HAND WRIST MATURITY ASSESSMENT IN FORENSIC ODONTOLOGY: A RETROSPECTIVE STUDY

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ABSTRACT:

Objective: To understand the correlation between skeletal maturity assessments through hand wrist radiographs and chronological age and to check whether this correlation is reliable and could be used in forensic odontology

Materials and methods: Radiographs of 67 patients,35 boys and 32 girls who underwent orthodontic and orthopedic treatment appeared in the Department of Pedodontics were selected for the study. Inclusion criteria were healthy children between the ages 8-16years who required skeletal maturity assessment

Results: Correlation between SMI stages and chronological age in males and females were assessed using ANOVA test (Fishers 'F'test).It showed that for males F = 24.418 and p= 0.000 and for females F= 19.185 and p=0.000.This indicates that the co-relation is very highly significant in both the sexes

Conclusions: Skeletal maturity indicators are a reliable tool in forensic odontology
The chronological age could be predicted reliably assessing the skeletal maturity index
The skeletal maturity is achieved faster in females compared to males

Keywords: Skeletal age, chronological age, SMI

INTRODUCTION:

Skeletal maturity assessment in dentistry is required to find out its relation with peak height velocity. This is required to find out the accelerated growth phase in males and females. In many malocclusion cases it is required to know this phase since the timing is critical in doing growth modification treatment. [1-6] Different areas of body are used for this purpose namely, hand wrist, cervical vertebrae, frontal sinus, antigonial notch , mid palatal suture etc The most reliable and widely used method is hand wrist radiograph. Among hand wrist radiograph itself various researchers' have advocated different methods like Greuliche and pyle method[7], Bjork,Grave and brown method[8], Fishmans method[9,10],Hagg and Taranger methos[11,12]etc.The most widely accepted method is Fishman's skeletal maturity indicators.(SMI) [9,10] A correlation can be assessed between skeletal maturity assessed by this method and chronological age so that it can be also used for identification of person as in case of forensic science and forensic odontology.

MATERIALS AND METHODS:

Radiographs of 67 patients,35 boys and 32 girls who underwent orthodontic and orthopedic treatment appeared in the Department of Pedodontics were selected for the study. Inclusion criteria were healthy children between the ages 8-16years who required skeletal maturity assessment. Patients with

systemic diseases ,those who were under medication etc were excluded from the study. A written informed consent was taken from the parents.

Fishmans skeletal maturity indicators (SMI)[9,10] was taken as the criteria for assessing hand wrist (table 1). The skeletal maturity assessment include 11 SMI in 6 anatomical sites(figure 1-4) located in thumb,third finger,fifth finger,and radius.The sequence of ossification stages include,the epiphyseal widening,the ossification of abductor sessamoid of the thumb,capping of epiphysis over diaphyses and fusion of epiphysis and diaphysis.

RESULTS:

Table 2 gives age wise distribution of SMI stages in males and table 3 in females. Table 4 shows correlation between SMI stages and chronological age in males and females. Statistical analysis using ANOVA test (Fishers 'F'test) showed that for males F = 24.418 and p= 0.000 and for females F= 19.185 and p=0.000.This indicates that the co-relation is very highly significant in both the sexes.

DISCUSSION:

Skeletal age assessment has great significance in forensic odontology. Chronological age may not be reliable in assessing the treatment timing. A correlation between chronological age and skeletal age helps the clinician while planning treatment. Another added advantage is we can predict the chronological age of the child from skeletal maturity. This finds its application in forensic odontology. There could be racial and ethnic variation in this regard. Hence this study was undertaken at Mangalore,Karnataka to have a record of co-relation between skeletal age and chronological age.

The application of this method finds its application while identification in age in asylum and refugee seekers,human trafficking,criminals child sexual abuse and pornography etc.[13]In these cases the accused individual might mimic the chronological age to get the benefit of being 'minor'.The forensic odontologyst can compare the skeletal maturity of the person with his recorded age.

Among the different skeletal maturity indicators, skeletal maturity indicators proposed by Fishman [9,10] is found to be very reliable. A hand wrist observation scheme was used to identify the exact stage of skeletal maturity.

