

Evaluation and comparison of skeletal and dental maturity indicators in individuals with different growth pattern

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Abstract: Introduction- Assessment of maturational status is a decisive factor in deciding treatment modality. Various methods till date have been tested to define individual's maturation. This study comprised of 60 samples divided in 3 groups. Group I normal grower (control), group II - vertical growers and group III - horizontal growers. Each sample was assessed for skeletal and dental age using CVMI, SMI stages and canine calcification stages respectively. All data in the groups was analyzed by Anova test. Subgroup data and comparisons were analyzed by Dunnett D test and t- test. Results showed that dental maturation was delayed in horizontal growers as compared to vertical growers with p-value of 0.00 and 0.044. There was non-significant difference in dental maturation of male and females with p-value >0.05. Comparison of skeletal maturation by hand wrist radiograph showed significant variation in group III with delayed skeletal maturation of horizontal growers than control group with p-value < 0.05. Dunnett D test showed main skeletal age by CVMI was significant with p-value of 0.00 which indicates that skeletal age of group III to be lower in all groups. Rest was non-significant.

Keywords: Chronological age, CVMI, Dental age, Skeletal age, SMI.

I. Introduction

Assessment of maturational status is a decisive factor in diagnosis, treatment planning and the eventual outcome of orthodontic treatment. Assessing maturational status is more important when the clinical considerations are based strongly on the increased or decreased rates of craniofacial growth left, such as the timing and use of extra oral traction and the use of functional appliances. Also it helps in predicting future growth potential of the facial skeleton in order to ensure successful outcome of the treatment of dentofacial deformities.^[1]

Racial & sexual differences and other less tangible factors such as climate, nutrition, socio-economic levels & urbanization may influence the rates of physiologic maturity of a child. This renders the chronological age as unreliable indicator of maturational levels.^[2] The hand wrist radiograph is commonly used for the assessment of skeletal development as many investigators have found significant correlation between maturation stages.^{[2][3][4][5][6]} Also changing concavities in the lower border of cervical vertebrae are also found to be a reliable method for assessing skeletal development apart from hand wrist.^{[7][8][9][10][11][12]}

Sandra Coutinho et al (1993)^[13] found a close relationship between the canine calcification stage G in the mandible with the pubertal growth spurt. However it remain questionable whether association based on dental stages are strong enough to make reliable clinical predictions. The difference in dental maturation between skeletal open bite and skeletal deep bite subjects was investigated by Janson et al (1998)^[14] and reported that skeletal open bite subjects presented a slight tendency to have an advanced dental maturation expressed by the dental age.

Janson (1998)^[14], Nanda and Rowe (1989)^[15] also concluded that timings of the adolescent growth spurt for various facial dimensions in open bite faces were earlier than deep bite faces. Also studies conducted by different investigators to assess the correlation between different facial types i.e. skeletal open bite & skeletal deep bite on dental maturation have shown that there is a difference in the timings of dental maturation between these extreme vertical facial types.^[16]

The timing of craniofacial growth and its relationship to other developmental events presents a particular challenge in subjects exhibiting variations in facial form. Considering the lack of data on variability of skeletal maturation between the two facial types, present study was carried out to establish whether the vertical and horizontal growth patterns influence the rate of dental & skeletal maturation as compared to normal growth patterns. Also the study probed any sexual dimorphism on the rate of dental and skeletal maturation between the vertical and the horizontal growers.

II. Methods

The study consisted of 60 individuals of chronological ages between 8-14 yrs. Selection criteria includes individuals with no history of bony deformities and pathosis, no muscular dystrophy, congenital abnormalities, traumatic injuries to the jaws and hands. Approval from ethical committee of DattaMeghe Institute of Medical Sciences Deemed University was taken prior to the study.

Lateral cephalogram, OPG (PlanmecaProline and Vision 100A) and hand wrist radiographs were taken for each sample. Mandibular plane angle was used to divide the samples into three groups i.e. Group I (normal growers- control group), Group II (vertical growers) and group III (horizontal growers). Group II and Group III were further subdivided into two subgroups as subgroup A (males) and B (females).

All the samples were evaluated for their respective stages of skeletal and dental maturation as per the methods developed by Fishman for SMI stages using handwrist radiographs, for CVMI stages using lateral cephalogram (Hassel and Farman)^[8]. Demirjian (1973)^[17] index was used to assess dental age using OPG.

