GROWTH DISTURBANCES IN INFANTILE PARALYSIS

By
Ahmed Zaki El-Sobky
Demonstrator of Orthopaedic Surgery,
Faculty of Medicine, Ain Shams University

A Thesis submitted in Partial Fulfilment of the Requirements for the Award of the Degree of
MASTER OF ORTHOPAEDICS. (M.S.Orth.)

Supervised by:
Prof. M. Mehrez
Professor of Orthopaedic Surgery
Faculty of Medicine, Ain Shams University

and

Dr. M. Hifny
Assistant Professor of Orthopaedic Surgery,
Faculty of Medicine, Ain Shams University.

Department of Orthopaedic Surgery
Faculty of Medicine
Ain Shams University
Cairo - U.A.R

1970

ACKNOWLEDGEMENT

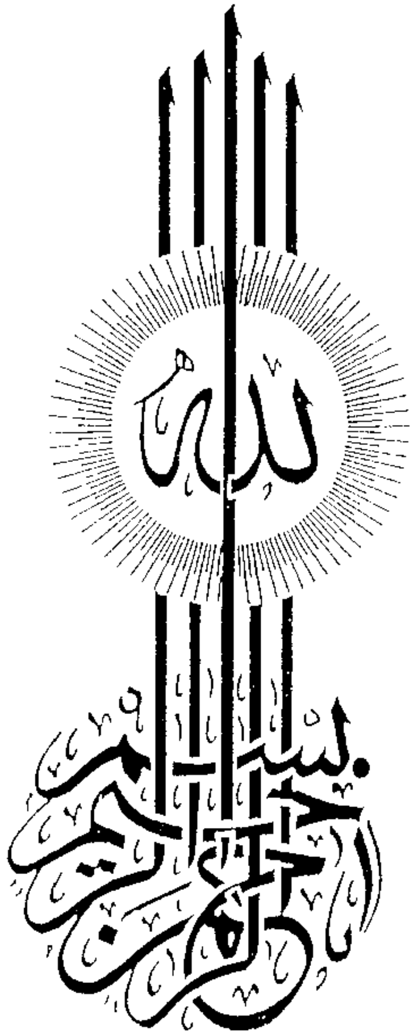
I am deeply grateful to Prof. Dr. M. Mehrez for suggesting this interresting and important subject, for giving me the broad outlines of the work, and for evaluating much of the important points. It is a real pleasure to acknowledge his help and encouragement.

I am fortunate that, Dr. M. Hifny is so interested in the subject of this thesis, that he was always willing to discuss its various aspects with me at length, and furthermore he gave me very direct assistance in the form of notes and illustrations to the various aspects of its subject.

I received much and extremely helpful advice from Dr. A.S. Khattab.

Dr. F. Borg went to a great deal of trouble to provide me with much help in the beginning of this work.

I again consulted Dr. E. [illegible] , Dr. M. [illegible] and Dr. H. El-Zaher who contributed so willingly; and reviewed with me many parts of this thesis.


بسم الله الرحمن الرحيم

Dr. [illegible]
constructing the radio-opaque ruler. I should like to thank other members of the orthopaedic section, who were specially helpful.

Dr, Yehia El-Gamal was kind enough to give me, most helpful aids in obtaining the young rabbits.

I received extremely generous assistance from all members of the radiography department.

Of my colleagues Dr. Refki Faris was always ready to discuss any thing related to the statistics, no matter how much I bothered him, and this helped enormously.

The continuous encouragement of my wife, Dr. Nadia El-Kadery, tided me over, the much difficulties I met with.

"THE SHORT LIMB AFTER POLIOMYELITIS IS MORE THAN 3180 YEARS OLD PROBLEM".

A photograph for the mummy of the king Siphtah (Family 19, 1210 B.C.).
The left foot is in equinus , and the whole lower limb is thinner and shorter than its fellow .

CONTENTS

[illegible]

The short limb is an important problem. It is common after poliomyelitis. It aggravates the disability from paralysis.

Apart from the disability to the patient, it is unsightly deformity, with a bad psychic effect, to the patient who often needs an appliance.

There is limp which may be marked; latter on pain from strain on the spine and pelvis develops.

For a child, the future for shortening is unpredictable, and the correction is difficult, if it is not impossible.

It is difficult to manage. It has been always a challenging problem to orthopoedic surgeon.

There is a very large number of surgical procedures, evolved for treatment. This indicates that no one of them have been completely successful.

Many factors which, probably affect the growth of the limb need to be studied; and clarified before we will be able to solve this problem.

[illegible] given little attention in the literature. The natural history of the short limb after poliomyelitis is a matter of controversy in the few literature published.

In this work, we stress that we are not searching for the cause of limb length discrepancy, but we hope to clarify important points in relation to shortening of the limb.

The aim of this work ; is to find the relationship between shortening in the lower extremity after poliomyelitis and the degree of muscle paralysis. To investigate the effect of age at onset of acute poliomyelitis on the amount of shortening.

