Original Research Paper

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Age Estimation by Willem's Method in Age Group of 6-12 year old Children : A Cross Sectional Study.

Abstract:

Aim and objective : This article focuses on Willems method of age estimation in age group of 6-12 year old children.

Material and Methods: 25 orthopantomagram of children aged 6-12 year old children were collected from the patients visiting the Department of Pediatric and Preventive dentistry, government college of Dentistry, Indore.

Results: Comparison of the Dental age (DA) using the Willems method, the CA and differences between Dental age and Chronological age (DA and CA) of both gender and age groups .The independent samples t-test results showcased that the mean CA was 1.81 for males and 2.22 for females and the mean DA was 1.97 for males and 1.64 for females. This mean dictated an under aging of the entire sample as by about 0.58 years. Independent t-test showed that these differences were statistically not significant as the p value is less ($P > 0.05$).

Pearson's correlation test showed r value for overall data as 0.86, for male as 0.87 and for female as 0.88. The p value was statistically significant in overall data and male (<0.001).

Conclusion: It is important to realize that no age estimation method will accurately determine the exact age for every individual since development naturally varies between individuals. One of the most important aspect of DA estimation is to remember that one should not restrict to only one age estimation technique, but to apply different techniques available and perform repetitive measurements and calculations. Also the sample size should be larger as compared to the present study, as well as equal numbers of both male and female should be studied.

Keywords : age estimation, willems method, over and under estimation of age

Introduction:

Age of a person is not just a number but also an important indicator of his or her physical, mental and emotional growth. Age estimation has been one of the essential factors in human identification. Age estimation is important in cases of leagal documentation, marriage, job, insurance claims, paternity cases, identification match of a person, rapes, juvenile crime etc.

The estimation of age can be done by 3B's, that are Belongings like identity proofs etc. Behavioral markers like mentality and behaviour. Biological markers which can be non skeletal including general appearance like weight height, developmental milestones; skeletal includes teeth examination, dentition, attrition, ossification centres, closure of epiphysial plates, closure of fontannels.

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Number of methods have been implied since ages for the estimation of age. The important onces to mention are - Moorrees, Fanning and Hunt method, Nolla method ,Demirjian et al, Anderson , Cameriere and willems method.

The developmental stages of the seven left permanent mandibular teeth are measured in Willems method. In

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comparison to Demirjian's method of age estimation Willems method has given more promising results. Thus this study was done using Willem's method in our sample population.

Material and Method:

The study was conducted in Department of Pediatric and Preventive Dentistry, Government College of Dentistry, Indore. The study sample consisted of 25 randomly selected subjects of age ranging from 6 to 13 years. The ethicial clearance was obtained to conduct the study.

Initial screening was done to satisfy the inclusion criteria namely children with no underlying medical history of systemic diseases, or nutritional disorders, with no missing left mandibular teeth. Subjects with serious medical illness (psychiatric problems, endocrine diseases), history of extraction of permanent teeth, Trauma to the face, impacted or ankylosed teeth, congenital developmental abnormalities, physically or mentally challenged children and gross malocclusion, were excluded from the study.

Clinical examination of all 25 individuals was performed. Name, sex, date of birth of each individual and date of radiography were recorded. These radiographs were prescribed as per the need of the patient. Parental consent was obtained to use radiographs of their respective child.All the radiographs were taken with KODAK 8000 C Digital panoramic and cephalometric system. (KOD-PANO01-C Carestream Health, Inc. 150 Verona Street Rochester NY 14 608, Manufacturing 2010)

Assessment of dental age using Willems method:

Calculation of Chronological age (CA) of an individual was done by subtracting the birth date from the date on which the radiographs were exposed for that particular individual. Digital panoramic radiographs (orthopantomograms [OPGs]) of all children were used to assessment . Assessment of the status of maturation on the basis of calcification of the permanent teeth in mandibular left side, from central incisor to the second molar, using Demirjian et al., method was done.

Tooth formation is divided in to eight stages and criteria of these stages for each tooth were given separately (A to H) [1]

After noting all stages of teeth from central incisor to the second molar by the two examiners, the developmental status of a particular tooth was calculated in years on the basis of tables given by Willems et al., . All the values from central incisor to the second molar thus obtained were summed to obtain an overall maturity score, which will indicate the DA of that particular patient.

