Comparative study between Greulich-Pyle bone age Tanner-W2 and Ebrí

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Abstract

We have carried out a review study in order to remind the pediatrician of the differences in bone age (EO) existing between the existing Greulich-Pyle (GP) or Tanner-Whitehouse 2 (TW2) methods with respect to Ebrí ages: EO Ebrí-carpal (EOIC) metacarpal (EOIMF) and Carpometacarpophalangeal (EOICMF). The study was carried out in Spanish longitudinal casuistry "Andrea Prader". It comprises 160 healthy children: 73 males and 87 females, distributed by sex and age from 0.5 to 20 years. By obtaining the EO for each method, a compassionate study can be carried out between them, and thus, observing if there are differences, being able to offer the pediatrician quantification, in order to take them into account. In previous studies, the equations for obtaining the EO were exposed by the Ebrí methods. These quantifications are presented throughout this review.

In this way, the clinician will be able to know the equivalences to EO Ebrí, when he only has the EO of a child by the GP or TW2 methods. However, when the pediatrician obtains the EO obtained by our method, no correction is necessary for a Spanish child since it has been obtained directly, and not through the filter of the two English and American methods. When the Ebrí method is applied to non-Spanish children, it is also convenient to assess these differences.

We observe how in women, GP has a tendency to overestimate, while Tanner and our methods to underestimate. In men, not only GP has a tendency to overestimate but also TW2 with respect to our methods.

Quantifying these differences translated into months, it is observed how in TW2 women, even underestimating a month and a half with respect to GP, presents an overestimation of 3 months with respect to EOIMF, 4 months with respect to EOIC and 4.7 months with respect to EOICMF. GP presents differences of up to 6 months with respect to EOIC, 6.5 months with respect to EOICMF, and 5 months with respect to EOIMF.

In males, TW2 presents overestimations of EO of up to 4 months different from EOICMF, 5 months from EOIMF and EOIC, and about a month and a half from GP. Greulich and Pyle show minor overestimations, up to 3.3 months with respect to EOIMF, 3.7 months with respect to EOIC, and 2.7 months with respect to EOICMF.

Introduction

We have carried out a review study in order to remind the pediatrician of the differences in bone age (EO) existing between the existing methods of Greulich-Pyle (GP) (1) or Tanner-Whitehouse 2 (TW2) (2) with respect to Ebrí ages. : EO Ebrí-carpal (EOIC) metacarpal (EOIMF) and Carpometacarpophalangic (EOICMF). The study was carried out in Spanish longitudinal casuistry "Andrea Prader" It comprises 160 healthy children: 73 men and 87 women, distributed by sex and years from 0.5 up to 20 years. Thus obtaining the EO for each method, a compassionate study between them can be carried out and thus observing if there are differences, being able to offer the pediatrician quantification, in order to take them into account. In previous studies, the equations for obtaining the EO were exposed by the methods: EOIC and EOIMF (3). These quantifications are presented throughout this review.

In this way, the clinician will be able to know the equivalences to EO Ebrí, when he only has the EO of a child by the GP or TW2 methods. However, when the pediatrician obtains the EO obtained by our method, no correction is necessary for a Spanish child since it has been obtained directly, and not through the filter of the two English and American methods. When the Ebrí method is applied to non-Spanish children, it is also convenient to assess these differences.

Material and methods

The casuistry object of study includes 160 healthy children: 73 men and 87 women, distributed by sex and years from 0.5 to 20 years. The left hand radiographs were provided, for their evaluation with our methods, by the Andrea Prader Center. Endorsed

and supported by the Government of Aragon (Spain) (4). It was also promoted by the Endocrinology Unit of the Miguel Servet Hospital in Zaragoza and authorized by the Research Committee, as well as the consent signed by the parents of children.

The children were carved and x-rayed in their left hand on each date of their birthday, being distributed by study groups. The table of the casuistry, the figures of the radiographs from which the measurements have been obtained to obtain the Ebrí ossificative indices and from them make the EO, as well as the equations to obtain the prediction of adult height (PTA) were offered in publication previous (3). For the current statistical work, the statistical package "Statistix" has been used, as well as the Excel program.

