

AVERAGE CHRONOLOGICAL AGE & OCCURRENCE OF PUBERTAL SPURT ASSESSED BY CVM METHOD IN PAKISTANI GIRLS AND BOYS

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ABSTRACT

The purpose of this study was to evaluate the mean chronological age at peak pubertal growth (CVMS III) and occurrence of peak pubertal spurt amongst male and female Pakistani subjects, assessed by Cervical maturation method (CVM) as an indicator of skeletal age in the circumpubertal period.

Lateral cephalometric radiographs of 205 Pakistani subjects attending OPD (Department of Orthodontics, Altamash Institute of Dental Medicine, Karachi) were selected. Both male and female patients, between the age categories of (8.0-11.0, 11.1-14.0 and 14.1-17years) were included in this research. Skeletal ages were assessed according to the CVM method.

Results showed that the mean chronological age at CVMS III in males was $13.7 \pm (1.4)$ and in females was $12.7 \pm (1.4)$ years.

It was concluded that maximum number of subjects in peak pubertal growth was in chronological age group between 12.1-15 years. The total numbers and percentage of girls with peak pubertal spurt was 38(26%). The total number and percentage of boys with peak pubertal growth spurt was 12 (20.3%).

Key Words: Chronological age, pubertal growth, skeletal age.

INTRODUCTION

The issue of optimal timing for dentofacial orthopedics is linked to the identification of periods of accelerated or intense growth that can contribute significantly to the correction of skeletal imbalances in a patient.¹ Therefore, various maturity indicators were used to assess growth spurts to determine optimal timing for growth modification treatment. These methods include sexual maturation characteristics, facial growth and

peak height velocities, chronologic age, dental development, body weight and hand-wrist maturity. Hand-wrist radiographs have been used routinely in orthodontics to assess the peak of the growth spurt. However, there are concerns about extra radiation exposure (Fig 1-a). In addition, the British Orthodontic Society guideline stated that the use of hand-wrist radiographs to predict the onset of the pubertal growth spurt was not indicated.² Among maturational indexes, the cervical vertebral maturation method has proved effective in assessing the adolescent growth peak both in body height and mandibular size.^{3,4} One obvious advantage of the CVM method is that a lateral cephalometric radiograph is routinely required for orthodontic diagnosis and treatment planning, so no additional radiograph is required.² In orthodontics, the use of a dentofacial orthopedic appliance is a main treatment modality in the correction of mandibular deficiency. The mechanism depends on the modification of the growth of the mandible and the maxilla. Studies have shown that functional appliance therapy can stimulate growth of the mandibular condyle and remodeling of the glenoid fossa. The effectiveness of these growth modifications depends on skeletal maturity.⁵

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Rufand Pancherz who used the Herbst appliance for jaw growth modification therapy to correct mandibular deficiency, the optimal time for growth modification was around the peak of the pubertal growth spurt.⁶ The skeletal responses were less in subjects both before and after maximum pubertal growth.⁷ In 1972 Lamparski created the first standards of cervical vertebral maturation related to chronological age and to skeletal maturation as observed on hand wrist radiograph.⁸ The shape and size of the vertebral bodies are relatively similar and regular, so it is feasible to evaluate skeletal maturation qualitatively and quantitatively by measuring parameters of the vertebral bodies.⁹ Hassel and Farman (Fig 1-b,) indicated the shapes of the cervical vertebrae change during each stage of skeletal growth and stated that skeletal maturation stages and residual growth potential of an individual can be determined in this way.¹⁰

The objective of this study was to determine the mean chronological age at pubertal spurt and frequency of peak pubertal spurt assessed by CVM in a sample attending orthodontic clinic.

TABLE 1: AGE RANGES OF SUBJECTS IN THE STUDY (n=205)

Age Group (years)	n	(%)
9.1- 12.0	54	26.3
12.1-15.0	108	52.7
> 15.0	43	21.0
Minimum age	9.1	
Maximum age	17	
Mean $\pm$ S.D	13.5 $\pm$ 1.9	

TABLE 2: DISTRIBUTION OF AGE ACCORDING TO GENDER IN STAGE CVMS 3 (n=50)

Gender	N (%)	Mean $\pm$ S.D
Male	12 (24%)	13.7 $\pm$ 1.4
Female	38 (76%)	12.7 $\pm$ 1.4