We have supplemented the clinical work by an experimental one. In the experimental work, we have investigated, the effect of loss of muscle function by tendon cutting, nerve cutting; or disuse by plaster immobilization; in the growing rabbits.

By correlating the results of both works; we were aiming to gain better information on the effect of muscle paralysis on bone growth.

REVIEW OF THE LITERATURE

PART I

BONE GROWTH AND DEVELOPMENT

All bone begins as mesenchymal condensations, during the embryonic period. Some condensations are more fibrous, these are called, membranous areas.

However, most condensations are more cellular, and become chondrified. The bones which then form are termed cartilage or replacing bones.

In both membrane and cartilage bones, the formation of bone as tissue is similar.

<u>Enchondral ossification</u> :

In sites to be occupied later by most of the bones of the skeleton, cartilage models of the bones-to-be are formed first.

Subsequently and gradually, the cartilage models are replaced by bone which forms as a result of ossification occurring along the sides and in the interior of the cartilage model.

The appearance of capillaries in the perichondrium is associated with a changing differentiation pattern of its inner layer.

In the presence of capillaries, the cells begins to differentiate into osteoblasts and osteocytes, with the result that a thin layer of bone is soon laid down, around the model.

Then the name of perichondrium is changed to periosteum. Osteogenic cells and osteoblasts together with capillaries, begin to move from the inner layer of the periosteum into the breaking down mid section of the cartilage model. These constitute what is called the periosteal bud. When it reachs the interior of the mid section of the cartilage model, they are said to constitute a diaphysial center of ossification.

The ossification center rapidly invading the cavities in the breaking down calcified cartilage up and down the model. Soon, there is a marrow cavity in the model.

In the long bones, further centers of ossification appear in the growing cartilaginous ends of the models and are termed epiphyseal centers of ossification.

However, the ossification stop short of replacing all the cartilage in the end of a model. Enough is left at each articulating end of a model to constitute an articular cartilage. Furthermore, a transverse plate of cartilage is left between the bone derived from the epiphysial center of ossification and that from the diaphysial center.

This plate, is termed the growth plate, and it persists until the postnatal longitudinal growth of bone is completed, only then is replaced by bone.

The further, longitudinal growth of a model of a long bone in which epiphyseal centers of ossification have appeared is accounted for by the continuance of the interstitial growth of cartilage cells in this growth plate.

B. GROWTH PLATE

Except for minor contribution by the enchondral ossification of the epiphysis itself, longitudinal growth of bone is lry a function of the growth plate.

When we speak about bone growth disturbance due to polio. we must mean, essentially, some affections of the growth plate.

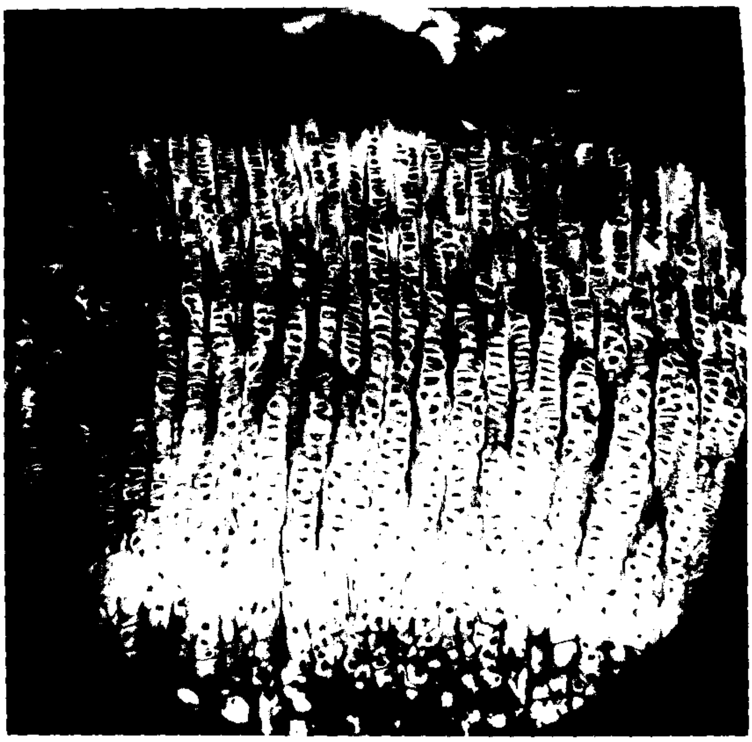
Therefore; the fine anatomical structure of this plate must be considered in some details.

Fine anatomical structure of the growth plate:

The growth plate has its epiphysial and metaphysial surfaces. Towards the epiphysial side, we find the bone plate, a sort of rudimentary cortex, limiting the epi-physial cancellous bone immediately adjacent, to the 1st. row of cartilage cells. The bone plate present at the time of epiphysial closure, remains vesible until late in life and is known as the epiphysial scar.

The divisions of the plate, adopted will be described as:

1. The growth zone.
2. The zone of cartilage transformation.
3. The zone of ossification.



Photomicrogram of the lower femoral epiphysial growth plate of a normal white rabbit.
(Mallory's stain)