

# Stress responses in children during endodontic treatment

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## ABSTRACT

Pediatric dentistry has been associated with lots of fear and anxiety shown by children toward dental personnel and to dental procedures. Therefore, the stress factor is high in children visiting dentists, and this stress may increase or decrease in the subsequent visits that follow dependent on to what they are exposed to during these visits, especially treatments like pulp therapies. This study was designed to evaluate the salivary cortisol levels in children undergoing endodontic treatment. The salivary cortisol levels were investigated in 60 children who were divided into two groups: one study group and one control group. Pulp therapies were performed on the study group in four scheduled appointments. The control group was not subjected to any procedure. Saliva samples were collected from both the groups. Salivary cortisol levels were evaluated using the Salivary Cortisol Enzyme Immunoassay Kit. The results indicated that the salivary cortisol levels increased in the study group when compared with the children in the control group ( $P < 0.001$ ). The study concludes that the salivary cortisol levels increased in children who were subjected to endodontic treatment when compared with the children who were not subjected to any such procedures.

**Key words:** Dental Anxiety, Stress, Salivary Cortisol Levels

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## INTRODUCTION

Pediatric dentistry has been associated with lots of fear and anxiety shown by children toward dental personnel and to dental procedures.<sup>[1,2]</sup> Therefore, the stress factor is high in children visiting dentists, and this stress may increase or decrease in the subsequent visits that follow dependent on to what they are exposed to during these visits. The techniques used until now to evaluate stress include questionnaires and pictorial scales.<sup>[3]</sup> Also, evaluation of pulse rate and body temperature has been used, but none of these have been conclusive.<sup>[3,4]</sup>

The ability to react to a stressful situation in each human being is different and depends on the individual's personality. In humans, the biochemical response to stress begins with the activation of the hypothalamus–pituitary–adrenal (HPA) system. This system first activates the

release of steroid hormones – glucocorticoids, including cortisol, the primary stress hormone in humans.<sup>[5]</sup> The HPA system then releases a set of neurotransmitters known as catecholamines, which include dopamine, norepinephrine and epinephrine or adrenaline. Catecholamines trigger an emotional response of fear and suppress activity in parts of the brain, allowing a human to react quickly to stressful situations. As the stressful phase passes, the cortisol levels reach back to normal due to the inhibitory feedback mechanisms.<sup>[5]</sup>

In a review of the literature available, we found a definite paucity of studies relating salivary cortisol levels in children during their visits to pediatric dentists for various dental procedures, especially endodontic treatment. Hence, this study was designed to evaluate the salivary cortisol levels in children during their visits to the pediatric dentists for endodontic treatment.

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## MATERIALS AND METHODS

The children included in the study group were subjected to pulp therapies and the children in the control group were not subjected to any treatment right now. The children who belonged to the control group were also to undergo endodontic treatment, but their endodontic therapies would be carried out on a later date after the study group. Informed consent from the parents and all the selected children of both the groups were taken. Patients who were physically and medically compromised and who had arrested carious lesions were excluded. Children who were also on medications, especially corticosteroids, were excluded from the study. The study was conducted after obtaining approval from the ethical clearance council of the university.

Sixty children aged 5-9 years ( $6.85 \pm 1.31$  years), who reported to the Department of Pediatric and Preventive Dentistry of our institute, were included in the study. These children were divided into two groups of 30 each comprising the study and control groups. All children of both the study group and the control group were indicated for pulp therapies as per the criteria mentioned below. The study group had 18 males and 12 females, all between the ages of 5 and 9 years ( $6.86 \pm 1.36$  years) and the control group had 17 males and 13 females, all between the ages of 5 and 9 years ( $6.83 \pm 1.29$  years).

For all the children included in both the study and the control groups, the dental caries status as part of the diagnosis for endodontic treatment (Pulpectomy) was assessed using the World Health Organization (WHO) oral assessment form.<sup>[6]</sup> In addition to the WHO oral assessment form, teeth that were to be subjected to pulp therapies also followed the criteria given by Camp<sup>[7]</sup> and Milledge.<sup>[8]</sup>

### Methodology for endodontic treatment and saliva collection

All the children of the study group were treated in four appointments. In the first appointment, the children were explained about the procedure that they would be undergoing. In the second appointment, the access was opened and cleaning and shaping finished of the root canals. In the third appointment, calcium hydroxide with iodoform (Metapex<sup>®</sup> Meta Biomed Co. Ltd., South Korea) obturation was completed, following which a temporary or intermediate restoration was given and in the fourth appointment, a permanent restoration was provided. At the end of each of the above-mentioned four appointments, saliva was collected for evaluation of cortisol levels. At the same time, the saliva of the control group was also collected, although these children were not subjected to any treatment. All the steps involved in

the research, inclusive of endodontic therapies and saliva collection, were performed by the same researcher to avoid any bias.

