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ORIGINAL RESEARCH

Correlation between Cervical Vertebrae Maturation and Chronological Age: A Radiographic Study

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ABSTRACT

Aim: The aim of the study is to find out the radiographic correlation between cervical vertebrae maturation (CVM) and chronological age.

Materials and methods: A total of 67 patients, 35 boys and 32 girls, who required orthodontic and orthopedic treatment were selected for the study after considering inclusion and exclusion criteria. Cervical vertebrae as seen in lateral cephalogram were assessed using the criteria as proposed by Lambarki modified by Hassel and Farman.

Results: Statistical analysis using analysis of variance (ANOVA) test (Fisher's F-test) showed that for males, F = 13.539 and p = 0.000 and for females, F = 22.159 and p = 0.000. This indicates that the correlation is very highly significant in both sexes.

Conclusion: The chronological age could be predicted reliably assessing the CVM index. The skeletal maturity is achieved faster in females compared with males.

Clinical significance: This method finds its application where growth modification treatment is indicated. The results have great value in forensic odontology.

Keywords: Cervical vertebrae, Chronological age, Skeletal age.

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INTRODUCTION

Dental, skeletal, sexual, and chronological ages are important while planning pedodontic and orthodontic diagnosis and treatment planning. Different studies have shown different correlation of these ages with each other.[1-6] Skeletal age is used for treatment planning of orthodontic and orthopedic cases in dentistry. It also has its application in forensic odontology.[7,8] Different studies have shown different correlation between skeletal and chronological ages. One of the methods of assessing skeletal age is by CVM.[9-12] This study aims at assessing the correlation of skeletal maturity using cervical vertebrae with chronological age. This study could find its application in age estimation in forensic odontology.

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MATERIALS AND METHODS

A total of 67 patients, 35 boys and 32 girls, who required orthodontic and orthopedic treatment appeared in the Department of Pedodontics were selected for the study. Inclusion criteria were healthy children between the ages 8 and 16 years 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.

Lateral cephalogram of the patient was taken with film of size 8 × 10" (Kodak X-Omat China) positioned vertically in a cassette holding device. Radiograph was taken using an extraoral radiograph machine (Planmeca Proline PM 2002cc, Finland) with exposure parameters 72 KVp, 10 mA, and exposure time of 1.2 seconds. Only radiographs of the high clarity and good contrast were taken up for the study.

Cervical vertebrae were assessed using the method proposed by Lamparski[11] and modified by Hassel and Farman[12] (Figs 1 to 3). Two pediatric dentists separately