In this study,among females it was found that ,the 11 SMI stages correlated with ages 9.50 to 14 years compared to 10.29 to 16 in males. This indicates that there is an early maturation in females compared to males and some increment of growth may present even at 16 years in males. We can safely identify the SMI with corresponding chronological age with this method. The corresponding age-SMI chart could be prepared in different geographical area.

A larger sample size may be needed to arrive at a final conclusion An intra examiner and inter examiner error was calculated and it was found that it is not statistically significant. Hence it could be reproduced reliably.

CONCLUSION:

Skeletal maturity indicators are a reliable tool in forensic odontology

The chronological age could be predicted reliably assessing the skeletal maturity index

The skeletal maturity is achieved faster in females compared to males.

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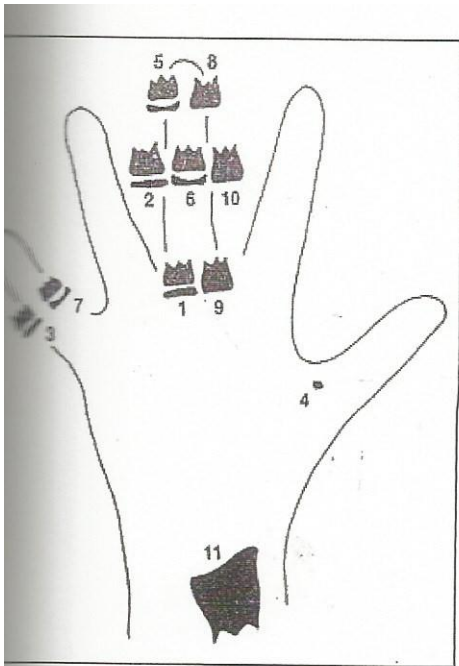
FIGURES:

