Testing Skeletal Maturity with BonAge

Introduction
The Sunlight BonAge ultrasound-based skeletal maturity testing system is an accurate and easy-to-use tool for estimating skeletal maturity (sometimes known as bone age) at the wrist in children aged 5 to 18 years. It measures bone acoustic parameters at the wrist to provide an estimation of bone age that correlates with Greulich & Pyle (GP) readings.

Skeletal Maturity Testing
Skeletal maturity data provides information about the developmental status of a child in addition to that provided by height, weight, and age. For this reason, such testing is used to identify growth patterns and deficiencies for pediatric patients. At least 5% of children and adolescents are categorized as having short stature or growth abnormalities, and these children – and often others – are tested for bone age to track their growth development and spot any problems in growth. On the basis of these measurement results, together with other data, including blood tests and parental growth history, the physician can determine whether a child’s growth rate is normal, or if the child requires follow-up or treatment for growth abnormalities.

Using X-ray Measurement for Skeletal Age Assessment
Today, this relatively common procedure is carried out by X-ray measurement of the patient’s left hand and analysis of this X-ray. The X-ray is then compared, usually by radiologists or pediatric endocrinologists, to a set of X-ray plates of children’s hands at different ages in the widely used Greulich and Pyle Atlas\(^1\), to determine the patient’s skeletal age. This method of testing has several major drawbacks: its use of radiation, its basis on subjective visual comparisons of X-rays by physicians, which leads to differences in interpretation, and the length of the entire procedure for patients, with referral, testing in another facility, and at least one follow-up visit. In addition, the intra-physician precision of measurement based on analysis of X-rays is between .25 and .40 years, while inter-physician precision is approximately .50 years (when measured at a confidence level of one SD).\(^2\)

Using Ultrasound for Skeletal Age Testing
Sunlight’s new skeletal age product is based on radiation-free ultrasound measurement. The testing device is capable of measuring bone acoustic parameters at the wrist and providing an estimation of bone maturity that highly correlates with Greulich & Pyle (GP) readings.

The device is comprised of a main unit, which contains the user interface and algorithmic calculation software, and a measurement unit that includes an ultrasound probe. The measurement unit is composed of a base that supports an ultrasound probe with two ultrasound transducers located on two stands at the sides of the device.
There is an armrest between the transducers, designed to fixate and support the patient’s hand and wrist. During measurement, ultrasonic waves are passed through the patient’s measurement area on the left wrist via attached transducers. This measurement site, the same site used to formulate the X-ray plates in the Gruelich and Pyle Atlas, includes centers of ossification that change with growth. This site, seen in the diagram at right, is thus an excellent site in which to observe skeletal development.

Eleven cycles of measurement are performed to ensure high precision, and the entire measurement takes about five minutes. The device uses the Speed-of-Sound (SOS) produced, the distance between the transducers, and a proprietary gender- and ethnicity-based algorithm to provide a numeric bone age result (in years and months). Clinical studies on varied populations have shown that this measurement method has high precision (inter-operator precision=0.24), and have demonstrated that results are highly correlated to results produced by comparison of X-rays to the Gruelich and Pyle Atlas.

**A Complete Picture**

The BonAge measurement device provides a complete picture of the growth and development of the patient. Alongside the tracking of bone age results, the growth module of the device provides software for the tracking of other growth and development parameters according to ethnic-specific databases\(^3\)\(^4\) (including height, weight, BMI, and others) in order to provide a comprehensive picture of growth for the physician. In addition, the device provides height prediction (according to two accepted formulas\(^5\)\(^6\)) based on the bone age result and other parameters inputted by the physician.
References


5 Bayley, N., Pinneau, S.R., Tables for Predicting Adult Height from Skeletal Age: Revised for Use with the Greulich-Pyle Hand Standards, Journal of Pediatrics, 14, 423-441, 1952