TABLE 3: SAMPLE DISTRIBUTION ACCORDING TO CERVICAL VERTEBRAE STAGES IN MALES AND FEMALES

Stages	Male		Female		Total	
	N	(%)	N	(%)	N	(%)
1: CVMS I	10	16.9	4	2.7	14	6.8
2: CVMS II	14	23.7	18	12.3	32	15.8
3: CVMS III	12	20.3	38	26.0	50	24.4
4: CVMS IV	5	8.5	35	24.0	40	19.5
5: CVMS V	15	25.4	46	31.5	61	29.8
6: CVMS VI	3	5.1	5	3.4	8	3.9

METHODOLOGY

The study has been conducted at Department of Orthodontics at Altamash Institute of Dental Medicine. All the subjects (n=205) were enrolled through consecutive sampling who fulfilled the inclusion criteria and gave consent for the study. It is a Cross-sectional non probability (purposive) study of six months duration. Both male and female patients, coming to orthodontic OPD, between the age categories of (9.1-11.0, 11.1-14.0, 14.1-17 years) were included in this study. The exclusion criteria consist of craniofacial anomalies, cleft lip and palate and poor quality of lateral cephalograms.

Orthodontic patients of ages between 9-17 years were included in this research that fulfilled the inclusion criteria. Lateral cephalograms were reviewed by the primary investigator to assess changes in the shape and concavity of cervical vertebrae C2, C3, C4. Additional radiographs were not needed as lateral cephalograms are routinely used for orthodontic diagnosis. Chronological age of respective patients was recorded to evaluate skeletal maturation with respect to chronological age. An informed verbal consent was obtained from the parents of all the participants of the study. To evaluate skeletal maturation, the anatomical changes observed in the concavity of the lower border, height, and shape of the vertebral body was observed.

The data was entered and analyzed in SPSS version 14.0. Descriptive statistics was used to summarize the continuous and categorical data. Continuous variable like age was reported as mean $\pm$ S.D and mean age of pubertal spurt as assessed by CVM. Categorical data was presented as percentage and frequency for gender and mean chronological ages. Pubertal spurt was presented as positive/negative on basis of presence or absence of concavity, affect of modifier variables being controlled by stratification according to age, gender.

RESULTS

In this study, 22.6% out of 205 subjects were in pre pubertal stage that is before approaching CVMS III, 24.4% were going through peak pubertal growth spurt



Fig 1-a: Third maturation stage of cervical vertebrae and medial phalange of third finger

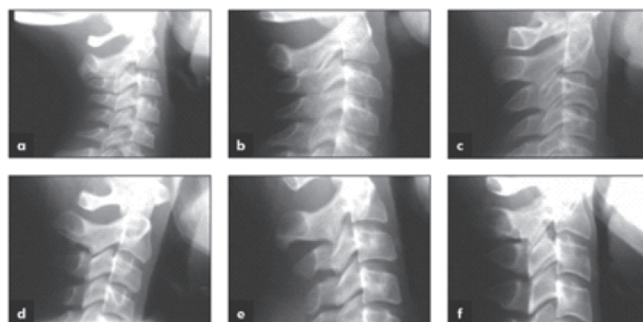


Fig 1-b: Radiographic representation of Vertebral bodies with respective descriptions of each maturation stage of cervical vertebrae according to the Hassel and Farman Classification (1995). a – Initiation; b – Acceleration; c – Transition; d-Deceleration; e – Maturation; f – Finalization

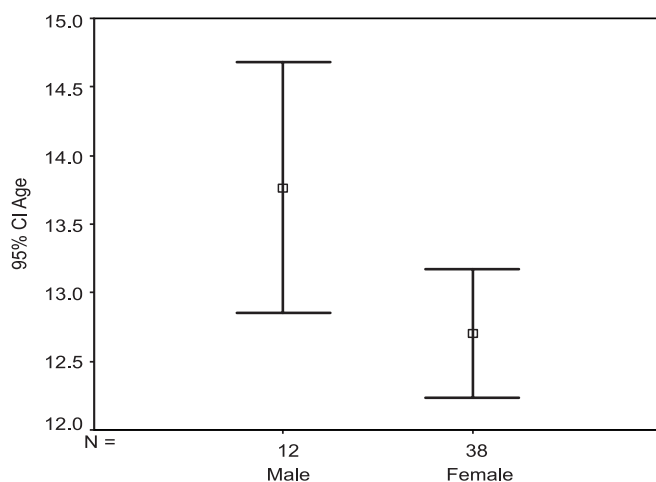


Fig 2: Mean Age according to gender by stage CVMS 3 (n=50)

