Open Access

SCHOLARENA

Journal of Pediatric Disorders and Neonatal Care

SHORT COMMUNICATION

Diagnosis of the Bone Age and Prediction of Adult Height by the Ebrí Methods (New Computer Programs): New Software, Bone Age Calculation

Ebrí Torné B* and Ebrí Verde I

Pediatric Service of the Miguel Servet University, Hospital of Zaragoza, Spain

***Corresponding author:** Ebrí Torné B, Pediatric Service of the Miguel Servet University, Hospital of Zaragoza, Paseo Isabel La Católica, 1-3, Zaragoza, Spain, 50009, Tel: 34976566695, Email: ebri@ebri.es

Citation: Ebrí Torné B, Ebrí Verde I (2018) Diagnosis of the Bone Age and Prediction of Adult Height by the Ebrí Methods (New Computer Programs): New Software, Bone Age Calculation. J Pediatr Dis Neonatal Care 1: 102

Article history: Received: 11 January 2018, **Accepted:** 05 March 2018, **Published:** 06 March 2018

Abstract

The authors offer the possibility of free download of three computer programs (Ebrí indexes) two new ones that are added to the existing one and that automatically give us the diagnoses of bone age and prediction of the adult height of children from 0.5 to 20 years, 0.5 to 4 years, by introducing measures of carpal and metacarpophalangeal bones with the digital mouse or a nonius on the physical radiograph, along with the size of the child and the parents. And the third program, introducing measures of bones of the tarsus for children from newly borns to four years. These programs can be downloaded free, from the website of the Illustrious College of Physicians of Zaragoza (Spain) www.comz.org. Once on the page, look for the banner: "Bone Maturation", and click on it.

Throughout the exposition of this article we recall the research of the authors, over more than forty years that has led to these programs. The pediatrician can also consult the guide that explains how to use these methods, handling the digital mouse, and how to perform the measurements on the digital radiographs stored on the Intranet Network of Insalud.

Keywords: New Software Ebrí; Bone Age Calculation 0.5 to 4 years; Carpal / Metacarpophalangeal Regions and Tarsus

Introduction

In this special article we briefly recall some concepts of the importance for the pediatrician of the study of bone maturation in children, and various contributions, publications, made in this regard by the authors to date. This possibility is informed in this article about the possibility of free download, on the website of the Zaragoza School of Medicine www.comz.org

Once on the page, click on the banner: "Maturation Bone". There, the new computer programs will be found, for the calculation of bone age, by the Ebrí methods, specifically for children from 0.5 years to 4 years in the carpal / metacarpophalangeal region and from birth to 4 years in the tarsal region. These programs are added to the existing one for children from 0.5 to 20 years, that the authors sent by email to the pediatricians who requested it after the publication by Annals of the method of calculation Ebrí, which also allowed the estimation of the size prediction of the child [1].

We carried out a brief analysis of the importance for the pediatrician of the calculation of the bone age, as well as the research of the authors in this field up to the creation of these computer programs that greatly facilitate this work.

Bone maturation for Martí Henneberg is the best general indicator of biological development available in the human species. Bone age expresses this process of maturation, requiring simple radiological studies to determine, with the left hand radiography in the opinion of most of the authors, the preferred anatomical region [2].

The evaluation of the individual's growth and the determination of the most intense periods that occur during maturation provide important clinical information for the interdisciplinary diagnosis, especially for the pediatric endocrinologist, to control the normal growth of the child. Of interest is the calculation of bone age not only for the pediatrician, but also for sports medicine in order to avoid the negative influences of excessive training on the growth and maturity of children and young people. It is also of interest in forensic medicine, when they analyze severely damaged human remains, presumably belonging to children or young people. All these considerations have been accredited by several authors, among them, Ebrí Torné, *et al.*, Eiben OG *et al.*, [3-6].

Bone age also provides a basis for predicting height and for following the child's development after treatment in that direction. It is also of interest to the parents themselves who want to know the future height of their children [7,8].