11 Skeletal maturity indicators

Sites of Skeletal maturity Indicators

WIDTH OF EPIPHYSIS

OSSIFICATION

CAPPING OF EPIPHYSIS

FUSION
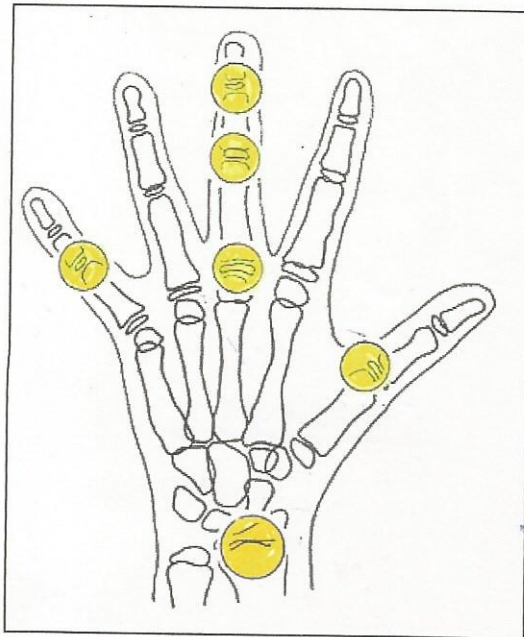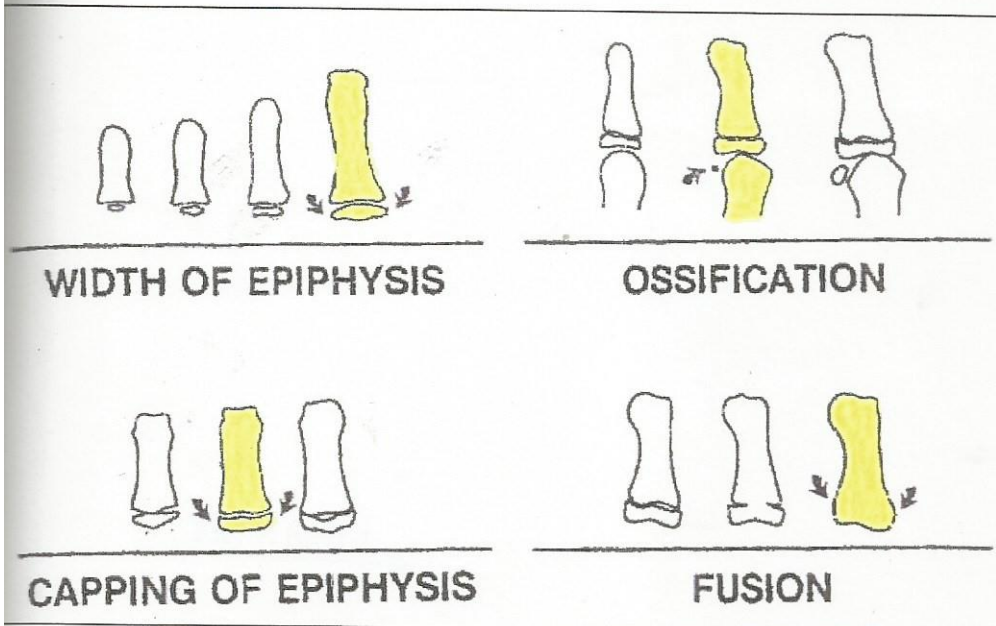
