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Original Research

A Comparative of Serum Calcium as Biological growth Indicator

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ABSTRACT

Aim: This study aims to determine the levels of serum calcium in different stages of puberty and to assess skeletal maturity in subjects. Purpose of this study is to evaluate the level of serum calcium increases during adolescence. **Materials and Methods:** One hundred twenty patients were selected for the study and were divided into three groups. These groups were of age 8 – 10 yrs, 11 – 12 yrs and 13 – 15 yrs. Blood investigation for serum calcium estimation was performed along with Hand–Wrist Radiograph, Lateral cephalogram, OPG. **Results:** Statistically significant differences ($p < 0.05$) were found between serum calcium, Dental calcification and skeletal age in the studied sample. Serum Calcium Level observed in Group A, Sub-Group III (13-15 years) was recorded higher than Group B. **Conclusion:** A statistically significant positive correlation was found between all the groups. It suggested that serum calcium is a biological marker in assessing and identifying growth status of an individual.

Key words: Growth pattern, orthodontics, serum calcium.

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INTRODUCTION

Adolescence is the transition period in life when an individual is no longer a child, but not yet an adult. It is a period in which an individual undergoes enormous physical and psychological changes[1]. In addition, the adolescent experiences changes in social expectations and perceptions. Physical growth and development are accompanied by sexual maturation, often leading to intimate relationships.[2] The individual's capacity for abstract and critical thought also develops, along with a sense of self-awareness when social expectations require emotional maturity. According to Todd[3] Growth and development reliable on one another and under the influence of morphogenetic pattern. Hence development = Growth +differentiation →maturation.

Skeletal maturation staging from the radiographic analysis is a widely used approach to predict the timing of pubertal growth, to estimate growth velocity, and to estimate the amount of growth remaining. Skeletal maturation is well identified and frequently used for measurement of biological maturity, which resolute by radiographic assessment of one or more areas in the body.[4] The standard method of evaluating skeletal maturity has been a hand wrist x-ray to compare the patient's hand-wrist bones with those in published atlases. In recent years, there has been renewed interest in the use of the maturation of the cervical vertebrae as an assessment of growth. This is because these bones are readily visible on the lateral cephalogram, an X-ray that is routinely used in orthodontic clinical practice. Recently the cervical vertebra maturation (CVM) method was

introduced for growth assessment; allocate skeletal age evaluation and diminish the need for additional radiographic exposure[5].

Calcium is the most abundant element in the human body. Bone is the primary reservoir in the body. About 99% of the calcium in the body is stored in the skeleton. The continual flux of bone mineral responds to cell-level control factors that maintain the serum calcium level at about 10mg/dl[6].

The aim of the study was carried out to assess whether serum calcium levels can be used as skeletal maturity indicator by comparing the mean levels of serum calcium with fish-man skeletal maturity indicator, cervical vertebrae maturity indicator lateral and dental calcification, to determine the "peak pubertal period".

MATERIALS AND METHODS

This study was conducted in our department. All the ethical committee clearance were obtained from the institutional ethical committee. An informed and written concent were obtained from from the patients involved in the study. A total of 120 patients were included in the study. They were divided into three groups according to the age 8 – 10 yrs, 11 -12 yrs, and 13 – 15 yrs. Subjects who were undergoing treatment for any systemic condition were excluded fro the study. Subjects who were suffering from any syndrome were also excluded from the study.

Investigations (or) intervention conducted on patients. The following radiographs were taken for this study: Hand – Wrist Radiograph, Cervical Vertebrae Radiograph and Ortho Pantomogram. Blood Samples for Histochemical assessment of serum Calcium levels. To compare & correlate the levels of Serum calcium to: Fishman's Skeletal Maturity Indicator, Hassel and Farman Skeletal Maturity Indicator, Schour and Massler's Dental Calcification Stages.

Digital lateral cephalograms, orthopantomograms and hand wrist radiographs were taken using Newton software by a single operator. The radiographs were evaluated by two postgraduate students of the department of orthodontics and dentofacial orthopaedics according to evaluate hand wrist radiograph, Fishman's Skeletal Maturity Indicator method was used. Hassel and Farman Skeletal Maturity Indicator method used for evaluating cervical vertebrae maturation status. To evaluate Dental Calcification Stages from orthopantomograms Schour and Massler's Dental Calcification method was used.

RESULTS

Our study stated that CVMI (Cervical Vertebrae Maturation Index), SMI (Fishman's Skeletal Maturation Index) and DC (Dental Calcification) showed a positive correlation among the serum calcium levels within different age groups with the maximum for group A. The above three also showed a positive correlation among the age groups with a positive correlation for group B. There were statistically significant differences between serum calcium and skeletal age of the samples. The peak activity period of increased serum calcium was observed first in female in the group B when compared to the males in group A. In boys, Serum Calcium Level continued to rise until puberty after which it remained stable until old age in which it declined.

