INTRODUCTION

Anxiety is a response to a supposed threat or danger from multiple systems. This involved a mixture of physiological changes in the body. Anxiety can occur without a reason, or it could be related to a specific occurrence that resulted in a reaction out to what would probably be expected1).

For many years the dental anxiety of the child has been a real barrier to dental procedures2). Dental anxiety may prevent patients from cooperating fully during treatment3), and its often caused by a sense of pain and discomfort that associated with the dental environment4).

Dentists must be able to assess anxiety in their patients as there is a significant relationship between dental anxiety and negative behavior5). The changes in endocrine are commonly used measures for identifying these patients1). Emotional stress increases the activity of the hypothalamus-pituitary-adrenal axis (HPA-axis) in various human studies, resulting in increased cortisol secretion6). Cortisol has been used as an indicator in stress studies, also called the stress hormone7).

Although the dental team has various approaches to support effective management of a dentally anxious child usually involved significant additional time, extra effort, and professional expertise, it has been recognized that behavioral therapy and psychological interventions can relieve the anxiety of the patient without the need for pharmacological assistance8,9).

Colors are commonly accepted to have a significant effect on both emotions and thoughts, this probably refers to children who may be extra color sensitive10). The application of colors that are child friendly in the dental attire and practice may build a positive dental atmosphere for children and could help to relieve dental stress and help to improve communication11). There's a gap in the base of information about how child-friendly colors can aid in a child’s comfort and minimize dental anxiety in pediatric dental practice. Thus, it was encouraging to establish a study to assess the effects of colors in the dental environment on the children’s anxiety to create a positive dental environment for children.

MATERIALS AND METHODS

Study design

This case controlled intervention clinical trial began after the approval of the ethical and scientific committee was obtained at the College of Dentistry/ University of Baghdad. The children were collected from four primary schools, aged 8-9 years, including boys and girls. Patients were randomly divided into 2 groups:

- Group A were treated in the conventional dental clinic.
- Group B were treated in the colorful dental clinic.

The anxiety was measured by using salivary cortisol level in the waiting room as a baseline, after local anesthesia, and after finishing dental procedure.

Results: In general, the children in group B showed less dental anxiety in the salivary cortisol level in comparison to the children in group A after local anesthesia and after the dental procedure.

Conclusion: The current study suggests that introducing pleasant colors to the clinical environment and the attire of the dentist would increase positive feelings and help decrease dental anxiety.

KEY WORDS

dental clinic, colors, salivary cortisol, dental anxiety.

ABSTRACT

Objective: Dental anxiety is a widespread problem that can occur at any age. The color of dental clinic affects children's behavior, and may contribute to a child's comfort and reduce dental anxiety. The purpose of this study was to evaluate the effect of a colorful dental environment on children's anxiety.

Materials and Methods: Eighty children between 8 and 9 years of age have been split into two groups: group A were treated in the conventional dental clinic and group B were treated in the colorful dental clinic. The dental procedure employed was restorative treatment for both groups. The anxiety was measured by using salivary cortisol level in the waiting room as a baseline, after local anesthesia, and after finishing dental procedure.

Results: In general, the children in group B showed less dental anxiety in the salivary cortisol level in comparison to the children in group A after local anesthesia and after the dental procedure.

Conclusion: The current study suggests that introducing pleasant colors to the clinical environment and the attire of the dentist would increase positive feelings and help decrease dental anxiety.

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groups, matched by age and gender, use a Microsoft excel program to create a random allocation list. The first group (group A) which was the control group, consisted of forty children, that was treated in the conventional dental clinic and the second group (group B) as the intervention group, consisted of forty children, that was treated in the colorful dental clinic.

Study measures

The dental anxiety was recorded at three stages: In the waiting room as a baseline, after local anesthetic injection, and then after finishing the treatment.

Saliva cortisol kits (Roche / Germany), were used for in vitro cortisol immunoassay for human saliva.

Materials used in colorful dental clinic

The Children's friendly colors blue, green, pink, yellow, purple, and orange have been used 12,13) (Figure 1).

1. A dental clinic with colorful sidewalls and the floor is distinguished by chromatic color combinations was standard for all patients.
2. Dental chair unit with child-friendly colored disposable dental chair cover.

Figure 1: The dental procedure in the colorful dental clinic with colored lab coat and in the conventional dental clinic with white coat.

Table 3: Comparisons of salivary cortisol level (μg/dl) between groups by time.

<table>
<thead>
<tr>
<th>Measure: Salivary cortisol level (μg/dl)</th>
<th>Groups</th>
<th>Statistics</th>
<th>In Waiting room</th>
<th>After local anesthesia</th>
<th>After finishing treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Groups</td>
<td></td>
<td>Minimum</td>
<td>0.080</td>
<td>0.070</td>
<td>0.050</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum</td>
<td>0.630</td>
<td>0.790</td>
<td>0.920</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>0.249 ± 0.142</td>
<td>0.359 ± 0.202</td>
<td>0.301 ± 0.165</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Minimum</td>
<td>0.110</td>
<td>0.050</td>
<td>0.050</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum</td>
<td>0.800</td>
<td>0.780</td>
<td>0.680</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mean ± SD</td>
<td>0.340 ± 0.212</td>
<td>0.328 ± 0.200</td>
<td>0.216 ± 0.126</td>
</tr>
</tbody>
</table>

Table 2: Comparisons of salivary cortisol level (μg/dl) among different times by groups.