For the collection of saliva, the child was seated in the coachman's position, head slightly down, and was asked not to swallow or move his tongue or lips during the period of collection. The children and their parents were advised to avoid any medications, especially those that could influence cortisol levels; they were also advised to maintain a normal diet and they were requested to brush their teeth after breakfast and before the saliva was collected. The saliva was allowed to accumulate in the mouth for 5 min and he or she was asked to drool the accumulated saliva into the receiving vessel.<sup>[9]</sup> Un-stimulated saliva (2 ml) was collected and frozen at  $-20^{\circ}\text{C}$  until evaluation.<sup>[9]</sup> All the saliva samples were collected at the same time (between 10 am and 11 am) on all appointments to rule out any bias owing to the diurnal variations. The salivary cortisol levels were evaluated using the Salivary Cortisol Enzyme Immunoassay Kit (Salimetrics<sup>™</sup> LLC, State College, PA, USA).

The data were subjected to statistical analysis using SPSS software version 16; tests used were primarily Student's *t* test.

## RESULTS

The children of the study and the control groups were compared for the cortisol levels of saliva as a whole. It was found that the study group generally had higher levels of cortisol than the control group. When the mean cortisol levels of saliva was compared, it was found that the children belonging to the study group had higher values and the results were found to be statistically very significant (Table 1,  $P < 0.001$ ).

When the whole population involved in the study and the control groups were divided into four groups based on the scheduled appointments, it was found that the study groups during the second and third appointments showed significantly higher levels of cortisol in saliva when compared with the control groups. The salivary cortisol levels did show differences even during the first and fourth appointments between the two groups, but these differences were not statistically significant (Table 2,  $P < 0.001$ , Figure 1).

## DISCUSSION

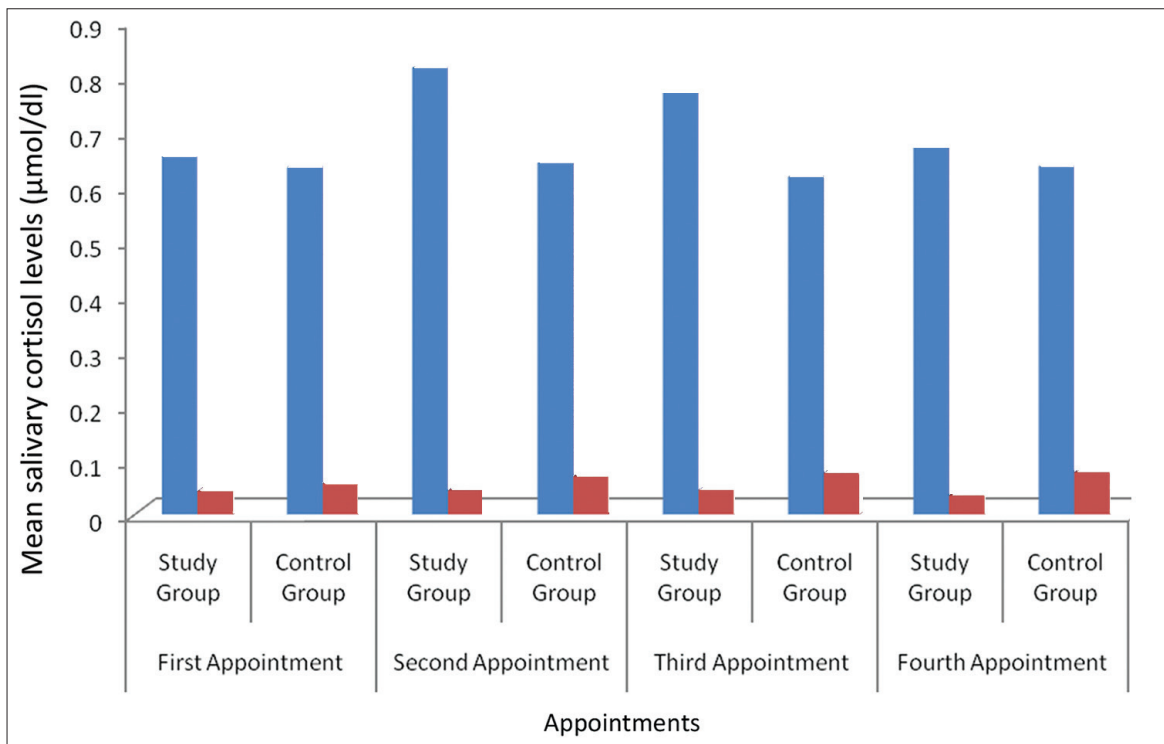
For a clinician, saliva means "whole saliva," which is the fluid present in the mouth, and comprises not only pure secretions from the major and minor salivary glands but