III. Results

The mean chronological age for Group I, II and III was 10.90±0.47, 10.14±0.98 and 10.24±1.45 respectively.

Table no.1: Mean dental age (years) in three groups (descriptive statistics)

Group	n	Mean	Standard deviation	Standard error	95% of confidence		Min.	Max.
					Lower bound	Upper bound		
Gr. III	20	9.66	1.46	0.32	8.97	10.35	7.30	12.40
Gr. II	20	10.67	1.02	0.23	10.18	11.15	7.90	12.40
Gr. I	20	11.49	0.74	0.16	11.14	11.84	10.00	12.50

Table no.2-Mean dental age (Multiple comparison Dunnett D test)

Group	Mean Difference (I-J)	Std. Error	p-value	95% confidence Interval	
				Lower Bound	Upper Bound
Gr. III	-1.86	0.35	0.000 S p<0.05	-2.63	-1.02
Gr. II	-0.82	0.35	0.044 S P<0.05	-1.63	-0.01

Table no.3-Results of Independent t-test between dental ages of vertical (Gr. II) and horizontal group (Gr. III)

Variable	Gr. II		Gr. III		Difference	p-value
	Mean	SD	Mean	SD		
Dental Age	10.67	1.04	9.66	1.46	-1.00	0.01 S p<0.05

Table no.4-Results of independent t-test in horizontal and vertical subgroups (male and female)

Group	Subgroup A		Subgroup B		Difference	p-value
	Mean	SD	Mean	SD		
Gr. III	9.89	0.76	9.44	1.96	0.45	0.50 NS p>0.05
Gr. II	10.08	0.99	11.16	0.77	-1.08	0.01 S P<0.05

Table no.5-Multiple comparison within groups: Dunnett D test (SMI with hand wrist)

Group	Mean Difference (I-J)	Std. Error	p-value	95% confidence Interval	
				Lower Bound	Upper Bound
Gr. III	-0.99	0.28	0.002 S p<0.05	-1.62	-0.35
Gr. II	-0.45	0.28	0.20NS p>0.05	-1.08	0.18

Table no.6-Results of Independent t-test between skeletal ages of Gr.II & Gr.III using SMI

Variable	Gr.II		Gr.III		Difference	p-value
	Mean	SD	Mean	SD		
Skeletal Age	11.64	1.03	11.10	0.88	-0.54	0.08 NS p>0.05

Table no.7-Results of independent t-test for skeletal age between subgroups (using SMI)

Group	Subgroup A		Subgroup B		Difference	p-value
	Mean	SD	Mean	SD		
Gr. III	11.24	0.50	10.97	1.16	0.27	0.50 NS p>0.05
Gr. II	12.10	1.11	11.19	0.75	0.91	0.04 S P<0.05

Table no.8-Multiple comparison within group: Dunnett D test(CVMI)

Group	Mean Difference (I-J)	Std. Error	p-value	95% confidence Interval	
				Lower Bound	Upper Bound
Gr. III	-1.41	0.30	0.000 S p<0.05	-2.10	-0.72
Gr. II	-1.00	0.30	0.003 S P<0.05	-1.68	-0.31

Table no.9- Results of independent t- test between skeletal ages (CVMI) of Vertical and Horizontal Group

Variable	Gr. II		Gr. III		Difference	p-value
	Mean	SD	Mean	SD		
Skeletal Age	10.60	0.98	10.19	0.98	-0.41	0.19 NS p>0.05

Table no.10- Results of independent t-test between skeletal agebetween subgroups (using CVMI).

Group	Subgroup A		Subgroup B		Difference	p-value
	Mean	SD	Mean	SD		
Gr. III	9.77	0.71	10.61	1.07	-0.84	0.05 NS p>0.05
Gr. II	10.41	1.15	10.80	0.78	-0.39	0.39 NSp>0.05

IV. Discussion

Comparison of dental maturation in all three groups (Demirjian stages)

The mean dental age for Group I, II and III was 11.49±0.74, 10.67±1.04 and 9.66±1.46 respectively.[Table no.1][Graph no.1].

Analysis of variance (One way Anova test) showed that there exists statistically significant variation in all the three types of growth patterns with p- value < 0.05 (0.00).

