Methods of Prediction of Leg Length Discrepancy

Essay

Submitted for fulfillment of M.Sc. in Orthopaedic Surgery

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2010

Acknowledgement

First and foremost I thank Allah the most merciful, from the start to the end whose magnificent help was the main factor in completing this work.

I would like to express my deepest gratitude to **Prof. Dr. Hisham AbdelGhani,** associate professor of orthopedics, faculty of medicine, Cairo university, for his constant help, encouragement, meticulous constructive advice, keen supervision.

I wish to present plentiful thanks to **Prof. Dr. Mohamed Hegazy,** associate professor of orthopedics, faculty of medicine, Cairo university, for his continuous help and support.

Finally, I wish to acknowledge my **family**, for their great support not only in this work but in all my life. They gave me everything and took nothing.

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List of Abbreviations

AP	Anteroposterior
Avg	Average
CFD	Congenital Femoral Deficiency
cm	Centimeter
G	Amount of growth remaining.
G_ε	Amount of femoral or tibial growth remaining at age of epiphysiodesis
I	Amount of growth inhibition.
In	inch
L	Current length of long limb
L'	Length of long limb as measured on previous radiographs
LLD	Leg Length Discrepancy
L_m	Length of femur or tibia at skeletal maturity
L_ε	Desired length of bone to undergo epiphysiodesis at time of epiphysiodesis.
M	Multiplier
mm	millimeter
M_ε	Multiplier at age of epiphysiodesis
PFFD	Proximal Femoral Focal Deficiency
S	Current length of short limb
S'	Length of short limb as measured on previous radiographs
SD	Standard Deviation
S_m	Length of the short limb at skeletal maturity
yr	year

Δ	Current limb-length discrepancy
Δ_g	discrepancy in growth remaining
Δ_m	Limb length discrepancy at skeletal maturity
ε	Desired correction following epiphysiodesis

Abstract

Prediction of LLD at skeletal maturity is an important prerequisite for determining the necessary treatment to equalize leg length. In order to determine this, future growth potential is estimated. There are several methods to predict future growth as the arithmetic method, the growth remaining method, the straight line graph method and the multiplier method, they differ significantly in their convenience, complexity, and accuracy, but the analysis moves through the same stages.

Key words: growth, L.L.D. arithmetic, growth remaining, straight line, multiplier.

Introduction

Introduction

The influence of growth must always be considered when evaluating orthopedic problems in children and adolescents. This is where pediatric orthopedics differs substantially from adult orthopedics. [1]

The growth rate does not remain constant throughout physical development. While it largely follows a linear pattern during childhood, the growth rate increases markedly during two phases of life, namely during infancy and puberty. [2]

The numerous causes of limb length inequality can generally be divided into two broad categories:

Congenital causes due to limb hypoplasia syndromes, hemihypertrophy or skeletal dysplasias.

Acquired causes include anything that injures or slows the growth of the physis, such as a bony bar due to trauma or infection; shortening from a femoral fracture with comminution or overriding bone fragments; and any systemic condition that results in asymmetric innervation or vascularization. [3]

In planning the surgical control of unequal extremity lengths during the growing years, knowledge of the amount of growth which may occur in the long bones after various ages is fundamental. Such knowledge is necessary in all techniques of arrest. This information is also useful in assessing the progress of abnormalities of growth and in estimating the ultimate extent of shortening in children with asymmetrical growth of the lower extremities. [4]

Several methods for Prediction of expected leg length discrepancy at maturity where developed, Hatcher's growth increment curve was the initial approach for determining the best timing for epiphyseal arrest.

The arithmetic method provides a rough estimate of growth potential for children older than 10 years. This method assumes that the distal femoral physis grows 10 mm per year and the proximal tibial physis grows 6 mm per year. The method also assumes that boys reach maturity at chronologic age 16, and girls at age 14. [5]

The growth-remaining method may be used to estimate growth potential in the distal femoral and proximal tibial physes at various skeletal ages. There are separate charts for boys and for girls. This method has withstood the test of time, and is especially useful if a treatment decision needs to be made without the benefit of serial measurements. [6]

The straight-line graph method is a logarithmic representation which allows the growth of both lower limbs and the skeletal age to be plotted as straight lines and no calculations are necessary but becomes more accurate if one has the luxury of multiple measurements over many years.[7]

The multiplier method allows for a quick calculation of the predicted limb-length discrepancy at skeletal maturity, without the need to plot graphs, is the same for the prediction of femoral, tibial, and total-limb lengths, its values are also independent of generation, height, socioeconomic class, ethnicity, and race. [8]

These methods differ significantly in their convenience, complexity, and accuracy, but the analysis moves through the same stages in all four. *The first stage* is the analysis of past growth, including the determination

of the present discrepancy. *The second stage* involves the prediction of future growth, including the lengths of the legs and discrepancy at maturity. *The third stage* is the prediction of the effects of corrective surgery. [9]