Sequence of ossification
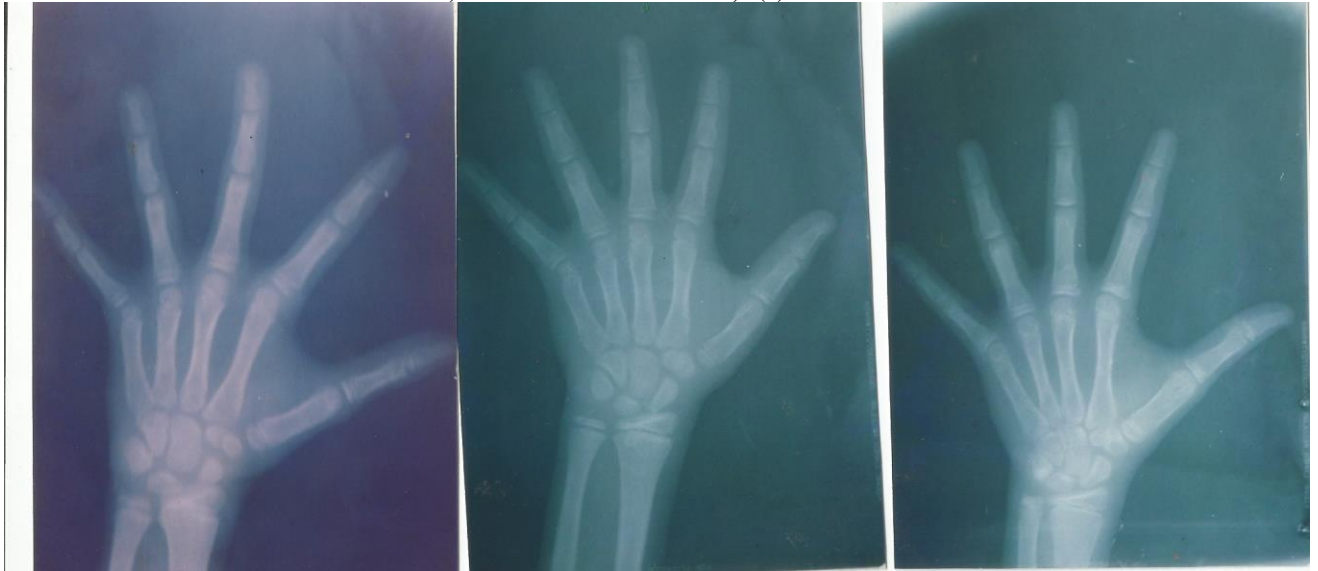
Figure 1: sequence of ossification
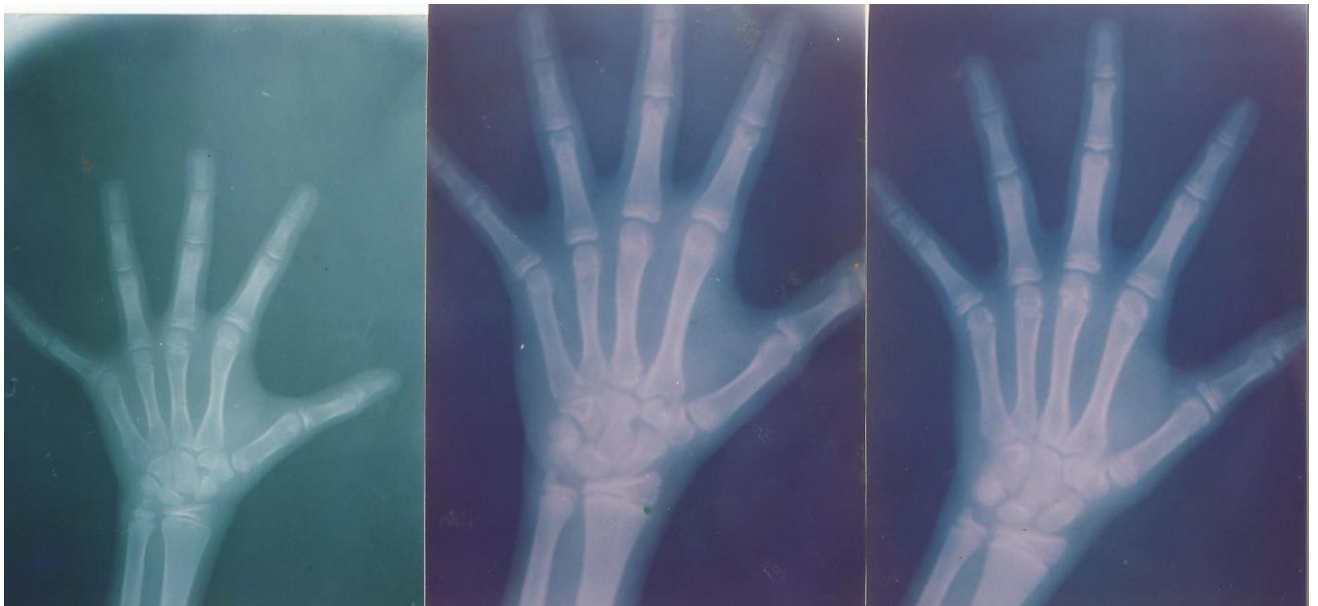
Figure 2: SMI 1,2,3