Morphological and numerical methods can be used to calculate bone age. Ebrí Torné B, for more than 40 years has investigated in different anatomical regions [9]. In a recent publication, he reviewed historically the main methods of calculating bone age and predicting adult height in the hand and tarsal regions, including his own studies [10].The methods proposed by Ebrí Torné B to study bone age in the carpus and tarsus were applied in a large cross-sectional study of 5,225 healthy children by the carpal IVO (bone valuation index) method and in 540 normal children and 96 fetuses, cross-sectional study, by the Tarsian IVO method. All these contributions were published for several years [11-17]. Recently, Ebrí Torné B and Ebrí Verde I, studied a longitudinal series of normal children to calculate the bone age and prediction of adult height, using three ossificative indexes: IC (carpal), IMF (metacarpophalangeal) and ICMF (Carpo-metacarpophalangeal). These indices are the result of the sum of the maximum diameters of the nuclei of each region studied, measured in mm [1,18,19]. The measurements can be made on the physical radiography with a nonius, as was done by the authors, or on digital radiography with the digital mouse (left hand Rx in dorsopalmar projection) downloaded from the Sanitary Intranet Network.

The longitudinal series studied came from the Aragonese Anthropometric General Survey "Andrea Prader Somatometric and Radiological", promoted by the Endocrinology Unit of the Miguel Servet University Hospital of Zaragoza [20].

The computer program based on these indexes and adapted to the Andrea Prader General Casuistry, from 0.5 to 20 years was sent to the pediatricians who requested it. As of 2015, this program could be downloaded directly from the website of the Illustrious College of Physicians of Zaragoza. This methodology can be applied by the pediatrician in your daily practice, being able to use it manually with a pocket calculator or through a software program. The program automatically gives us the diagnosis of bone age and size prediction, when it is entered in the computer column downloaded on the computer, the date of birth of the child, the measurements of each bone, its size and that of the parents, coincident in date with the Rx.

Although there is concordance of our indexes with the main methods of studying bone age: the methods of Greulich-Pyle (GP) and Tanner, our numerical method has an advantage over the morphological of Greulich, since it relativizes the asynchronies and the own subjectivity of the doctor when choosing the most similar Rx of the American Atlas with respect to that of the child under study [21]. And with respect to Tanner, it saves the sometimes difficult interpretations that occur in the last stages when giving the scores, among other points [22, 23].

In 2012, Ebrí Torné B and Ebrí Verde I, carried out a comparative study between the Ebrí bone ages and those obtained by GP and Tanner W2 (TW2), reaching the conclusion that in GP girls it overestimates up to six months with respect to the bony age Ebrí carpal (EOIC), five months with respect to bone age Metacarpophalangeal Ebrí (EOIMF) and six and a half months with respect to bone age Ebrí carpo metacarpofalángica (EOICMF) [24]. TW2 in girls, also overestimates up to four months with respect to EOIC, three months with respect to EOIMF and 4.7 months with respect to EOICMF. In men, GP overestimates up to 3.7 months with respect to EOIC, 3.3 months with respect to EOIMF and 2.7 months with respect to EOICMF. TW2, in males, also overestimates up to five months with respect to EOIC and EOIMF. Regarding EOICMF, it also overestimates up to 4 months.

However, when studying Hispanic children by our method, no adjustment is necessary, as if they were studied by the GP or TW2 methods. These foreign methods are based on their own casuistry: American and English, and these racial differences can explain these differences, independently of the own characteristics of each method.

Regarding possible differences between methods with respect to predictions of adult height, the authors have not observed them, adding in the multi-regression equations, the current size of the child and that of the parents to their own bone age.

When the diagnosis of bone age given by the program is interpreted, once the data already mentioned have been entered, it should be noted that this bone age (calculated through IVOS: IC, IMF, ICMF, IT) with respect to chronological age, it may be "normal, advanced or delayed". But if the delay or advance is not found in a significant way (as the program does, if it occurs) will not require further investigation of the cause, since they are within the normal distribution of the Gaussian curve. Consequently, there may be, for example, a delayed or advanced bone age compared to the chronological age, and be considered normal, however.

Why the presentation of this article? What is its originality?