**Table 1: Comparison of mean scores of salivary cortisol levels among the study and control groups**

	Group	N (Total number of samples)	Mean salivary cortisol levels ( $\mu\text{mol/l}$ )	Std. deviation	Sig. P value
Salivary cortisol Levels ( $\mu\text{mol/l}$ )	Study	120	0.727	0.079	0.001
	Control	120	0.632	0.069	

**Table 2: Comparison of the mean salivary cortisol levels between the study and the control groups during the four scheduled appointments**

Appointments of the patients	Group	N samples	Mean	Std. deviation	P value
First appointment	Study group	30	0.653	0.0424	0.14
	Control group	30	0.634	0.055	
Second appointment	Study group	30	0.815	0.043	0.001
	Control group	30	0.642	0.068	
Third appointment	Study group	30	0.771	0.044	0.001
	Control group	30	0.616	0.075	
Fourth appointment	Study group	30	0.670	0.034	0.02
	Control group	30	0.635	0.077	



**Figure 1:** Graphical representation of mean salivary cortisol levels between the study and the control groups during the four scheduled appointments

also gingival exudates, microorganisms and their products, epithelial cells, food remnants and also, to some extent, nasal exudates.<sup>[10]</sup>

Cortisol is a potent stress hormone and the secretion is regulated by the HPA-axis. Cortisol is secreted in a specific diurnal pattern with a normal curve presenting a sharp peak in the early morning to then gradually decreasing over the day and ending up very low in the evening and at night. Except for the increased secretion in stressful situations, there are also smaller peaks during

the day when the body is exposed to exercise, food and tobacco.<sup>[11]</sup>

Dental anxiety has been associated with avoidance of dental care and affects not only general health in the form of sleep disturbance but also social interactions and work performance.<sup>[12,13]</sup> Dental treatments may cause pain and discomfort. Even the expectation of pain may increase dental anxiety thus maintaining the number of dentally anxious persons.<sup>[14]</sup> Dental anxiety and fear of

pain associated with dentistry are relatively stable over time, despite advances in dental equipment, procedures and preventive measures. Thus, dental anxiety is a confounding problem with which dentists especially have to cope up.<sup>[15,16]</sup>

When we compared the cortisol levels of saliva in children belonging to the study and the control groups, the results suggest an increase in the cortisol levels of saliva in children belonging to the study group as compared with the control groups.

This general difference in the salivary cortisol levels between the study and the control groups could be due to the reason that, definitely, the study group was exposed to dental therapies resulting in an increased level of stress in these children, which showed elevated levels of cortisol when compared with the control group who were not subjected to any procedure except for collection of saliva [Table 1].

When the salivary cortisol levels were evaluated during the four different appointments, it was found that the levels were increased profoundly during the second and third appointments when compared with the control group, and the results were statistically significant. The levels of the salivary cortisol did show an increase during the first and fourth appointment also when compared with the control group, but then the results were not statistically significant.

During the second and third appointments, the salivary cortisol levels showed a significant increase in the study group when compared with the control group. It was during the second appointment that the local anesthesia for a nerve block was administered, following which access was obtained for endodontic therapy and also the use of suction was performed. Another reason for the increased levels of salivary cortisol could be due to the sound of all the dental operator for a longer period of time and also the use of irrigants that could have resulted in the increased levels of anxiety, which in turn directly reflected on the levels of salivary cortisol. During the third appointment again there was a use of the dental operator and also use of calcium hydroxide with iodoform (Metapex® Meta Biomed Co. Ltd.) in a syringe formulation, which could also be a reason for the increased levels of anxiety and stress and hence increased salivary cortisol levels.

During the first and fourth appointments of the children, the procedures performed were not invasive when compared with the second and third appointments, which could be a vital reason for the presenting results. Although the salivary cortisol levels were increased in the

study group when compared with the control group, this increase was not statistically significant.

Although technology has advanced paramount in dentistry, yet, there are concerns that need to be addressed toward pediatric dentistry. We need to conduct more researches on bringing out a dental operator that is much more silent than the present ones so as to be less intimidating to the child, as was seen during our study. It was seen in this study that the administration of local anesthesia was much less intimidating when compared with the introduction of the air rotor handpieces and suction, which made more sound and vibrations when kept inside the oral cavity. The sound and appearance of parts of the dental operator is what makes it more stressful to the child than anything else. Therefore, studies and future research should focus on these aspects and also, more importantly, on the availability of the same economically.

## CONCLUSION

Salivary cortisol levels are increased in children when they were subjected to endodontic treatment as compared with the control group. It is therefore understood that the stress and anxiety that result from these procedures are definitely depicted in the salivary cortisol levels.

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