Original Article

Reliability of Greulich-Pyle Method in Comparing the Skeletal Age in Pukhtoons of District Peshawar

Age Estimation of Pakhtoons by Greulich-Pyle Method

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ABSTRACT

Objective: To compare the skeletal age in both genders in Pukhtoon population aged 11-16 years.
Study design: Cross sectional/ non- interventional study.
Place and Duration of Study: The study was conducted at Khyber Teaching Hospital and Forensic Department of Khyber Medical College. The duration of study was from December 2016 to May 2017.
Materials and Methods: The study sample comprised of 600 healthy subjects in the age group of 11-16 years. Dates of birth of subjects were confirmed from their birth certificates and the chronological age was calculated properly. Hand-wrist radiographs were taken and bone age determined by Greulich-Pyle method.
Results: A total of 600 subjects (male to female ratio 45.5:55.5) were evaluated for skeletal age by using Greulich-Pyle method of age determination. Chronological age was compared with skeletal age using the student "t" test in the study population comprising both genders. It was observed that females attained skeletal maturity earlier than the males.
Conclusion: It was concluded that Pukhtoon children were more advanced in bone maturation than the Europeans. Furthermore, the females show earlier bone maturation than their male counterparts.This radiographic bone assessment can be correlated to assess the age in many medical and medicolegal cases.
Key Words: Greulich-Pyle, Skeletal age, chronological age.

Citation of articles: Ambreen S, Khattak MS, Shah Z, Aamir S, Rehman Z. Reliability of Greulich-Pyle Method in Comparing the Skeletal Age in Pukhtoons of District Peshawar. Med Forum 2017;28(11):74-76.

INTRODUCTION

Age estimation is required in medicolegal cases and to treat many conditions related to endocrinology and paediatric dentistry [1]. Regarding certain paediatric orthopedic interventions like limb discrepancies and scoliosis,doctors have to check proper bone age. Similarly periodic bone assessment is required to treat certain hormone related diseases[2,3,4]. Osteogenesis is a complex process. Microscopic examination shows two types of bone development. The embryological bone development is known as primary or woven bone having less inorganic constituents as compared to its organic constituents. The adult form is known as secondary or lamellar bone which is more mature and organized form[5]. This pattern persists throughout the life of an individual[6].

Regarding ossification of limbbones, the ossification centersappear approximatelyat 8th week of intrauterine life.

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Received: July 03, 2017; Accepted: September 19, 2017

Primary ossification centers appear in almost all the bones at the time of birth while the secondary ossification centers develop after birth[7].

Long bones increase in length at the epiphyseal-diaphysial junction. Growth plates (epiphysealcartilage plates) are responsible for the lengthening of bones. Bones start ossifying at the end of embryonic period therefore the pregnant females are advised to take supplements containing calcium and phosphorus in order to keep their teeth and bones healthy. Children with vitamin D deficiency can manifest Rickets. Vitamin D is essential for absorption of calcium by the intestine. Calcium deficiency thus leads to disturbed ossification resulting in shortened and deformed bones[8].

Development of fetal bones is a fully programmed process being controlled by set of certain proteins. Important among them are bone morphogenic proteins (BMP5 and BMP7), growth and differentiation factor (Gdf5) and member of tumor growth factor (TGf-B)[9].Abnormalities in bone development like failure of phalanges to develop may occur due to excessive apoptosis in the absence of protein Gdf 5[10].

During skeletal development there is marked sexual dimorphism. In postnatal period, girls have advancement in skeletal maturation than boys though they have less bone mineral density. This pattern of sexual dimorphism is increased at puberty due to differential hormone secretion. Decreased bone mineral density has been observed in neonates born as a preterm

labor[11]. Neonatal bones are of critical importance because of their impact on bone development during childhood and in adult age. It has been observed that neonates born with higher birth weight acquire greater bone mineral density[12].

Skeletal framework of newly born babies closely resembles an adult but it is having 206 bones in comparison with adults whose skeleton is made up of 300 bones[13].

Radiological assessment of bones have been in practice in forensic science since 1896 for human age estimation[14].Radiographs of the specific parts of skeleton are used to assess the skeletal maturity[15].It is best done with hand-wrist radiography which is the easiest and most convenient method[16]. It is also helpful in evaluating the skeletal growth velocity, timing of pubertal growth and the proportion of the remaining growth of the bone. A significant difference has been observed in bone age of different population due to different ethnicity, socio-economic backgrounds, race and nutritional habits[17,18].