Data were analyzed by Statistical Package for the Social Sciences computer software (SPSS, version 20.0, SPSS Inc., Chicago, IL, USA) using paired t-test and Fischer's exact test, $P < 0.05$was considered to be significant. Pearson's Correlation Test was performed for correlation of actual and calculated age.

The differences between Dental age and Chronological age in different age groups in both sexes were tabulated using descriptive statistics.

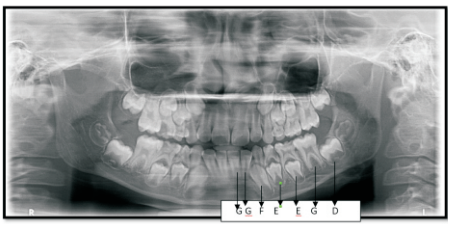
Table No 1: Description for developmental stages of teeth [1]

STAGE	DESCRIPTION
A	A beginning of calcification is seen at the superior level of crypt in the form of cones. There is no fusion of these calcified points
B	Fusion of the calcified points forms one or several cusps, giving a regularly outlined occlusal surface
C	Enamel and dentin formation is complete at the occlusal surface and converge at cervical region Dentin deposition is seen The outline of the pulp chamber has a curved shape at the occlusal border
D	Crown formation is completed down to the cementoenamel junction Superior border of pulp chamber in uniradicular teeth hasa definite curved form; projection of pulp horns gives an umbrella top. In molars, pulp chamber has a trapezoidal form Beginning of root formation is seen in the form of a spicule
E	Uniradicular teeth The walls of pulp chamber form straight lines, whose continuity is broken by the pulp hornThe root length is less than the crown height In molars Initiation of radicular bifurcation is seen as a calcified point or a semi? lunar shape Root length is less than crown height
F	Uniradicular teeth The walls of pulp chamber form isosceles triangle. Apex ends in a funnel shape The root length is equal to or greater than the crown height In molars The bifurcation has developed down to give the roots a distinct outline with funnel shaped endings Root length is equal to or greater than crown height
G	The walls of root canal are now parallel and its apical end is partially open (distal root in molars)
H	The apical end of the root canal is completely closed Periodontal membrane has a uniform width around the root and apex

Table No 2: Developmental tooth stages with corresponding age scores expressed directly in years for each of the seven left mandibular teeth in boys and girls [1]

GENDER	TOOTH	A	B	C	D	E	F	G	H
MALE	CENTRAL INCISOR	-	-	1.68	1.49	1.5	1.86	2.07	2.19
	LATERAL INCISOR	-	-	0.55	0.63	0.74	1.08	1.32	1.64
	CANINE	-	-	-	0.04	0.31	0.47	1.09	1.9
	FIRST PREMOLAR	0.15	0.56	0.75	1.11	1.48	2.03	2.43	2.83
	SECOND PREMOLAR	0.08	0.05	0.12	0.27	0.33	0.45	0.4	1.15
	FIRST MOLAR	-	-	-	0.69	1.14	1.6	1.95	2.15
	SECOND MOLAR	0.18	0.48	0.71	0.8	1.31	2	2.48	4.17
GENDER	TOOTH	A	B	C	D	E	F	G	H
FEMALE	CENTRAL INCISOR	-	-	1.83	2.19	2.34	2.82	3.19	3.14
	LATERAL INCISOR	-	-	-	0.29	0.32	0.49	0.79	0.7
	CANINE	-	-	0.6	0.54	0.62	1.08	1.72	2
	FIRST PREMOLAR	- 0.95	-0.15	0.16	0.41	0.6	1.27	1.58	2.19
	SECOND PREMOLAR	- 0.19	0.01	0.27	0.17	0.35	0.35	0.55	1.51
	FIRST MOLAR	-	-	-	0.62	0.9	1.56	1.82	2.21
	SECOND MOLAR	0.14	0.11	0.21	0.32	0.66	1.28	2.09	4.04

Figure No 1: Assessment of stage of tooth development



Results:

Comparison of the Dental age (DA) using the Willems method, the CA and differences between Dental age and Chronological age (DA and CA) of both gender and age groups are presented in Table 3.