and 53.2% were in post pubertal stage which was beyond the CVMS III. Out of 205 subjects, 50 patients were in CVMS III which showed the peak pubertal spurt. The mean chronological age at CVMS III in males was $13.7 \pm (1.4)$ and in females was $12.7 \pm (1.4)$ years. The number and percentage of girls with peak pubertal

spurt, between the age groups of 9.1-12 was 11 (28.9%), 12.1-15 was 27 (71.1%) and > 15 (0%) respectively, total number and percentage being 38 (26%). The number and percentage of boys with peak pubertal growth spurt between the age group of 9.1-12 was 1 (8.3%), 12.1-15 was 9 (75%), > 15 was 2 (16.7%) respectively, total number and percentage being 12 (20.3%).

DISCUSSION

Cervical Vertebral Maturation method (CVM) of skeletal maturity measurement was sensitive and precise in evaluating the maturity changes in this period. The wide range of the subjects might affect sensitivity of result because of inability of skeletal maturity method to detect changes in skeletal maturity precisely when the subjects are either too young or too old. The special point about this study is that it is narrowed to the 'circum pubertal period'. The sensitivity of the CVM away from circum pubertal period is low. To ensure that the subjects were in or close to the circum pubertal period, different age ranges for the sexes were selected for this study. This is because of the difference in the onset of the circum pubertal periods between boys and girls.

The CVM method can be used to determine the optimal treatment time for various orthodontic procedures. The CVM method has an advantage for the assessment of the stages of mandibular growth because they can be determined on the lateral cephalometric radiograph that is regularly taken for orthodontic treatment.⁸

As stated, treatment for a retrognathic mandible with dentofacial orthopedic appliances was more effective when included in the peak.⁶ when the CVM of a patient is CVS3, it is an optimal time for growth modification, and maximum growth response to treatment can be expected. If the CVM is CVS4 or above, growth modification can still be performed, but the growth response might be less. If the CVM is CVS2 or below, the patient should be reviewed at 3-month intervals, and standing height should be recorded to determine the pubertal growth spurt. The growth modification treatment should be started around the peak of the growth spurt.

In case of maxillary transverse deficiencies, maxillary expansion has a greater effect at pre pubertal stages. In patients treated before the pubertal peak, there are significant and more effective long-term changes at the skeletal level.¹¹

As stated, in maxillary protraction treatment for maxillary deficiency, the findings showed that orthopedic treatment of Class III malocclusion was more effective when it began at an early developmental phase of the dentition (CVS1-CVS3). In the correction of vertical problems of the face caused by deficiency of the mandibular ramus, height can be controlled with

orthopedic treatment at the peak in mandibular growth (CVS3).¹²

Hunter¹³ found that girls were ahead by an average of 2.4 years in their chronological age than boys in the onset of Puberty, with a mean value of 12.8 years for boys and 10.4 years for girls. While our results showed that subjects who were in CVMS III were in chronological ages 13.7 years for boys and 12.7 years for girls with a mean difference of one year. This shows that Pakistani subjects are behind in attaining skeletal maturity stages.

BS, Ahmed J, Shenoy N, Ongole R determined the average chronological age of males and females which was 11.81 and 11.9 years respectively, they compared it to the average skeletal age of the same subjects determined by CVM. In males it was 11.94 years and females 12.4 years.¹⁴

CVM gives the orthodontist needed information for the timing of various treatment procedures other than growth modification therapy and for obtaining a more objective diagnosis and treatment plan. Thus, treatment will be more optimally timed, and a better result can be expected.

CONCLUSION

Maximum numbers of subjects in peak pubertal growth were in chronological age group between 12.1-15 years. Mean chronological age in male subjects was $13.7 \pm (1.4)$ years, a year ahead of the female subjects which was $12.7 \pm (1.4)$. In male subjects 16.7% attained puberty at the age above 15 years whereas in females there were no patients in this category, therefore showing a difference of one year in both achieving pubertal spurt.

CVM method therefore can be used as an alternate method determining the skeletal maturity in the circumpubertal period. CVMS III stage in CVM is around the peak of the growth spurt, when growth modification treatment by dentofacial orthopedic appliances can start.

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