Assessment of dental anxiety by physiological measurement (salivary cortisol) and psychological measurement (dental anxiety scale) in children

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Abstract

Dental anxiety is considered one of the most common sources of fear and anxiety that cause activation of adrenal gland to increase secretion of cortisol hormone. The aims of the present study are: measurement of the level of dental anxiety by physiological measurement (cortisol level in saliva) and psychological measurement (dental anxiety scale (DAS)); evaluation of the stress response during several stages of dental treatment; assessment of the effects of dental anxiety on the oral health status of the child; and evaluation of factors that could affect dental anxiety in the children.

The studied group included 85 children, aged between 9-13 years, 39 female, 46 male, selected from patients attended to the Dental Preventive Health Center in Al-Kadhimiya City, accompanied by the mother. Interviewing with each child's mother were conducted including a questionnaire about different variables affect dental anxiety, then another interviewing with each child including (DAS). Then saliva samples were collected from the children at the waiting room. All children received dental treatment according to their chief complaint, except 15 children, they received amalgam restoration under local anesthesia and saliva samples were collected from them during different stages of the treatment:


The control group included 30 children, from them saliva samples had been collected in their school away from dental fear.

A highly significant difference in the level of salivary cortisol was found between control and studied group and a significant correlation was observed between DAS scores and salivary cortisol level at the waiting room which indicates that both of these two methods are valid and can be used as a tool for the assessment of dental anxiety. Anesthetic injection was associated with a higher increase in the level of salivary cortisol. Patients reported high scores in DAS, have less filled, more decayed surfaces and more plaque accumulation than those who reported low scores in the scale.

It is found that anesthetic injection, and pain associated with dental treatment is the most common sources and reasons for dental anxiety, so the dentist must decrease or eliminate any procedure that provoke anxiety and fear because of its effect on later perception of the child to the dentistry in general.

Keywords: salivary cortisol, dental anxiety, children dental anxiety scale (DAS).

الخلاصة

الخوف من طب الأسنان يعتبر واحد من مصادر الخوف والتوتر الشائعة والتي تسبب تنشيط الغدة الكظرية لفرز هرمون الكورتيزول. الهدف من هذه الدراسة هو: قياس مستوى الخوف من طب الأسنان بواسطة المقياس الفسالي (مستوى الكورتيزول الساليفي) والمقياس النفسى (المقياس المدرج للخوف من طب الأسنان) (DAS) قياس الاستجابة للتوتر خلال عدة مراحل من العلاج في عيادة طب الأسنان، تدغي تأثيرات الخوف من طب الأسنان على حالة صحة الفم للطفل تقييم العوامل التي قد تؤثر على الخوف من طب الأسنان عند الأطفال.

العينة المدراسية تشمل 85 طفل تتراوح أعمارهم ب 9-13 سنة 46 ذكر، 39 أنثى. مختارة من مراجعين حاضرين عيادة طب الأسنان مصاحبين والداتهم. مقابلة مع ودة كل طفل جرب لجمع أجابات عن استجابة عائدة مختلفة المتغيرات المذكورة في الخوف من طب الأسنان، مقابلة أخرى جرب مع كل طفل متضمنة اسئلة تشمل (المقياس المدرج للخوف من طب
Introduction

Fear and anxiety continue to play a significant role in the dental practice. Patients with severe dental anxiety frequently delay or avoid not only restorative and periodontal care but also preventive services (Martin 1995). Recently, the behavioral sciences have become an increasingly important component of dental education and research, although this subject is not a major health problem, but considered of sufficient magnitude to cause interest among dentists (Kent et al. 1998).

The child's emotional and behavioral response to the dental treatment is a matter of serious concern to both practitioners and researchers. In addition to the effect on the quality of treatment provided, the reactions of young children will affect the perception and attitudes towards dental care which affect their later abilities to follow preventive routines and restorative care (Venham et al. 1980).

Certain situations in the dental clinic provoke fear and anxiety. These include: local anesthetic injection, anticipation of pain and drilling procedure. If the dentist is aware of the level of his patient anxiety and the components of the dental procedure most frightening to him, so he could take precautionary measures to deal with such a problem before it is exacerbated (kleinknecht et al.1973).

The quantification of dental anxiety is considered as a major problem encountered in studying this subject, because emotion is difficult to quantify. This quantification has been determined by many methods including, psych-logical measurements and physiological measurements. The psychological measurements include a wide range of methodological approaches like questionnaire, rating scale and behavioral measures. The most important and widely used tool of them are Corah's Dental Anxiety Scale (DAS) (Corah 1969), which is a four multiple-choice items dealing with the patients subjective reactions about going to the dentist, waiting in the dentist’s office and anticipation of drilling and scaling. Figure (1), the scores range from (4-20) with high scores indicating greater level of dental anxiety.