<table>
<thead>
<tr>
<th>Measure: Salivary cortisol level (μg/dl)</th>
<th>Groups</th>
<th>(I) Time</th>
<th>(J) Time</th>
<th>Mean Difference (I-J)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Step</td>
<td></td>
<td>In the waiting room</td>
<td>After local anesthesia</td>
<td>After finishing treatment</td>
<td></td>
</tr>
<tr>
<td>A</td>
<td></td>
<td>In the waiting room</td>
<td>After local anesthesia</td>
<td>-0.110</td>
<td>0.000*</td>
</tr>
<tr>
<td>B</td>
<td></td>
<td>In the waiting room</td>
<td>After local anesthesia</td>
<td>0.012</td>
<td>0.691</td>
</tr>
</tbody>
</table>

Table 3: Comparisons of salivary cortisol level (μg/dl) between groups by time.

<table>
<thead>
<tr>
<th>Measure: Salivary cortisol level (μg/dl)</th>
<th>Groups</th>
<th>(I) Groups</th>
<th>(J) Groups</th>
<th>Mean Difference (I-J)</th>
<th>P Value</th>
<th>Effect Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the Waiting room</td>
<td>A</td>
<td>B</td>
<td>-0.090</td>
<td>4.998</td>
<td>0.028</td>
<td>0.060</td>
</tr>
<tr>
<td>After local anesthesia</td>
<td>A</td>
<td>B</td>
<td>0.031</td>
<td>0.481</td>
<td>0.490</td>
<td>0.006</td>
</tr>
<tr>
<td>After finishing treatment</td>
<td>A</td>
<td>B</td>
<td>0.085</td>
<td>6.661</td>
<td>0.012</td>
<td>0.079</td>
</tr>
</tbody>
</table>


The selection of colors in points 2, 3, and 4 was according to patients’ preferences.

Procedure

Parents were clarified on the methodology and objectives of the study, oral and signed permission was obtained for approval of their children's study participation. For at least thirty minutes before saliva collection, the participants were instructed not to either drink, eat, or clean their teeth14,15). The first Salivary samples were collected at the waiting room according to previous strategies16,17). All children in both groups were treated by a traditional dental procedure (Figure 1), after 10 minutes of local anesthesia, the second saliva samples were collected. The cavity was prepared in a conventional way. After 10 minutes of completion of dental procedure the third saliva samples were collected.

STATISTICAL ANALYSIS

Data analyzes were carried out using SPSS version 22. Descriptive Analysis for quantitative variables were expressed a minimum, maximum, mean and standard deviation (SD). As well as repeated Measure One Way ANOVA which is used to detect the differences between K related means of the quantitative variable with Bonferroni post hoc test.
The scores in Table 1 depict and evaluate the change in salivary cortisol level (μg/dl), in both groups. In group A: there were increased scores of salivary cortisol after local anesthesia and after finishing treatment to be higher than the baseline in the waiting room. While in group B: there were decreased scores of salivary cortisol after local anesthesia and after finishing treatment to be lower than the baseline in the waiting room.

The intra-comparison of salivary cortisol level among different times by groups is shown in Table 2. In group A: there was statistically highly significant difference between salivary cortisol level in the waiting room and after local anesthesia, whereas non-significant difference was found between the means in the waiting room and after finishing treatment. While, in group B: there was non-significant difference between the level of cortisol in the waiting room and after local anesthesia, and the highly significant difference between its level in the waiting room and after finishing treatment.

One way ANOVA statistical test was performed to evaluate the differences between groups, in the salivary cortisol level, as Table 3 displays. A significant intergroup difference was found in the waiting room, and after finishing treatment.

**DISCUSSION**

Dental procedures, especially the administration of local anesthesia, frequently cause anxiety and discomfort in children, and an increase in pain reactivity 18). Since colors are important in children’s lives 19) consequently, one of the purposes of this research was to assess the efficacy of diversion using colors on anxiety levels of children undergoing dental procedures.

Cortisol levels in both Saliva and serum are correlated to each other, and the collection of a salivary sample provides the simple and non-invasive method that does not cause pain or discomfort as blood sample collection 20). In this study, the findings showed elevation of the salivary cortisol levels in group A relative to the baseline in the waiting room. There are different stimuli such as; dental setting characteristics, dentist attire which can trigger dental anxiety, either individually or synchronously. It has been also noticed that dental procedures including local anesthetic injections had increased cortisol levels in saliva 21(22).

Comparatively, in group B, the level of salivary cortisol decreases, after local anesthesia and after completion of the dental procedure, so less dental anxiety. No previous research in the colorful dental clinic on child's anxiety is available however, this outcome could be explained through different possible reasons; creating a friendly dental environment through using colors to minimize children's anxiety and improve healthcare quality 23. Additionally, this can be interpreted by that the pediatric dental clinic should be designed to give children a feeling of relaxation and a space for respecting their choices. The children favored a painted dental environment rather than a plain clinic 21. Furthermore, the dental office can give a comfortable environment for children by using friendly color 23.

It is highly recommended according to the result of the current study, that reveal the significant effect of the application of colored dental clinic and reduced child’s dental anxiety, it is wise for both dentists and health institutions to apply the colored dental clinic in their practice which will give a positive and helpful feedback for both patients and health professionals. Moreover, the presence of children-friendly colors dentist attire has a positive effect on the children’s attitude and the quality of dental clinic service.

**CONCLUSION**

Adding attractive colors to the pediatric dental clinic and the incorporation of different colors in the dental clinic and dentist's attire can help to reduce dental anxiety.

**CONFLICT OF INTEREST**

This study does not have any conflicts of interests.

**REFERENCES**