The independent samples t-test results showcased that the mean CA was 1.81 for males and 2.22 for females and the mean DA was 1.97 for males and 1.64 for females. This mean dictated an under aging of the entire sample as by about 0.58 years. Independent t-test showed that these differences were statistically not significant as the p value is less (P > 0.05).

Mean absolute differences and standard deviations for age cohort for males and females are presented in Table 4. Pearson's correlation test showed r value for overall data as 0.86, for male as 0.87 and for female as 0.88. The p value was statistically significant in overall data and male (<0.001).

Table no. 5 Showed the conclusive values. The total number of patients showing correct age estimation were 11 (male- 02, female- 09). Over estimation was seen in 1 male patient and 2 female whereas under estimation seen in 3 male and 8 female.

TABLE NO 3: Paired t test between DA according to Willems method and CA in males and females with the mean difference between both

	Gender	N	Mean	SD	Mean Difference	95% Confidence Interval of the Difference		t	df	p-value
						Lower	Upper			
31	Male	6	2.11	0.06	-0.76	-1.15	-0.37	-4.02	23	0.001*
	Female	19	2.87	0.46						
32	Male	6	1.43	0.17	0.54	0.24	0.83	3.79	23	0.001*
	Female	19	0.89	0.33						
33	Male	6	0.52	0.29	-0.55	-1.04	-0.07	-2.38	23	0.03*
	Female	19	1.07	0.54						
34	Male	6	1.67	0.48	0.50	0.02	0.97	2.18	23	0.04*
	Female	19	1.17	0.49						
35	Male	6	0.34	0.07	0.02	-0.05	0.08	0.51	23	0.62(NS)
	Female	19	0.33	0.07						
36	Male	6	1.84	0.27	-0.08	-0.40	0.24	-0.51	23	0.62(NS)
	Female	19	1.92	0.34						
37	Male	6	1.27	0.77	0.46	-0.04	0.97	1.91	23	0.07(NS)
	Female	19	0.80	0.42						
Calculated age	Male	6	9.16	1.97	0.11	-1.56	1.78	0.14	23	0.89(NS)
	Female	19	9.05	1.64						
Actual age	Male	6	9.64	1.81	-0.003	-2.08	2.07	-0.003	23	1.00(NS)
	Female	19	9.65	2.22						
Diff in age	Male	6	0.49	1.00	-0.11	-1.17	0.94	-0.22	23	0.83(NS)
	Female	19	0.60	1.11						

Table No 4: Summarised data of collected samples.

	Gender	N	Mean	SD	Mean Difference	95% Confidence Interval of the Difference		t	df	p-value
						Lower	Upper			
Overall	Calculated age	25	9.07	1.69	-0.57	-1.01	-0.13	-2.69	24	0.01*
	Actual age	25	9.65	2.10						
Male	Calculated age	6	9.16	1.97	-0.49	-1.53	0.56	-1.20	5	0.29(NS)
	Actual age	6	9.64	1.81						
Female	Calculated age	19	9.05	1.64	-0.60	-1.13	-0.06	-2.35	18	0.03*
	Actual age	19	9.65	2.22						

Table no 5. Conclusive values

Conclusion	Gender		Total	Fischer's Exact Test
	Male	Female		p- value
Correct	2	9	11	1.00(NS)
	33.3%	47.4%	44.0%	
Over estimation	1	2	3	
	16.7%	10.5%	12%	
Underestimation	3	8	11	
	50%	42.1%	44%	
Total	6	19	25	
	100%	100%	100%	

Discussion:

Age estimation plays a a vital role in identification of an individual. Radiographs are used frequently for dental maturity and age estimation as a single radiograph gives the complete developmental status of dentition in children. Different methods employed for age assessment are Demirjian's, Nolla's stage , Cameriere , Haavikko, Willem's etc.

