

Reference values of cortical thickness, bone width, and Bone Health Index in metacarpals of children from age 0 y, as determined with an extension of the fully automated BoneXpert bone age method

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Introduction

The BoneXpert method for automated bone age was introduced in 2009, covering the Greulich-Pyle bone age (BA GP) down to 2.5 years for boys and 2.0 years for girls.

The method was recently extended down to newborns.

BoneXpert also performs digital radiogrammetry of the cortical thickness (T), the bone width (W) and length (L) in metacarpals 2-4.

From these, the method derives the cortical area:

$$A = \pi \cdot W \cdot T (1 - T/W),$$

the metacarpal index

$$MCI = A / W^2,$$

and the Bone Health Index (BHI)

$$BHI = A / (W^{1.33} \cdot L^{0.33}).$$

The aim of this study is to report reference curves for bone measurements for children starting at BA GP 0.08 years.

Methods

410 healthy children born in Paris in 1955 were followed with hand X-rays at ages 1, 3, 6, 9, 12 and 18 months, and then annually until age 20 years. Reference curves were defined versus BA GP determined automatically with BoneXpert, averaging over radius, ulna and 19 short bones.

Results

For males, T drops from 0.74 mm at BA GP 0.08 y to a minimum of 0.58 mm at BA GP 1 y, a reduction of 22%.

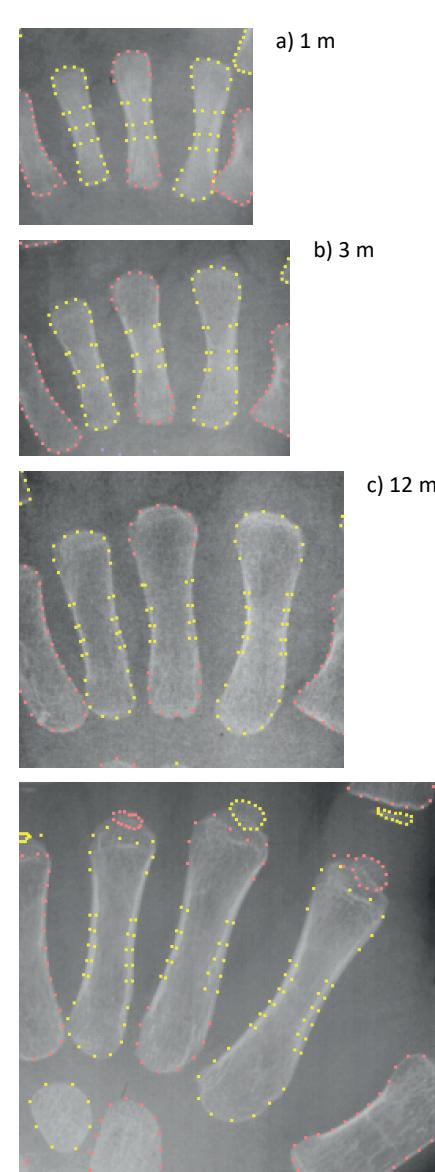


Figure 1: Example of metacarpal bones from a male individual at the age of 1 month, 3 months, 12 months, and 36 months.