Figure 3: SMI 4,5,6
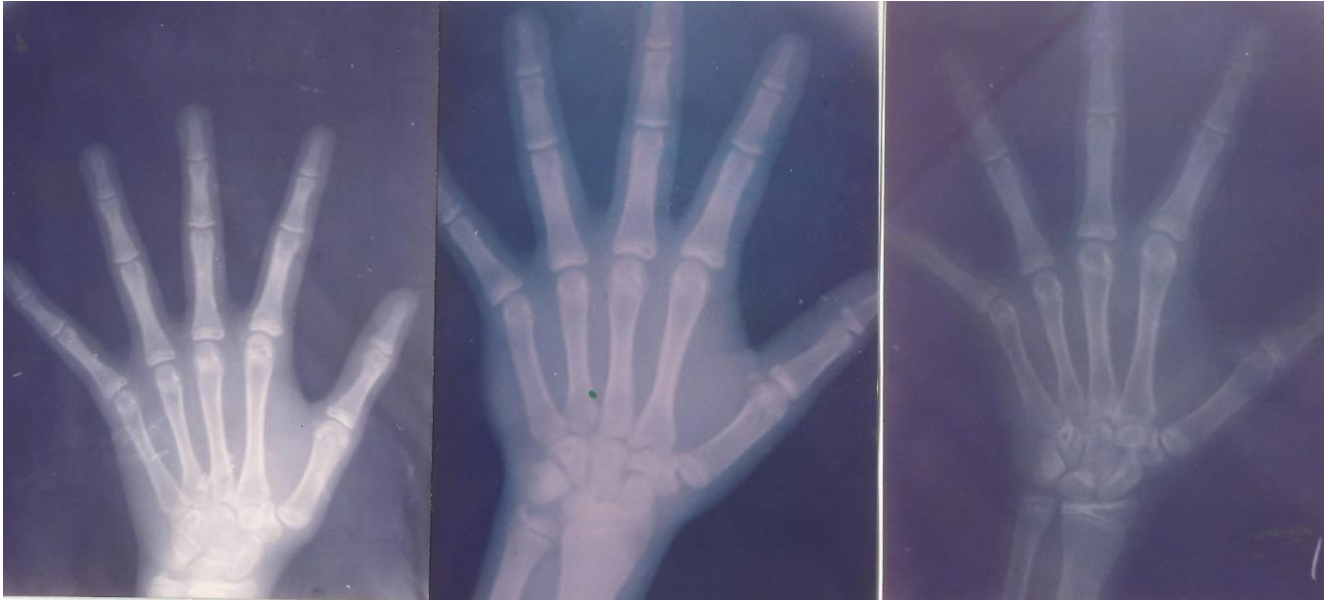
Figure 4: SMI 7,8,9

Figure 5: SMI 10,11

TABLES:

Table 1: Skeletal maturity indicators [12]

Width of epiphysis as wide as diaphysis	
SMI 1	Third finger-proximal phalanx
SMI 2	Third finger-middle phalanx
SMI 3	Fifth finger-middle phalanx
Ossification	
SMI 4	Abductor sessamoid
Capping of epiphysis	
SMI 5	Third finger-distal phalanx
SMI 6	Third finger- middle phalanx
SMI 7	Fifth finger- middle phalanx
Fusion of epiphysis and diaphysis	
SMI 8	Third finger-distal phalanx
SMI 9	Third finger- proximal phalanx
SMI 10	Third finger- middle phalanx
SMI 11	Radius

	8 yrs	9 yrs	10 yrs	11yrs	12yrs	13yrs	14 yrs	15 yrs	16 yrs
SMI 1	-	-	-	2	2	-	-	-	-
SMI 2	-	-	-	2	4	-	-	-	-
SMI 3	-	-	-	-	2	5	-	-	-
SMI 4	-	-	-	-	-	-	2	-	-
SMI 5	-	-	-	-	-	-	1	1	-
SMI 6	-	-	-	-	-	-	-	-	-
SMI 7	-	-	-	-	-	-	2	4	-
SMI 8	-	-	-	-	-	-	-	1	-
SMI 9	-	-	-	-	-	-	-	1	-
SMI 10	-	-	-	-	-	-	-	1	1
SMI 11	-	-	-	-	-	-	-	1	3

Table 2: Age wise distribution of SMI in males

	8 yrs	9 yrs	10 yrs	11yrs	12yrs	13yrs	14 yrs	15 yrs	16 yrs
SMI 1	-	2	-	-	-	-	-	-	-
SMI 2	-	2	2	2	-	-	-	-	-
SMI 3	-	-	1	-	-	-	-	-	-
SMI 4	-	-	1	-	-	-	-	-	-
SMI 5	-	-	5	2	4	-	-	-	-
SMI 6	-	-	-	-	2	-	-	-	-
SMI 7	-	-	-	-	3	3	1	-	-
SMI 8	-	-	-	-	-	-	-	-	-
SMI 9	-	-	-	-	-	-	1	-	-
SMI 10	-	-	-	-	-	-	2	-	-
SMI 11	-	-	-	-	-	-	3	-	-

Table 3: Age wise distribution of SMI in females

	males		females	
	mean	Standard deviation	mean	Standard deviation
SMI 1	11.5	-	9	0.00
SMI 2	11.6	1.00	10	0.00
SMI 3	12.7	0.41	10	0.00
SMI 4	14	0.00	10	0.00
SMI 5	14.5	-	10.90	0.79
SMI 6	-	-	12	0.00
SMI 7	14.6	0.00	12.7	0.76
SMI 8	15	0.00	-	-
SMI 9	15	0.00	14	0.00
SMI 10	15.5	0.00	14	0.55
SMI 11	15.7	0.00	14	0.00

Table 4: correlation between SMI stages and chronological age