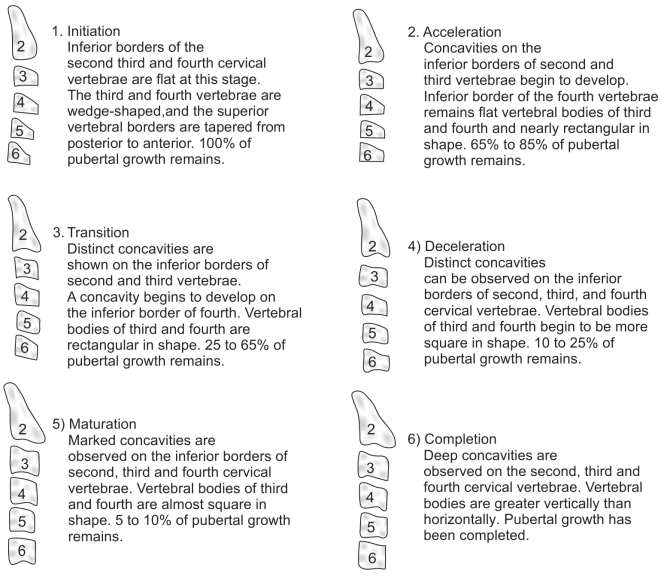
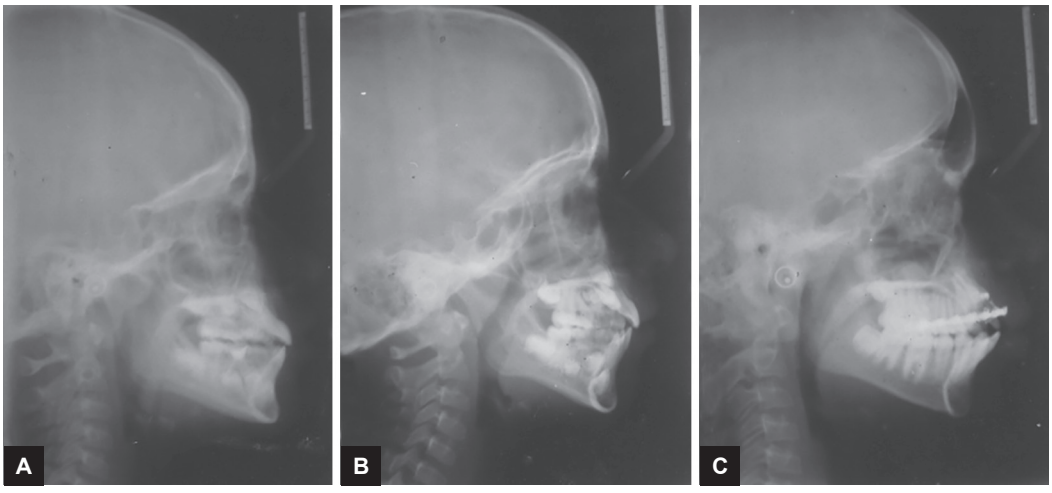
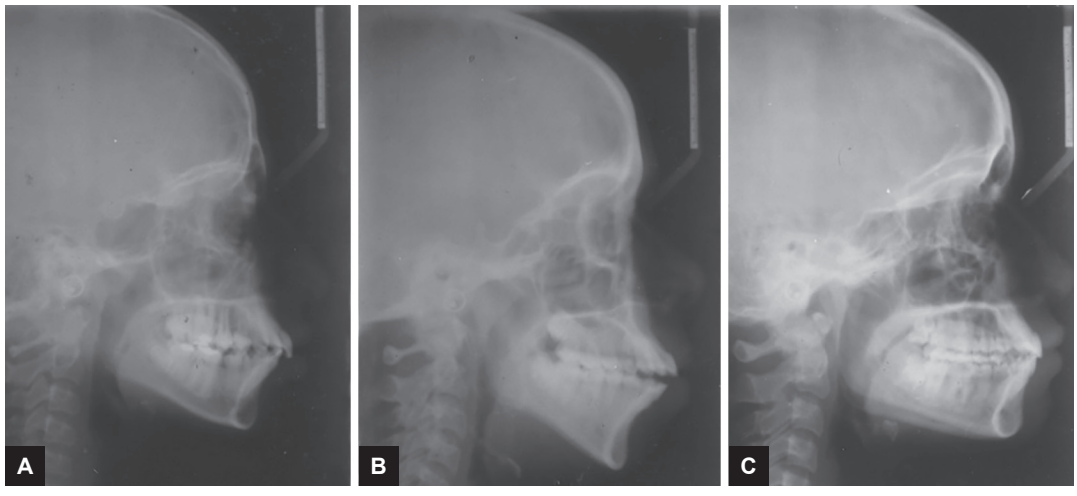


Fig. 1: CVMI stages (proposed by Lamparski modified by Hassel and Farman)



Figs 2A to C: (A) CVMI 1; (B) CVMI 2; and (C) CVMI 3



Figs 3A to C: (A) CVMI 4; (B) CVMI 5; and (C) CVMI 6

assessed the CVM indicator (CVMI) stages and their average was taken up for the study. Chronological age was assessed from questionnaire obtained from the parents.