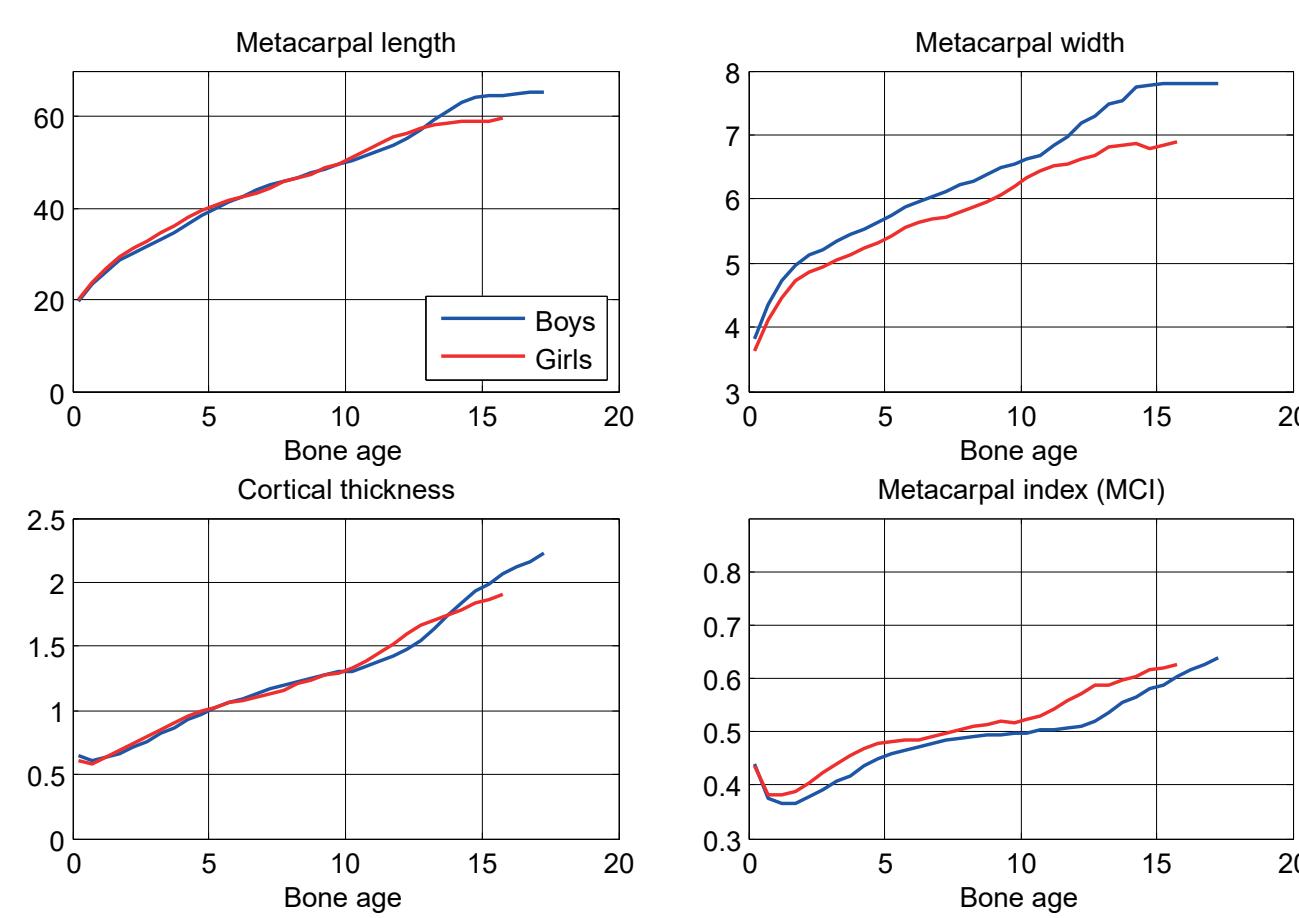


Figure 2: Graphs of metacarpal length, width, metacarpal cortical thickness, and metacarpal index versus bone age.

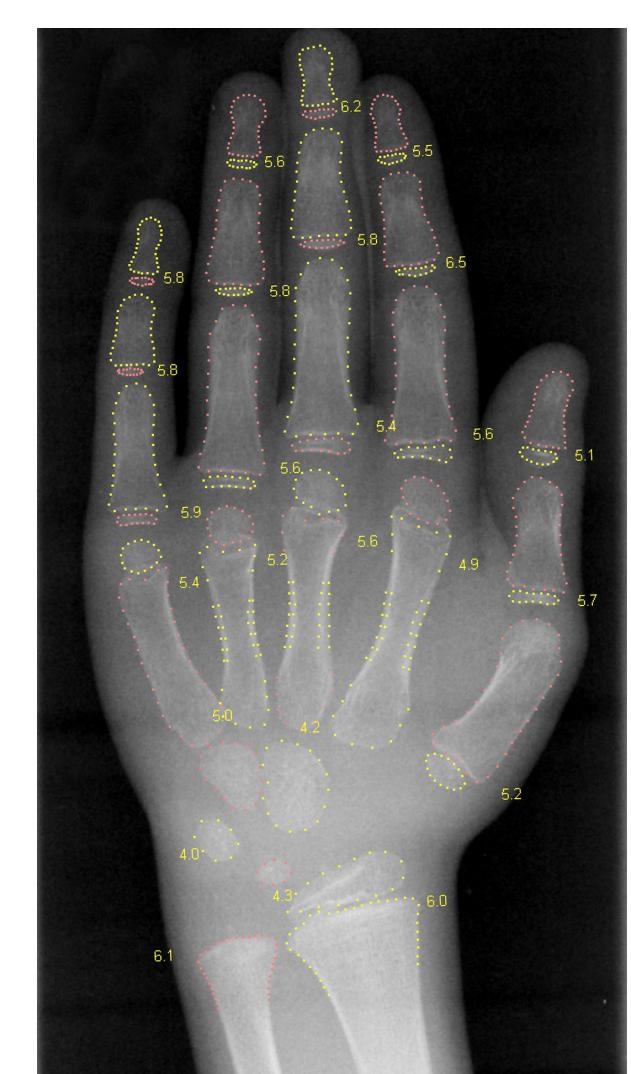


Figure 3: Example of a hand analyzed by BoneXpert version 3.0.