Results

In the attached table I, the lags between the various methods analyzed are shown in both sexes and by age groups from 0.5 to 20 years, of the differences between the chronological age (CA) of the child and his EO. These differences can be positive (they overestimate) or negative (they underestimate). An average of these differences has been made in all the analyzed methods, studying all the age intervals, in such a way that the mean obtained from these differences is the one that serves as a model to quantify these lags, once they are added or subtracted, when relating a foreign method with respect to ours. These differences are offered in fractions of years, however they can be translated into months. Thus, for example 0.25 years is equivalent to 3 months of lag.

We observe how in women, GP has a tendency to overestimate, while Tanner and our methods to underestimate. In men, not only GP has a tendency to overestimate but also TW2 with respect to our methods.

Quantifying these differences translated into months, it is observed how in TW2 women, even underestimating a month and a half with respect to GP, presents an overestimation of 3 months with respect to EOIMF, 4 months with respect to EOIC and 4.7 months with respect to EOICMF. GP presents differences of up to 6 months with respect to EOIC, 6.5 months with respect to EOICMF, and 5 months with respect to EOIMF.

In males, TW2 presents overestimations of EO of up to 4 months of difference from EOICMF, 5 months from EOIMF and EOIC, and about a month and a half from GP. Greulich and Pyle present minor overestimations, up to 3.3 months with respect to EOIMF, 3.7 months with respect to EOIC, and 2.7 months with respect to EOICMF

Discussion

It is known that there are genetic racial and exogenous environmental differences between population groups with respect to EO, in such a way that each racial group has its own bone age (5) regardless of the differences in the technique itself due to the limitations of each method. In this regard, there have been authors who have tried to adapt these foreign methods to a Spanish child, such as Hernández, when in 1991 he published a TW2 atlas adapted to the Spanish population (6) or Tanner himself when in 2001 he standardized the Rus and Carpal system for a North American child, naming it TW3 (7,8). For this reason, and given that there are these racial and technical differences, we have considered it convenient to estimate the EO lags when these

foreign methods are used with respect to ours in Spanish children, also given that in many studies carried out only these foreign EO are available. Let us also remember the recommendations of different authors such as García Almansa, Palacios, Ferrández Longás, Hernández, Sarría and Ebrí Torné (9, 10), each country should have its own anthropometric and bone age standards.

Let us remember here that the ideal would be to use an aseptic method for obtaining bone age for each country, generated according to the racial, genetic-environmental characteristics of their own children.

Our general method for obtaining bone age (EO) (3) offers this possibility of creating standards specific to each country or racial group without the limitations of indirectly assessing the EO of one population with the standards of another, as occurs with the aforementioned methods, despite to correction attempts by the authors reviewed. In this way, the standards created in future prospective studies would only translate these racial-environmental differences, but not the purely technical ones due to the limitations of these methods developed in foreign children and then "transplanted", applied to the study of other children, no longer having a need for correction, applying these differences outlined.

In Table II, we recall the general differential characteristics between the Ebrí method and the GP and TW2 methods (11)

Conclusions

Knowing the pediatrician these differences in EO between methods, when he only has the EO of a child by the GP or TW2 methods, he can apply these to the EO Ebrí. However, when the pediatrician obtains the EO obtained by our method, no it will be necessary for a Spanish child no correction, since the EO has been obtained directly,

and not through the filter of the two English and American methods. When the Ebrí method is applied to non-Spanish children, it is also convenient to assess these differences

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Table I. COMPATIVE TABLE OF BONE AGE DIFFERENCES BETWEEN METHODS

