum of the tibia of growing rabbits was loosened by a modification of Ollier's (1867) method. The periosteum was loosened from the middle of the diaphysis up to the vicinity of the proximal epiphyseal cartilage of one of the tibiae. An indicator was applied to the tibia on either side to estimate growth from each epiphyseal cartilage of the experimental leg and of the control leg. The operation was followed by a progressive increase in the growth from the distal epiphyseal cartilage on the experimental side and an almost corresponding inhibition of growth from the proximal epiphyseal cartilage.

It was considered that the nutritional pathways of the epiphyseal cartilage should be investigated because any changes in circulation would reasonably be more readily detected near that part of the epiphyseal cartilage where substances from the blood stream could most readily enter the cartilage. An acid fluorescent substance, 3-oxypyrene-5, 8, 10-trisulphonate in 5 per cent solution was injected intravenously into the rabbit. The animal was killed $\frac{1}{2}$ -10 minutes later, and the epiphyseal cartilage of the radius and of the ulna were immediately removed, frozen and sectioned. The preparation was mounted in paraffin and photographed in ultraviolet light. The most intense fluorescence was seen in those parts of the cartilage facing the metaphysis and the epiphysis. The perichondrium was also strongly fluorescent. The fluorescence decreased rapidly from the perichondrium and epiphysis in direction into the cartilage, and gradually became weaker in the direction from the metaphysis into the cartilage. The infiltration thus appeared to be mainly from the metaphysis. Spectrophotometry showed a similar spread in the epiphyseal cartilage in experiments in which water in soluble benzpyrene was used.

By means of washed erythrocytes tagged with radioactive chromate and injected into operated and unoperated rabbits the amounts of blood in corresponding parts of the two lower legs were determined.

The operation was found to be followed by an increased amount of blood in the operative field for a period of up to 2½ weeks and for about 1 week at the level of the distal epiphyseal cartilage of the operated leg.

The above mentioned oxypyrene was used for the investigation of the circulation in the bone marrow near the epiphyseal cartilage. About 20 seconds after the injection the animals were killed and both lower legs frozen in a freezing mixture at -80° C. The marrow cavities were opened and photographed in ultraviolet light at a temperature of -10° C to -15° C. By means of a photometer the degree of blackening near the epiphyseal cartilage and the breadth of the blackened portions were determined. Evidence was produced that the supply of blood near the quicker growing epiphyseal cartilage was increased for a period of up to 6 weeks after the operation. It is possible that the flow of blood to the slower growing proximal epiphyseal cartilage was somewhat decreased.