Given that numerous pediatricians and radiologists from different geographical areas, especially in the Latin American area, who follow our methods, they ask us to have specific computer programs for ages where the diagnosis of bone age can be more difficult, due to the existence of asynchronies of the ossification nuclei, we proceed to present these programs that present a greater diagnostic precision

Consequently, the authors have proceeded by creating two computer programs (added to the existing one for children up to the age of twenty) adjusted for ages up to four years: One by which you can obtain bone age automatically through measurements made in the carpus and metacarpofalanges, through the IVOS (IC, IMF, ICMF), from 0.5 years. And another through measures taken in the tarsus, for children from birth. The tarsus, already showing at birth, bones such as the calcaneus, talus, and in many cases the cuboid, is more interesting at these ages than the hand itself, where the carpal bones may not appear until later.

These children come from the cross-sectional caseload of 540 children and 96 Spanish fetuses subject of the doctoral thesis of Ebrí Torné B (year 1977) [25].

Acting jointly in these two anatomical regions: hand and tarsus, we can improve the ossificative diagnosis that acting separately.

All these computer programs are already "posted" on the aforementioned website of the Zaragoza Medical Association, available to pediatricians, radiologists .The authors consider their dissemination of great interest, and hence the reason for this special article.

The authors consider that regardless of the use of the current computer programs that we present for Spanish children and also used in the Latin American area, other programs could also be created for new geographical areas, from the creation of new cases, applying the method "aseptic" Ebri of measurement of the maximum nuclear distances, whose addends constitute the various indices that we have created for Spanish children, applied in the computer programs that we present.

Acknowledgement

To the Medical Staff of the Andrea Prader Center in Zaragoza, especially to its director: Dr. Ángel Ferrández Longás, for his invaluable collaboration in providing the radiographic material and sizes, of the children studied by our methods of calculating bone age, children currently already adults who were part of the Study Longitudinal Aragonese child.

To Professor Altarriba Farrán, Professor of Veterinary Genetics and Improvement of Zaragoza, for his computer help.

To all the Medical Staff of the Pediatric Service of the Miguel Servet University Hospital of Zaragoza.

References

1. Ebrí Torné B, Ebrí Verde I (2012) Metacarpophalangeal and carpal numeric indices to calculate bone age and predict adult size. An Pediatr (Barc) 76: 199-213.

2. Martí Henneberg C, Roy MP, Passe NP (1975) The analysis of skeletal maturation in man (El análisis de la maduración esquelética en el hombre). Metodología, Med Clin 2: 49.

3. Ebrí Torne B (1988) Maturation on Tarsus and carpal bone (Clinical-radiological study Child) Editorial Heraldo de Aragón. Zaragoza.

4. Bernardo E, Inmaculada E (2015) Bone Maturation in Spanish Child by Locals and Foreing Methods of Assessment of Bone Age and Prediction of Adult Size [Maduración Ósea en el niño español por diferentes métodos propios y foráneos de Valoración de la Edad Ósea y de Predicción de Talla adulta] INO Editorial. Zaragoza, Spain Z-384.

5. Peña E, Cardenas E, JL del Olmo (1982) Bone growth and maturation athletes tweens and teens. Galvan and Ramos R (Eds). Antro is Biol. II Colloquium Antro. Physical J. Comas, México City: Antro Inv Inst 453-66.

6. Eiben OG, Panto E, Cyenis G, Frohlich J (1986) Physique of young female gymnasts. Anthrop Kazl 30: 209-20.

7. Ferrández Longás A (1975) The bone maturation as a fundamental element forecast human development. Clinical Medicine 64: 97-100.

8. Sobradillo B (1979) Prediction of adult height monograph on nutrition, growth and development. Research Institute Growth and Development. Faustino Orbegozo Foundation. Bilbao 55-63.

9. Ebrí Torné B, Ebrí Verde I (2015) Studies in Spanish Children to calculate Bone Age and Predict Adult Height: Forty Years of Own Investigation. Pediat Therapeut 5: 227.

10. Ebrí Torné B, Ebrí Verde I (2016) Bone Maturation and Height Prediction: Historical Review of The Calculation Methods. JIRMERPS 10: 24-33.

11. Ebrí Torne B (1979) Presentation of a new biometric method (IVO) for the assessment of bone age in children. Klink Medizinische 214: 50-6.