	WOMEN					MEN				
AGE	***EOGP***	***EOTW2***	***EOIC***	***EOIMF***	***EOICMF***	***EOGP***	***EOTW2***	***EOIC***	***EOIMF***	***EOICMF***
0,5	0,07	0	-0,34	-2,3	-1,36	0,16	0	0,79	-0,04	-0,1
1	0,17	0	-0,33	-0,16	-0,87	0,1	0	0,63	-0,74	-0,33
2	0,07	0	-0,3	0,39	-0,06	-0,12	0	0,35	-0,54	-0,15
3	-0,02	0	-0,29	1,14	0,29	-0,08	0	0,06	0,39	0,14
4	0,01	0,24	-0,23	1,29	0,43	-0,04	0	-0,25	0,82	0,18
5	0,16	-0,42	0,16	1,24	0,68	0	-0,59	-0,38	1,07	0,24
6	0,03	-0,08	0,48	1,25	0,85	-0,07	-0,52	-0,39	0,99	0,22
7	0,18	0,32	0,95	1,44	1,18	-0,05	-0,51	-0,19	0,91	0,32
8	0,16	0,18	1,14	1,37	1,23	0	-0,22	0,07	0,82	0,42
9	0,23	0,62	1,28	1,23	1,28	-0,02	0,07	0,25	0,73	0,48
10	0,35	0,95	1,57	1,23	1,43	0,43	0,51	0,35	0,57	0,45
11	-0,25	1,22	1,55	1,13	1,39	0,39	0,48	0,45	0,44	0,46
12	0,48	1,34	1,37	0,92	1,19	0,51	1,04	0,7	0,47	0,63
13	-0,57	1,3	0,89	0,49	0,73	0,17	0,92	0,67	0,22	0,51
14	0,86	1,63	0,38	0,04	0,26	0,13	1,04	0,61	0,14	0,44
15	0,71	0,95	-0,61	-0,89	-0,7	0,18	1,28	0,3	-0,08	0,17
16	0,49	0,01	-1,53	-1,77	-1,59	0,34	1,45	-0,23	-0,62	-0,34
17	0,16	-0,98	-2,42	-2,63	-2,47	0,45	0,6	-1,04	-1,44	-1,15
18	-0,33	-1,98	-3,46	-3,6	-3,46	0,13	0,05	-1,91	-2,27	-2,01
19	-1,21	-3,03	-4,69	-4,87	-4,74	-0,44	-0,84	-2,62	-2,92	-2,71
20	-2,04	-4,04	-6,12	-6,18	-6,14	-1,28	-1,95	-3,88	-4,14	-3,97
MEDIA	**0,01**	**-0,15**	**-0,5**	**-0,43**	**-0,55**	**0,05**	**0,18**	**-0,27**	**-0,25**	**-0,18**

Age: years; EOGP: Greulich-Pyle Bone Age; EOTW2: Tanner Bone Age; EOIC: Carpal Bone Age; EOIMF: Metacarpophalangeal Bone Age; EOICMF: Carpometacarpophalangeal Bone Age; mean: average of the differences (in years) of all age groups and all bone ages analyzed. The differences can be positive or negative.

Table II. Comparison of Greulich-Pyle, Tanner Whitehouse and Ebrí bone age calculation methods.
Differences between them

A-Greulich and Pyle:

1- Morphological, qualitative, and approximate method for bone age calculation.
2- We cannot discard the subject approach of the explorer in regards to an accurate diagnosis. In order to minimize this problem, the serial observations of a single patient have to be done by the same observer.
3- Frequent asynchronies in early ages, which hinder an accurate diagnosis of the bone age.
4- Created for American child, with early maturation. As a result, it can yield gaps of false advancement of bone age in Latin child.
5- It uses chronological age as the measurement unit, but not all children are equal.
6- Greulich & Pyle atlas only offers the average value, but not the normal margin expressed in percentages or standard deviations, within which a radiography cannot be considered as pathological.

B-Tanner-Whitehouse:

1- British numerical method, created for Anglosaxon child.
2- Technically difficult. It requires the observer a great experience.
3- It assigns values to the ossifying bones in the late stages of the carpal with a doubtful interpretation, due to large punctuation breaks by overlapping cores and to a non-strict universality of some of the index described, implying differences of up to two years (Andersen 1971).
4- Gaps for Latin child, generally providing false advancements of the bone age.

C-Ebrí:

1- Numerical method. Applicable to any child, especially Latin American child.
2- For these children it does not require to correct gaps in bone age in regards to the two methods.
3- Relativizes the appearance of asynchronies, as it provides an average value of all the bones and its maximum lengths.
4- Software method that enables a direct and fast calculation of the bone age and adult height
5. You can download the software program for free at: **www.comz.org/maduracion-osea**

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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