Cortisol: A Biomarker in Assessing Skeletal Maturation during Circumpubertal Development

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ABSTRACT

Objective: To assess the Salivary Cortisol levels at different pubertal status and to correlate with cervical vertebrae maturation stages to use Salivary Cortisol as a biological indicator for skeletal maturation. Materials and Methods: The study was conducted on 27 girls who were categorized into 3 groups based on their Cervical vertebrae maturation. Mean Salivary Cortisol was estimated using Electrochemiluminescence (ECL) Immunoassay. Results: Mean salivary Cortisol levels were higher in the post pubertal group compared to the prepubertal and pubertal groups. Pearson correlation showed a positive correlation between Pre pubertal and Post pubertal groups. Conclusion: Peak Salivary Cortisol levels correlated with the pubertal Group. Hence, Salivary Cortisol can be used to predict peak growth velocity.

KEYWORDS: Cortisol, Biomarker, Circumpubertal Development

INTRODUCTION

In clinical orthodontics, an understanding of growth events plays an important role. Estimating the amount of growth and the maturational status will be of help for the orthodontist in taking clinical decisions depending upon the pubertal status of a child, the Orthodontist will be able to formulate ideal treatment goals, treatment planning and eventual outcome of the orthodontic treatment. Some of the mixed dentition treatment philosophies like orthodontic treatment, functional appliance philosophy, extraction and nonextraction treatment planning will always be based on the maturational/Pubertal status of the child. Hence, predicting both the time and amount of active growth of craniofacial complex would be useful to the orthodontist’s selection of the appropriate appliance for the child.

The pubertal status of the patient and subsequent evaluation of growth spurt during the preadolescence and adolescence is important. There is a strong correlation between craniofacial growth and somatic changes in puberty as stated by Nanda. The radiographic methods for assessing skeletal maturity are hand wrist radiographs, cervical vertebrae maturation, dental eruption; dental calcification stages and frontal sinus enlargement. These methods are highly subjective techniques involving radiation exposure. In the recent past, a lot of emphases has been given on biochemical methods for detection of skeletal maturity. Some of them are Serum Alkaline phosphates (Himes et al 1993), Alkaline phosphates in gingival crevicular fluid (Perinetti et al 2012), Serum Insulin-like growth factor-1 (Gupta et al 2012), DHEAS (Premkumar 2012) and Serum PTHrP (Hussain et al 2013) have been used to explore their role in assessing the skeletal maturation of an individual.

One of the Hormones which plays a significant role in the growth is Glucocorticoid. It was observed that chronic administration of Glucocorticoid in vivo inhibits GH secretion and in turn hampers the growth (Malera M et al 2005). Cortisol is the principal Glucocorticoid, which is produced and secreted by the adrenal cortex and is regulated by hypothalamic pituitary-adrenal (HPA) axis. Cortisol circulates in the plasma mostly in bound form. It binds to globulin or albumin. Trace amounts of Cortisol are found in saliva due to its properties of low molecular weight and lipophilic nature. Clemens Kirschbaum has described in detail the passive diffusion property of Cortisol. The present study was conducted to evaluate the level of Cortisol in saliva and its role as a biomarker in assessing skeletal maturation during circumpubertal development growth.

MATERIALS AND METHODS

The study was conducted in the Department of Orthodontics and Dentofacial Orthopedics, GITAM Dental College and Hospital, Vishakhapatnam, Andhra Pradesh, India. A total of 27 female patients of age 9 -16 years were selected and they were categorized into 3 groups based on their maturational status according to the CVM stages given by Mc Namara, Franchii, and Baccetti (2005) (Table 1):
Post Hoc Bonferroni analysis showed that there was a statistical significant value when Group I was compared to either of Group II or Group III, but there was a statistical insignificant difference between the Salivary Cortisol levels for Group II and Group III.

### DISCUSSION

This study was attempted to establish a relationship between different pubertal stages and the mean Salivary Cortisol levels during the circumpubertal growth spurt. This method would enable the Orthodontist to use Salivary Cortisol as a biomarker to assess patient’s skeletal maturity.

One of the hormones which influence growth is the Growth Hormone. An in-vitro study conducted by D. Swolin-Eide. It was shown that Cortisol has the capability to modulate the Growth hormone action at the cellular level, by GH-receptor expression in hOB-like cells. In an another in-vitro study done by Senaris RM et al it was shown that Cortisol boosts GH synthesis and release in vitro by activating on GH gene transcription and upregulating GH-releasing hormone (GHRH) receptor expression. In an invivo study conducted by Martinelli CE Jr and Moreira AC they assessed the relationship between the Growth Hormone and Cortisol secretion in children. Their results showed that there was a positive relationship. Hence, we conclude by these studies that Growth hormone and Glucocorticoid hormones are interrelated.

In the present study, Cortisol hormone was analyzed to establish a relationship between the pubertal status of the individual and the hormone levels. In the recent years, it...
was proved that the salivary Cortisol is directly correlated with plasma free Cortisol and this plasma free Cortisol is the biologically active form of the hormone.16

The results of the present study showed that the salivary Cortisol levels are less in the Prepubertal group (Group I) when compared with the Pubertal (Group II) and Post pubertal groups (Group III). The results of the present study are in accordance with the study conducted by Linder B.L et al18, Gandia A et al19, Sarah L. Tsai 20, Kiess W21. There was a sudden increase in the salivary Cortisol level in the pubertal group. The probable reason for the sudden increase may be due to the increase in the growth hormone release in the pubertal spurt and the high activity of the adrenal glands. The Salivary Cortisol levels in the Post pubertal group increased gradually in comparison to other two groups.

**CONCLUSION**

The individual skeletal maturation stages identification is crucial to the success of functional and orthopedic treatment. Radiographic methods are used conventionally for the identification of pubertal growth status of the individual. Their main drawback was the radiation exposure. Hence, to overcome this noninvasive procedure was used in the study. The results of the study show that the Salivary Cortisol levels are increased in the pubertal group. The validity of using salivary Cortisol as a biomarker for assessing the pubertal status need to be confirmed by longitudinal studies with larger sample size.

**REFERENCES**


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