RESULTS

Table 1 gives the age-wise distribution of the study participants among males and females. Table 2 gives age-wise distribution of CVMI stages in males and Table 3 gives distribution in females. Table 4 shows correlation between CVMI stages and chronological age in males and females.

Statistical analysis using ANOVA test (Fisher's "F"-test) showed that for males F = 13.539 and p = 0.000 and for females F = 22.159 and p =0.000. This indicates that the correlation is very highly significant in both sexes.

Interexaminer error was calculated with Kruskal–Wallis test and intraexaminer error with Wilcoxon's signed-rank sum test. Both inter- and intraexaminer errors were statistically not significant.

Table 1: Age-wise distribution of study participants

Age (years)	*Males*	*Females*
8	–	–
9	–	5
10	10	6
11	2	8
12	5	4
13	7	3
14	9	3
15	–	3
16	2	–

DISCUSSION

Among different types of age assessments,[1] skeletal age is the most relevant in orthodontic diagnosis and treatment planning. 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

Table 2: Age-wise distribution of CVMI in males

	8 years	9 years	10 years	11 years	12 years	13 years	14 years	15 years	16 years
CVMI 1	–	–	6	–	1	–	–	–	–
CVMI 2	–	–	4	2	4	5	3	–	–
CVMI 3	–	–	–	–	–	2	1	–	–
CVMI 4	–	–	–	–	–	–	3	–	–
CVMI 5	–	–	–	–	–	–	2	–	–
CVMI 6	–	–	–	–	–	–	–	–	2

Table 3: Age-wise distribution of CVMI in females

	8 years	9 years	10 years	11 years	12 years	13 years	14 years	15 years	16 years
CVMI 1	–	2	2	–	–	–	–	–	–
CVMI 2	–	3	3	3	2	–	–	–	–
CVMI 3	–	–	1	5	–	–	–	–	–
CVMI 4	–	–	–	–	2	–	–	–	–
CVMI 5	–	–	–	–	–	3	2	3	–
CVMI 6	–	–	–	–	–	–	–	–	–

Table 4: Correlation between CVMI stages and chronological age

	Males	Females
	Mean ± SD	Mean ± SD
CVMI 1	10.29 ± 0.76	9.50 ± 0.58
CVMI 2	12.06 ± 1.43	10.36 ± 1.12
CVMI 3	13.33 ± 0.58	11.83 ± 0.41
CVMI 4	14.00 ± 0.00	12.00 ± 0.00
CVMI 5	14.00 ± 0.00	14.00 ± 0.93
CVMI 6	16.00 ± 0.00	14.00 ± 0.00

SD: Standard deviation

odontology. There could be racial and ethnic variation in this regard. Hence, this study was undertaken at Mangaluru, Karnataka, India, to have a record of correlation between skeletal age and chronological age.

Among the different skeletal maturity indicators, CVM is found to be very reliable.[10] A method proposed by Lamparski[11] and modified by Hassel and Farman[12] CVMI forms the gold standard in assessing cervical vertebrae. Another advantage is usually a lateral cephalogram is taken for an orthopedic diagnostic purpose. Hence, an additional radiograph as in the case of hand wrist radiograph is not required.

In this study, among females, it was found that the CVMI stages correlated with ages 9.50 to 14 compared with 10.29 to 16 in males. This indicates that there is an early maturation in females compared with males and some increment of growth may present even at 16 years in males, whereas in females, it is safe to conclude that no orthopedic treatment may be attempted after 14 years. This is in accordance with the previous studies.[13-15]

It is also important to know if this assessment is reliable and could be reproduced without errors. An intraexaminer and interexaminer error, which was not statistically significant, showed the reliability of this method.

Prediction of chronological age could be calculated for different areas and ethnic groups with this method. A larger sample size may be needed to arrive at a final conclusion.

CONCLUSION

The chronological age could be predicted reliably assessing the CVM index. The skeletal maturity is achieved faster in females compared with males. An orthopedic or myofunctional appliance therapy should be attempted at an earlier age in females compared with males.

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