

USEFULNESS OF BONE AGE IN PAEDIATRIC ENDOCRINOLOGY

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In most children growth, puberty and related endocrine changes follow a well orchestrated pattern but the pace of maturation varies widely so that these events should be related to physical maturity rather than chronological age. For this reason bone age, which by means of an evaluation of skeletal maturation reflects physical maturity and may be considered a sort of "biological age", is particularly useful in the clinical evaluation of children with growth and/or puberty disorders. Bone age assessment provides precious information, but if not properly used, can be misleading and it should always be considered ancillary to the clinical and auxological examination. Besides bone age assessment, the hand and wrist x-ray film may also provide a useful picture of bone shape.

The two most widely used systems are the Greulich-Pyle Atlas method (GP method) and the Tanner-Whitehouse 2 Individual Bones method (TW2 method). They are not always comparable and cannot be considered interchangeable. Therefore, in the follow-up of a patient or in comparing different groups of patients it is important to stick to the same method.

A. Bone age is necessary:

- for confirming the diagnosis of the normal variants of growth, such as familial short stature (FSS) and constitutional growth delay growth (CGD), the former associated with normal skeletal maturation and the latter with delayed bone age;

- for interpreting of hormone blood levels in children at the pubertal age: in particular, the results of laboratory investigations of pituitary-gonadal axis in delayed puberty should be evaluated according to bone age rather than chronological age (for example, we should not expect pubertal values of LH and FSH in a child with bone age less than 12 yrs);
- for diagnosing precocious puberty (differential diagnosis with premature telarche and premature pubarche) or conditions of hyperandrogenism such as congenital adrenal hyperplasia (CAH) characterized by advanced bone age;
- for deciding whether to treat or not children with the above mentioned conditions (precocious puberty and CAH), and in monitoring the response of skeletal maturation to the treatment with GnRH analogs and hydrocortisone respectively;
- for predicting adult height in normal children.

B. Bone age is useful:

- in evaluating any child with growth retardation and advanced or delayed puberty;
- in deciding the right time to start a child with hypogonadism on replacement treatment;
- in monitoring children in replacement therapy with growth hormone.

C. Bone age can be misleading:

- in evaluating children with disorders of bone mineralization, such as osteochondrodysplasias;
- in predicting adult height in children with precocious puberty or born small for gestational age: adult height prediction should actually be performed in normal children only;
- in conditions such as FSS and CGD, in which bone age is valuable for the diagnosis, if considered an absolute diagnostic marker;

- whatever the aim, if different readers, not accurately trained to follow the same procedure, are involved in bone age assessment.

Further information obtainable from an accurate assessment of left hand and wrist x-ray

In evaluating hand and wrist x-ray we should not miss the opportunity to look for bone shape abnormalities:

- accessory unusual secondary ossification centers may appear in otherwise unusual ends of a bone when growth is overstimulated in rapid catch-up growth (accessories after initiation of thyroid replacement therapy in a hypothyroid child);

- important changes in the rate of longitudinal bone growth are registered as growth arrest lines, also known as Harris growth lines, which appear as transverse lines of increased radiodensity confined to the metaphyses (previous severe chronic disease);

- several disorders of chondrogenesis and/or osteogenesis can result in typical images such as wider and stunted bones (hypochondroplasia), irregular metaphyses (Turner syndrome), shortness of 4th and fifth metacarpal (pseudohypoparathyroidism)

Bibliography

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FINAL TABLE

Bone age is necessary:

- in the diagnosis of FSS and CGD;
- for interpreting hormone levels in pubertal age;
- for diagnosis of precocious puberty or hyperandrogenism;
- for deciding whether to treat or not the above mentioned conditions;
- for predicting adult height in normal children.

Bone age is useful:

- in evaluating any child with growth and/or puberty disorders;
- in deciding the time to start replacement therapy in hypogonadism;
- in monitoring children on growth hormone therapy.

Bone age can be misleading:

- in evaluating children with disorders of bone mineralization;
- in predicting adult height in pathological conditions;
- if considered an absolute diagnostic marker;
- if, during the follow-up of a patient or in comparing groups of patients, different readers are involved or different methods are employed.

... and don't forget to look for bone shape abnormalities!

ACRONYM TABLE

GP: Greulich Pyle, TW2: Tanner Whitehouse 2, FSS: Familial Short Stature, CGD: Constitutional Growth Delay, CAH: Congenital Adrenal Hyperplasia