The physiological measurements are most appropriate and offer an objective method for the quantification of dental anxiety (Benjamin et al. 1992).

Stress caused by dental anxiety will induce the activation of hypothalamus-pituitary-adrenal axis, the main result being an increase secretion of cortisol, this hormone which is also called stress hormone, can be measured in serum, urine and saliva (Burtis et al. 1999). In the dental chair, saliva samples can be readily obtained in which the free cortisol serum level is well
reflected (Ferguson 1984), provided that contamination with blood is absent, the cortisol concentration in saliva may be an accurate indicator of the level of dental anxiety (Benjamins et al 1992).

Only a few studies have measured physiological stress induced by routine dental procedures (Dembo et al 1992), and this attempt did not employed previously in our country, therefore, the aims of the present study are: estimation of the level of dental anxiety by the measurement of cortisol level in saliva; correlate physiological (Salivary cortisol level) and psychological measurements (DAS) of dental anxiety; evaluation of the level of salivary cortisol changes in children during several stages of dental treatment; observation of the effect of dental anxiety on the oral health status of the child; and evaluation of factors that could affect dental anxiety in children.

**Materials and Methods**

**The sample**

The studied sample included 85 children, aged between 9-13 years, 39 females and 46 males, randomly selected from patients attended the Dental Preventive Health Center in Al-Kadhimiyah City. They should follow certain criteria: healthy, normally developed with no history of systemic disease, accompanied by the mother, with history of dental treatment at least once.

The control group included 30 children, 15 males and 15 females, aged 9-13 years, saliva samples have been collected from them at 9:30Am, at their schools, they were healthy, normally developed with no history of systemic diseases.

**The procedure**

The experimental procedure, are shown in (Figure 2). An interviewing has been carried out between the researcher and the child’s mother including consent form, and some questions about different variables that could affect dental anxiety in children. Another interviewing between the researcher and each child patient to complete four questions (DAS) (Corah 1969), (arabic translated) and two self-report questions concerning specific sources and reasons for being afraid from dentists.

Saliva samples were collected from each child at the waiting room, and clinical examination for the assessment of dental caries and oral health status of the children were carried out.

Then each child received dental treatment according to their chief complaint except 15 children, for them class I amalgam filling was performed and saliva samples were collected after: local anesthetic injection, cavity drilling, and after finishing the treatment.

**Saliva samples**

All the samples have been collected between 9Am and 11Am, because secretory rate of cortisol are high in the early morning but low in the late evening, so the measurements of cortisol levels are meaningful only when expressed in terms of the time at which the collection are made (Guyton et al 1996).

The children were instructed to rinse their mouth by tap-water before collection which is done by spitting in large glass test tubes. Whole mixed non-stimulated salivary samples (1-2ml) were collected from each child at the waiting room. Evidence of blood contamination was determined by visual inspection, samples containing trace amounts of blood were substituted by another clear one because of the likelihood of contamination with plasma cortisol (Miller et al 1995).

The saliva then transferred into small plastic tubes and stored at -20°C at least 1 month, thawing and centrifugation the samples in cooled centrifuge at 4°C lead to the precipitation of salivary glycoproteins leaving behind a pipettable clear fluid for the biochemical analysis (Burtis et al 1999).
Results

A moderately strong positive linear correlation was found between DAS scores and baseline salivary cortisol level at the waiting room (P<0.01) Figure (3).

The mean value of salivary cortisol level of the controls was 0.3 nmol/L while for the study group was 0.58 nmol/L. A highly significant increase in the values was observed (Figure 4).

The results of the changes of salivary cortisol levels between different stages of dental work are as follow:

A. After local anesthetic injection, the salivary cortisol values increase markedly after local anesthetic injection than its level at the waiting room, mean percent changes was 87.0%.

B. After drilling and removing the carious lesion under local anesthesia, there is a decrease in the level of salivary cortisol from the level observed after local anesthetic injection, mean percent change was 32.8%.

C. After filling, another increase was observed in salivary cortisol level after finishing the treatment, mean percent change was 86.3%.

A highly significant correlation was found between DAS scores and filled surfaces (P<0.01, r=-0.45) (Table 1).

A significant correlation was found between DAS scores and decayed teeth surfaces (P<0.05, r=-0.28) and plaque index (P<0.05, r=0.25). (Table 1).

The mean DAS scores for the uncooperative child during the last visits to dental clinic was 16.8 while for the cooperative child was 10.8, a highly significant correlation observed between the two variables (Table 2).