MATERIALS AND METHODS

The study comprised of 600 healthy subjects belonging to pukhtoon families in Forensic Department of Khyber Medical College (KMC) and Khyber Teaching Hospital (KTH).

The study sample was in the age group of 11-16 years and the subjects were grouped into 6 different sub Groups.

Hand-wrist radiographs were taken and gender based differences observed. Chronological age was determined from the date of birth of the subject.Bone age calculated by utilizing Greulich Pyle atlas and both genders were compared in relation to their chronological age.

RESULTS

A total number of 600 children were assessed for the skeletal age. Out of 600 children 333 were females and 267 were males. The chronological age was compared with the skeletal age in the age group of 11-16 years. Student "t" test was applied and the acquired data was analyzed. In the age group of 11 years, the mean chronological age determined was 11.35+_0.17 for males and 11.31+-0.13 for females. Meanwhile the skeletal age came out to be 12.14+_0.25 years for males and 12.27+_0.13 years for females. The difference between chronological age skeletal age was significant for males (p<_ 0.05) and females (p<_0.05) (Table 1). Same significance was observed in the subsequent age groups given in the tables below.

Table No.1: Comparison of Skeletal age with Chronological age in the age group of 11 Years.

Sex	Mean		"t" Value	Inference
	Chronological Age	Skeletal Age		
Male	11.35 ± 0.17	12.14 ± 0.25	1.99	Significant
Female	11.31 ± 0.13	12.27 ± 0.13	1.98	Significant
Combined	11.33 ± 0.15	12.20 ± 0.19	1.99	Significant

Confidence level of 95 % is statistically significant.

Table No.2: Comparison of Skeletal age with Chronological age in the age group of 13 years

Sex	Mean		"t" Value	Inference
	Chronological Age	Skeletal Age		
Male	13.29 ± 0.17	14.11 ± 0.12	1.99	Significant
Female	13.29 ± 0.15	14.27 ± 0.20	1.98	Significant
Combined	13.29 ± 0.16	14.19 ± 0.16	1.99	Significant

Confidence level of 95 % is statistically significant

Table No.3: Comparison of Skeletal age with Chronological age in the age group of 15 years.

Sex	Mean		"t" Value	Inference
	Chronological Age	Skeletal Age		
Male	15.24 ± 0.13	16.24 ± 0.10	1.99	Significant
Female	15.25 ± 0.12	16.27 ± 0.12	1.98	Significant
Combined	15.24 ± 0.12	16.25 ± 0.11	1.98	Significant

Confidence level of 95 % is statistically significant

Table No.4: Comparison of Mean Chronological age with Mean Skeletal Age.

Gender	Number	Mean Chronological Age	Mean Skeletal Age
Male	267	13.77 ± 0.15	14.64 ± 0.16
Female	333	13.79 ± 0.14	14.77 ± 0.16

DISCUSSION

As a matter of fact the somatic development is closely related to the chronological age. So if accurate age data is not available then somatic maturity indicators like the appearance of secondary sexual character, height and skeletal age can be used to assess the age[19].

The present study was conducted to assess the skeletal age by using Greulich_Pyle atlas of hand and wrist. Comparison between chronological and skeletal age was done. Moreover, gender based differences in age observed. It was noted that mean age difference between the chronological age and skeletal age come

out to be 0.87 years for males and 0.98 years for females.

This observation matches with the study done in Larkana, Pakistan by Rikashore where same increasing pattern of skeletal development was achieved in females as compared to their male counterpart[20]. In a series of studies done on white and Black races it was noticed that the blacks are ahead of the Greulich-Pyle standards[21]. Similarly the present study does not match accurately with the Greulich-Pyle digit atlas standards which is based on data derived from the study done on the children residing in Ohio,USA.

CONCLUSION

Skeletal development is more advanced in females as compared to the males as assessed by Greulich-Pyle method of bone age determination in Pukhtoons of Khyber Pukhtoonkhwa. There is marked sexual dimorphism seen in different races, therefore, it is suggested to check the applicability of Greulich-Pyle method by using a much larger sample and new standard curves should be generated specifically for each region of the country.

Author's Contribution:

Concept & Design of Study:	Sadaf Ambreen
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Conflict of Interest: The study has no conflict of interest to declare by any author.

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