The previous study done by Olze et al. in 2005 had reviewed various methods of dental development staging and found that the Demirjian method can define the chronological age accurately .[2] In 2001, Willems et al., evaluated the accuracy of Demirjian's method in Belgian Caucasian population and modified the scoring system.. It is a modification of Demirjian's method. The new adapted method was validated and resulted in more accurate dental age estimations in Belgian population. Willems, compared modified Demirjian tables with the original tables and found that dental age is overestimated by 0.5 to 0.6 years for boys and girls respectively in Demirjian's method and the overestimation is decreased to 0 to 0.2 years for boys and girls respectively in Willems method. [3]

Whereas a study done by Willems showed higher accuracy in estimating age and has been tested in various populations (Willems et al. 2001, 2012; Grover et al. 2012; Ambarkova et al. 2014; Ye et al. 2014).[3,4,5,6]

In present study, the population of Indore (Madhya Pradesh) was studied.

The overall mean difference between the estimated DA and CA for males was 0.49 ± 1.00 years (p value 0.83) while for females, it was 0.60 ± 1.11 years (P value 0.83). In this study 25 children were assessed, out of which 6 were males and 19 were girls. The correct age estimation was seen in 2 boys i.e 33.3% and 9 girls i.e 47.4%, bringing to a total of 44.0%. Overestimation was seen in 1 male i.e 16.7%, 2 females i.e 10.5%, total 12.0%. Underestimation was seen in 3 males i.e. 50% and 8 females i.e 42%, total 44%.

When the entire sample was considered, underestimation of age was noted, in agreement with previous studies.[7,8,9] These differences can be because of difference in the age and age group studied, sample size, method of age calculation, sex distribution of the original study population and statistical methodologies.

When comparison among genders is done, it is seen that females mature earlier than males, but the mean difference between DA and CA was not statistically significant (P > 0.05). In the present study Willems method was found to be better applied for females when compared with males, which is in agreement with Grover et al.,[4]

Maber et al., who found an overall underestimation of age using the Willems method in their population.[10]According to Galić I ET AL Dental age for Willems method was underestimated for −0.20 and −0.05 year for girls and boys, respectively.[11]

According to Patnana AK, Willems method showed an underestimation of age about 0.25 and 0.15 years in boys and girls.[12] The correlation of this method with girls is more than boys which is coinciding with the previous studies Maber (2006) who found an overall underestimation of age using the Willems method in their population.[10]

According to S A Mani et al, study done on Malaysian population showed Using this method, our study found an overestimation of 0.55 and 0.41 years among boys and girls, respectively, which was statistically significant.[13]

In Egyptian study, El-Bakary et al. found that Willems method overestimated the age by 0.29 and 0.14 years among boys and girls, [14]respectively while the study on Bosnian-Herzegovian children by Galic´ et al. showed that the Willems method overestimated the age by 0.42 and 0.24 years among boys and girls, respectively.[15]

Shekhar Grover (2012) in Faridabad, India studied and evaluated the accuracy of Willems methods and they found that an overestimation of dental age about 0.36 and 0.24 years in boys and girls respectively with chronologic age. The mean overestimation of age was less in girls than boys which was statistically significant.[4]

Vesna Ambarkova (2013), compared the accuracy of Demirjian's and Willems methods of dental age estimation methods in the Former Yugoslav Republic of Macedonia in 6 to 13 years old age group children and concluded that Willems method was the most accurate while Demirjian's methods for dental age calculation are not suitable on children in this population.[16]

According to Gupta et al Using the Willems method, our study revealed an overestimation of age by 0.4 years among males and an underestimation of 0.4 years among females. The age differences among both males and females were found to be statistically insignificant, thus the Willems method is applicable to both Indian males and females.[17]

Hegde et al. 2016 Willems method predicted age of boys more accurately[18]. whereas

Javadinejad et al. 2013. Studied 537 children aged 3.9±14 analyzed using Demirjian, Willems, Cameriere and Smith methods. Demirjian and Willems methods overestimated chronological age and hence less accurate[19]

Conclusion:

It is important to realize that no age estimation method will accurately determine the exact age for every individual since development naturally varies between individuals. One of the most important aspect of DA estimation is to remember that one should not restrict to only one age estimation technique, but to apply different techniques available and perform repetitive measurements and calculations. Also the sample size should be larger as compared to the present study, as well as equal numbers of both male and female should be studied.

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