A significant correlation was found between DAS scores and fear from physician (Table 2). Pain associated with dental treatment found to be the most common reason of being afraid from dentists (Figure 5), while anesthetic injection was the most common sources of fear in the dental clinic (Figure 6).

Discussion

Dental anxiety considered one of the most common concerns for both dentists and patients. In the present study, the evaluation of dental anxiety has been done by psychological method DAS and physiological measurement (Salivary cortisol).

Corah's DAS (1969) is the widely accepted scale for estimation of dental anxiety, and has been previously established among children aged more than 9 years old ( Parkin 1989). In the present study α-reliability coefficient of the items included in the DAS is 0.72 which is near the perfect value, basically this value ranges from 0 which indicated for no reliability, to 1 which is considered as perfect reliability. A high coefficient indicates that the 4 questions selected for inclusion in the questionnaire (Figure 1) can be viewed as unbiased items.

The measurement of cortisol level in saliva was analyzed as a measure of the human stress response, which is performed in saliva for several reasons: it reflect the biologically active free fraction of the hormone in plasma, saliva can be collected easily in a stress free and noninvasive manner, and analysis does not require complex procedures ( Burtis et al1999).

Figure (3) reveals a moderately strong positive linear correlation (P<0.01) between DAS scores and salivary cortisol level at the waiting room.

A significant increase in the values of mean salivary cortisol level between controls and experimental group (P<0.001) were observed (Figure 4).

The explanation for these results, is that, Anticipation of pain during dental treatment while the patients still in the waiting room, will cause anxiety and stress, this is more apparent in highly dentally anxious patients as those patients are in a state of extreme stress while they are waiting for dental treatment. The high level of stress cause extreme increase in adrenal hyperactivity which lead to increase secretion of cortisol level ( Brand et al 1995). Measurement of salivary cortisol concentration allows determination of rapid changes in adrenocortical activity (Vining et al 1983). Therefore, the increase in salivary cortisol level is related to the level of
dental anxiety, this findings is agreed with Benjamins et al. (1992) and Kandemir et al. (1997) and disagreed with Brand (1999).

These findings provide additional support for the validity and usefulness of DAS as it is a tool for estimation of the level of dental anxiety perceived by the patients and it is well related to the level of stress measured by physiological analysis of cortisol level in saliva and indicated that both tools can be used as a method for the assessment of dental anxiety.

After dental injection, the salivary cortisol values increase markedly than its level at the waiting room (mean percent change is 87.0%). Psychological factors are of prime importance in the adrenocortical hyperactivity associated with intra oral injection, as the sight of the syringe and the sensation of anesthetic injection considered the most fear provoking subject in the dental clinic, this finding is agreed with Dembo et al. (1992).

A decrease in the level of salivary cortisol was observed after drilling and removing carious lesion, the mean percent change was 32.8%. In this study, cavity drilling was done under local anesthesia, so the procedure was painless which cause a decrease in the level of anxiety and stress of the patient (Akyuz et al. 1996). This result is in agreement with Kandemir et al. (1997) and disagreed with Akyuz et al. (1996) who perform the cavity drilling without local anesthesia.

Another increase in the level of salivary cortisol was observed at the end of the treatment, the mean percent changes was 86.3%. This result is agreed with several studies in which they concluded that significant cortisol increase are seen in post operative period, because of the stress response to post operative discomfort and the children still afraid of this experience (Miller et al 1995 and Kandemir et al 1997), this result disagreed with Akyuz et al. (1996) because of the differences in the methodology employed.

Other hypothesis we hoped to test in the present study was that children who are fearful of dental treatment may avoid seeking dental care, and this would result in lower levels of oral health status. Although there is no significant relation between total DMFS scores and DAS scores, a highly significant correlation observed between filled teeth surfaces and DAS scores and a significant correlation between the latter and decayed surfaces.

These results prove that fearful children obtain poorer dental care and avoid seeking dental treatment because of fear and anxiety, as well as the parents avoid attending with their children to perform appropriate treatment needed and prefer teeth to be extracted rather than restored, in addition to that, the dentist himself might avoid performing treatment for fearful children because of their uncooperative behavior, as a result, those children will have less filled and more decayed teeth surfaces, this findings is agreed with Bedi et al (1991), Poulton et al (1996) and Kruger et al (1997) and disagreed with Vignchsa et al. (1990).

The significant correlation observed between DAS scores and plaque index indicate that fearful children obtain poor preventive services and avoid even brushing their teeth which lead to more accumulation of debris. This result is in agreement with Doer et al. (1998).