Table 1: Correlation between CVMI, SMI, DC and serum calcium in boys (among all specified boys).

Correlations[a]					
		CVMI stage	SMI stage	dental calcification	serum calcium mg/dl
CVMI stage	Pearson Correlation	1	.872**	.793**	.536**
	P VALUE		.000	.000	.000
	N	40	40	40	40
SMI stage	Pearson Correlation	.872**	1	.736**	.542**
	P VALUE	.000		.000	.000
	N	40	40	40	40
dental calcification	Pearson Correlation	.793**	.736**	1	.421**
	P VALUE	.000	.000		.001
	N	40	40	40	40
serum calcium mg/dl	Pearson Correlation	.536**	.542**	.421**	1
	P VALUE	.000	.000	.001	
	N	40	40	40	40
**. Correlation is significant at the 0.01 level (2-tailed).					

DISCUSSION

In the present times, a lot of stress have been given to interventional orthodontics. A lot of pressure has been given to growth modification. All the details of the patient's growth potential have become compulsory. All the clinical decisions in relation to force applied and treatment plan is completely based on the speculation of the growth[7]. Therefore, the accurate prediction of precise growth pattern in craniofacial complex is very necessary and useful of a quality treatment.

The growth pattern and facial development is very similar to common skeletal growth[8]. Maximum pubertal growth of craniofacial structures occurs between 6 to 8 months. In orthodontics it is of immense importance to measure physical development by providing the ratings of skeletal growth. Many previous studies stated a close relationship between the ages at which peak growth velocities occur in stature and facial dimensions & attainment of ossification events in the skeleton of the hand and wrist and the cervical vertebrae maturation index[9]. This is very important in diagnosis and planning the exact treatment plan. It is also necessary to estimate whether growth is accelerating or decelerating.

The amount, rate, and activity of the released biomarkersreflect the activity of individual cells and also indicate the activity in the involved tissues or organs[10]. Potential biological markers can be collected from different tissue samples, and suitable sampling is important to reflect biological processes accurately. Several possible biomarkers representing these biological changes during specific phenomenon, that is, bone remodeling (formation and resorption), inflammation, and root resorption have also been proposed[11]. A biomarker can be used as an indicator of normal biologic processes, pathogenic processes, or pharmacologic responses to a therapeutic intervention[12].

Orthodontic tooth movement is strongly influenced by a factor such as physical activity, age, diatery intake and genetics as well as mediators including growth factors, cytokines, hormones and calcium availability[13].So this study was undertaken to investigate the relationship among SMI, CVMI, and chronologic age and serum calcium levels among school children. This study is intended to investigate the role of serum calcium in assessing skeletal age.

Schour in 1942[14] studied the development of deciduous and permanent teeth, describing 21 chronological steps from 4 months to 21 years of age and published the numerical development charts for them.Roman et al[15] indicated that the Hassel and Farman classification could be used to estimate the maturation stage in both sexes, whereas the Lamparski classification is not sufficiently accurate in males and can be used only in females. The Hassel and Farman classification includes a more detailed description of every stage and uses a limited number of vertebral bodies to perform the staging. In our study, for these reasons, Hassel and Framan's method was used instead of the classification of Lamparski.

Mineral equilibrium is maintained by the the process of calcium homeostasis. Minimum concentration of calcim levels should me maintained at 10 mg/dl to carry out the minimum function by our human body. A failure in this may leave patient with inadequate bone mass for Orthodontics and Orthognathic surgery[16].

In this present study we concluded that the peak activity period of serum calcium levels was highest among the 13-15 age group of boys and for girls 11-12years. This study is in relation to Donald et al in which the mean age of peak calcium level was 14 yrs for boys and 12.5 years for girls.In another report by Burritt MF, it has been reported that boys showed significantly higher serum calcium level than girls.

The pre-pubertal, pubertal and post-pubertal serum calcium level in both sexes suggest that serum calcium can be a marker for growth identification. Also, the correlation between chronological age, CVMI, SMI and DC and serum calcium level were found to be statistically significant which suggest that serum calcium can be bio-marker for identifying growth status in adjunct to other maturity indicators. This normative data also helps in identifying the "peak activity period" for boys 13-15 years of age and for girls 11-12 years of age to commence orthodontic treatment. Prospective longitudinal studies with a greater number of samples are needed to confirm the usefulness of this technique to accurately determine the timing and intensity of a patient's growth spurt.

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