12. Ebrí Torné B (1990) Biometric method adaptation al Basic. Acta Paediatr Scand 79: 1242-3.

13. Ebrí Torné B (1993) Biometric method for the ossification evaluation of children since birth up to the ages of two and four, applied to the Tarsus. Acta Paediatr Scand 82: 872.

14. Ebrí Torne B (1988) Study Spanish population of 5225 and 540 children of both sexes by the set method of Carpo (IVOC) and Tarsus (IVOT). Basic program. Adaptation bone age bone age Ebrí to Greulich-Pyle and Tanner Whitehouse for height prediction. Speech at the Royal Academy of Medicine of Zaragoza. Vol communications conference and the Royal Academy of Medicine of Zaragoza. Course 89: 9-31.

15. Ebrí Torné B (1993) New index valuation the ossification of Carpe (IVOC) 5225 Study on Children Spanish. Pediatrics 48: 813-7.

16. Ebrí Torné B (1994) New equations to calculate bone age Carpal in the carpal Ebrí method in children from birth to two and four years. Act Pediatr Esp 52: 79-82.

17. Ebrí Torne B (1994) Statistical and descriptive study in Swiss child in the carpal bone age by Tanner and methods Ebrí. Spanish J Hand Surg 21: 67-75.

18. Ebrí Torné B, Ebrí Verde I (2012) New Ebrí-Carpo-Metacarpophalangeal Bone Rating Index and Adult Size Prediction [Nuevo Índice de Valoración Ósea Ebrí-Carpo-Metacarpofalángico y de Predicción de Talla Adulta] Pediatr Integral XVI: 822.e1-e9.

19. Ebrí Torné B, Ebrí Verde I (2013) Biometric Method for the Ossification Evaluation of Children from Birth Up to the ages of Two and Four-Applied to the Metacarpal and Phalanxes in Spanish Longitudinal Series. Cureus 5: e151.

20. Ferrández Longás A, Baguer L (2005) Longitudinal study of normal Spanish children from birth to adulthood: anthropometric, puberal, radiological and intellectual data [Estudio Longitudinal de niños españoles normales desde el nacimiento hasta la edad adulta. Datos antropométricos, puberales, radiológicos e intelectuales]. Zaragoza Fundación Andrea Prader.

21. Greulich W, Walter W, Pyle SI (1959) Radiographic Atlas of Skeletal Development of the Hand and Wrist (2nd Edn) Stanford University Press, USA.

22. Ebrí Torné B (1996) Metacarpophalangeal bone titration index. Longitudinal study of a Swiss child. Study compared with Tanner II Rus [Indice de valoración Ósea Metacarpofalángico. Estudio Longitudinal de niño Suizo. Estudio comparado con Tanner II Rus]. Act Pediatr Esp 54: 94-102.

23. Ebrí Torné B (1997) Comparative study of bone ages Tanner-Rus, Tanner Carpal- Ebrí Carpal, Ebrí Metacarpofalángica, and Greulich and Pyle [Estudio comparativo de las edades óseas Tanner-Rus, Tanner Carpal- Ebrí Carpal, Ebrí Metacarpofalángica, y Greulich y Pyle]. Act Pediatr Esp 55: 369-74.

24. Ebrí Torné B, Ebrí Verde I (2012) Comparative study between the bone ages Greulich Pyle, Tanner-W2 and Ebrí, and between predictions of adult height [Estudio comparativo entre las edades óseas Greulich Pyle, Tanner-W2 y Ebrí, y entre predicciones de talla adulta] Pediatr Integral XVI: 741.e1-e7.

25. Ebrí Torné B (1977) Contribution to the study of ossification of Tarsus. Study of bone age from birth to 16 years, following numerical methodology, based on an index obtained in Tarsus, called Tarsian Index [Contribución al estudio de la osificación del Tarso. Estudio de la edad ósea desde el nacimiento hasta los 16 años, siguiendo metodología numérica, basada en un índice obtenido en el Tarso, denominado Indice Tarsiano]. Revista del Seminario de la Cátedra de Patología Médica A, de Barcelona. Arch Esp Med Inter 10: 721-34.