A highly significant correlation was found between DAS scores and child behaviour during the last dental visit (Table 2), bad dental experiences will aid to increase in the level of dental anxiety, in other hand, anxious child usually behave uncooperatively because of his high level of fear, while cooperative children are found to have low level of anxiety.

A significant correlation found between DAS scores and fear from physician (Table 2), this is due to the similarity of the environment of both medical and dental field which is in agreement with Salih (1991). Pain associated with dental treatment is the most common reason for dental fear (Figure 5). This finding is agreed with Litt (1995) as he suggested that no area of health care is more associated with pain than is dentistry, while anesthetic injection was the most common sources of fear in the dental clinic (Figure 6), this fact agree with Salih (1997).
Conclusion:

- Both DAS and salivary cortisol level can be considered as valid measurement for estimation of dental anxiety.
- Dental work that cause extreme elevation in salivary cortisol is the anesthetic injection.
- Patients with high level of dental anxiety will have poorer oral hygiene than those with lower level of dental anxiety.
- A significant correlation was found between DAS scores and past dental experience and fear from physician.
- Pain associated with dental treatment is the most common reasons of dental fear, while anesthetic injection is the most common sources of fear as perceived by the children.

References


1. If you had to go to the dentist tomorrow, how would you feel about it?
   a. I would look forward to it as a reasonably enjoyable experience.
   b. I wouldn't care one way or the other.
   c. I would be a little uneasy about it.
   d. I would be afraid that it would be unpleasant painful.
   e. I would be very frightened of what the dentist might do.
2. When you are waiting in the dentist's office for your turn in the chair, how do you feel?
   a. Relaxed.
   b. A little uneasy.
   c. Tense.
   d. Anxious.
   e. So anxious that I sometimes break out in a sweat or almost feel physically sick.
3. When you are in the dentist's chair waiting while he gets his drill ready to begin working on your teeth, how do you feel, (Same alternatives as number 2.)
4. You are in the dentist's chair to have your teeth cleaned. While you are waiting and the dentist is getting out the instruments which he will use to scrape your teeth around the gums, how do you feel? (Same alternatives as number 2.)

Figure (1): Dental Anxiety Scale (DAS)
Clinical work

<table>
<thead>
<tr>
<th>Study group</th>
<th>85 child</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Preoperative questionnaire</td>
<td></td>
</tr>
<tr>
<td>- Saliva samples at the waiting room</td>
<td></td>
</tr>
<tr>
<td>- Clinical examination</td>
<td></td>
</tr>
</tbody>
</table>

Laboratory work

- Freezing
- Thawing
- Centrifugation
- Biochemical analysis

<table>
<thead>
<tr>
<th>Control group</th>
<th>30 child</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saliva sample collection at 9:30AM at their school</td>
<td></td>
</tr>
</tbody>
</table>

**Figure (2): Experimental procedure**

![Experimental procedure diagram](image-url)

**Figure (3): The linear correlation between DAS and baseline salivary cortisol level at the waiting room.**

![Linear correlation graph](image-url)
Figure (4): A comparism of the mean baseline salivary cortisol level (with its 95% confidence interval CI) between controls and studied group at the waiting room. (P<0.001): very highly significant.

(Figure 5): The relative frequency of reported reasons for being afraid from dentist.
(Figure 6): The relative frequency of reported source of fear in a dental clinic.

Table 1: Correlation between DAS scores and DMFS, PI, and GI of the children

<table>
<thead>
<tr>
<th>Spearman's correlation coefficient</th>
<th>Dental anxiety score(/20)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Decayed surfaces</td>
<td>.28*</td>
</tr>
<tr>
<td>Missed teeth</td>
<td>-.170</td>
</tr>
<tr>
<td>Filled surfaces</td>
<td>-.45**</td>
</tr>
<tr>
<td>Total DMFS score</td>
<td>-.030</td>
</tr>
<tr>
<td>Gingival index</td>
<td>.174</td>
</tr>
<tr>
<td>Plaque index</td>
<td>.25*</td>
</tr>
</tbody>
</table>

* Significant correlation at P<0.05
** Highly Significant correlation at P<0.01
Table 2: Relationship between DAS scores and child's behavior during the last visits to dental clinic and fear from physician

<table>
<thead>
<tr>
<th>Child's behavior during the last visits to dental clinic</th>
<th>Dental anxiety scores</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Min.</td>
<td>Max.</td>
</tr>
<tr>
<td>Uncooperative</td>
<td>12</td>
<td>20</td>
</tr>
<tr>
<td>Cooperative</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>P(t-test)&lt; 0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fear from physician</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Positive</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>P(t-test) =0.007</td>
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<td></td>
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</table>