Multiple comparison Dunnett D test showed that mean dental age of group III was lowest followed by group II as compared with p value of 0.00 and 0.044 respectively.[Table no.2] [[Graph no.1].

Independent t-test showed statistically significant variation with p-value of 0.01, suggestive of delayed dental maturation in horizontal growers when compared to vertical growers.[Table no.3].

The present study showed results which are comparable to those of **Neves et al (2005)**^[16] showing early maturation and a more advanced dental age for the vertical growers with the mean difference of 1.00 as compared to horizontal growers. Also **Janson et al (1998)**^[14] studied the differences in dental maturation between skeletal open and deep bite subjects in 40 subjects with mean of 9.2 years and reported that skeletal open bite subjects have advanced dental maturation, expressed by dental age, as compared to skeletal deep bite subjects.

Dental maturation in subgroups was found to be significant with p- value > 0.05 (0.01) suggestive of female vertical growers to be ahead in growth spurt as compared to male vertical growers. However present study showed no significant difference in dental maturation in female horizontal growers.[Table no.4].This is comparable with the results of **Nanda (1988)**^[18] who conducted a study on 16 males and 16 females and reported that female open bite subjects were earlier in timing of adolescent growth spurt than the male open bite subjects. Comparison of skeletal maturation in all three groups:

(A) SMI stages using hand wrist radiographs:

The mean skeletal age for Group I, II, and III was 12.09±0.72,11.64±1.03 and 11.10±0.88,respectively. Multiple comparison Dunnett D Test showed that Group III was statistically significant with p- value < 0.05 when the groups were compared. It suggests that horizontal growers when compared to normal growers showed delayed skeletal maturation whereas no significant variation in skeletal maturation was seen when vertical growers were compared to normal growers.[Table no.5]

Independent t-test showed that the skeletal age is ahead in Group II as compared to Group III but with statistically non-significant.(p>1.77) [Table no.6].Suggestive of non-significant variation in skeletal maturation when horizontal growers were compared to vertical growers.

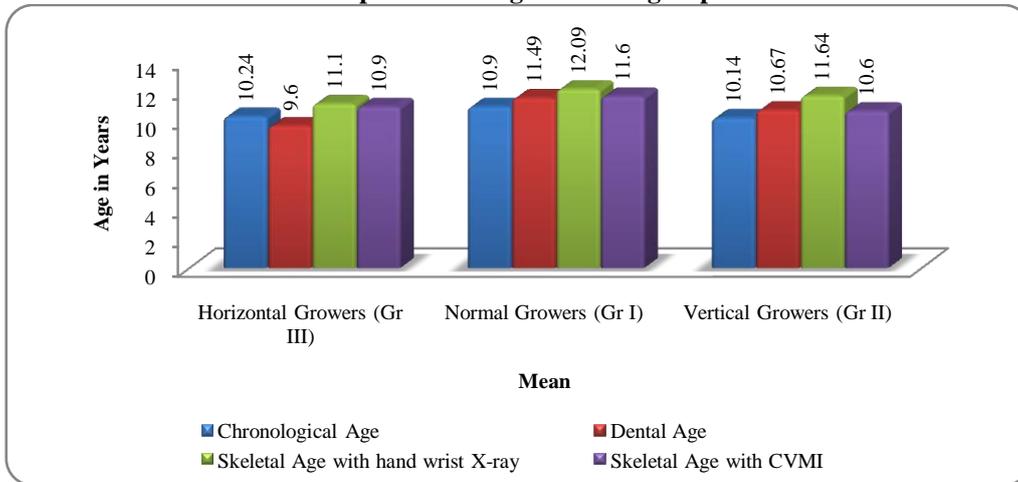
Significant difference between males and females was found in subgroup II with p-value <0.05(0.04) suggestive of male vertical growers being ahead of skeletal maturation when compared to female vertical growers.[Table no.7]

(B) Comparison of Skeletal maturation using CVMI:

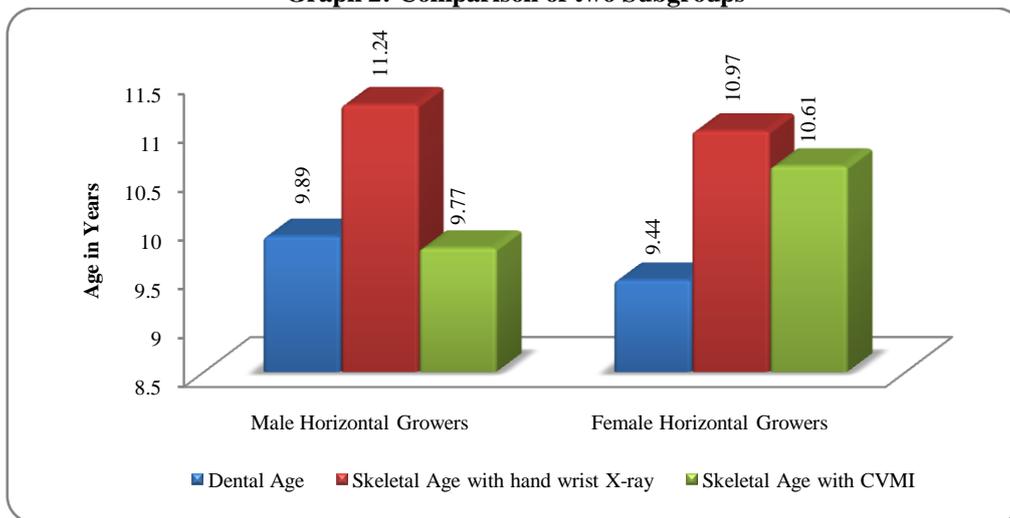
Multiple comparison Dunnett D test showed mean skeletal age of group III to be lowest followed by group II and was statistically significant with p value of 0.00 and 0.003 respectively when compared with group I.[Table no.8]

Also no significant variations in skeletal maturation was observed when horizontal growers were compared to vertical growers.[Table no.9 and 10]

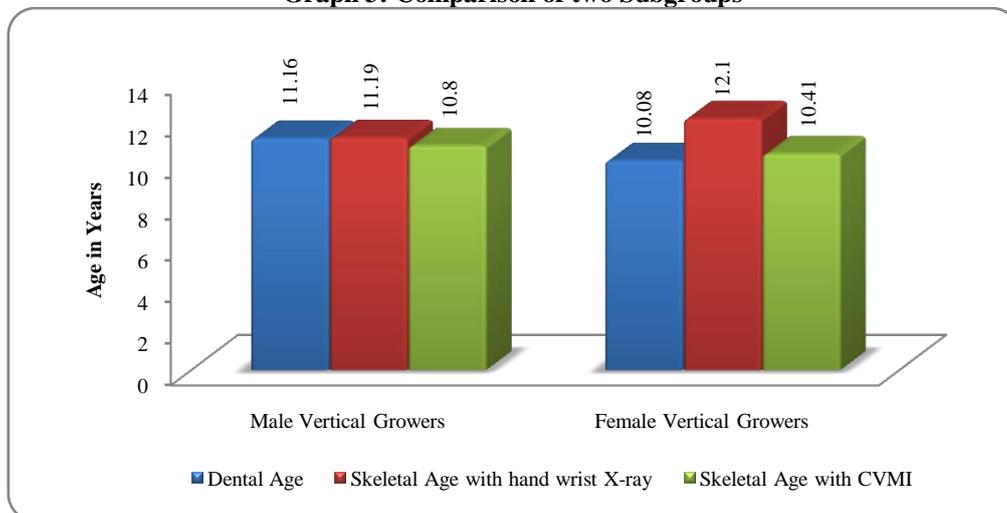
Graph 1: Mean ages of three groups



Graph 2: Comparison of two Subgroups



Graph 3: Comparison of two Subgroups



V. Conclusion

Following conclusions were drawn:

1) Dental maturation in vertical and horizontal growing individuals using OPG:

- Individuals with horizontal growth pattern showed delayed dental maturation when compared to vertical growers.
- Female vertical growers are ahead of males in dental maturation.

2) Skeletal maturation in vertical and horizontal growing individuals using SMI and CVMI :

- Although it was found that horizontal growth pattern individuals showed a delay in skeletal maturation when compared to vertical growers but the difference was not statistically significant.
- Female vertical growers have advanced skeletal maturation than male vertical growers.

3) Skeletal maturation in vertical and horizontal growing individuals using CVMI in lateral cephalogram:

- Although female vertical and horizontal growers have advanced skeletal maturation but the difference was not statistically significant.

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