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Evaluation of dental anxiety and hemodynamic changes (Sympatho-Adrenal Response) during various dental procedures using smartphone applications v/s traditional behaviour management techniques in pediatric patients

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Abstract

Aim and objective: The aim of the present study was to evaluate the influence of using smartphone applications to reduce dental anxiety and hemodynamic changes produced in pediatric patients aged 5-10 years.

Study design: A total of 60 patients (aged 5-10 years old) who were scheduled for elective dental treatment were included in this randomized controlled trial. Patients in Group I were not shown any smartphone application and conventional behavior management techniques were used while patients in Group II were shown Kid dentist and Monsters dentist smartphone applications. The physiological parameters to measure hemodynamic changes were noted using multipara (Shenzhen Mindray MEC-1200) in these patients of both the groups preoperatively and post operatively after modelling them with smartphone app.

Results: Both smartphone application and conventional behavioral technique showed reduction in all anxiety parameters, however, the reduction in anxiety parameters was almost double in smartphone application group as compared to conventional behavior management techniques

Conclusion: Smartphone application intervention reduced anxiety in pediatric patients in a better way as compared to conventional behavior modification techniques.

Keywords: Anxiety, Hemodynamic changes, Smartphone application, Distraction

Introduction

McElory (1895) has beautifully stated that "Although operative dentistry may be perfect, the appointment is a failure if a child departs in tears", it stresses the importance of behaviour management over technical excellence in pediatric dentistry. Fear and anxiety are often associated with child's first dental visit and have a negative impact on child's psychology making the dental appointment an unpleasant one [1].

Child dental anxiety has been a matter of concern for many years and can be defined as a nonspecific feeling of apprehension, worry, uneasiness or dread, the source of which may be vague or unknown [2]. Hence means of conquering this anxiety in a dental setting has been long sought after [3] and is essential to identify anxious children at the earliest age possible in order to institute a precocious behavioural treatment [1].

Sometimes a child may vocalize their fears and anxiety, while others manifest it in behaviour such as crying, agitation, and cessation of conversation or play and even attempting to escape from care providers. It may also be accompanied by significant physiological changes such as increase in heart rate, other hemodynamic changes and secretion of stress hormones [3].

The cornerstone of success in pediatric dentistry is behaviour management and the use of these of behaviour management techniques (BMTs) enable children to learn appropriate behaviour, coping skills, reduce anxiety, and facilitate the delivery of adequate oral health care. Owing to the limitless burden of expectations from parent, society and child there has been a constant evolution in application of behaviour management techniques in dental clinics [5].

It is an established fact that there is a strong relationship between a child’s dental anxiety and successful dental treatment. Monitoring this anxiety through various instruments like pulse oximeter and the multiparameter machine provides essential information on principle vital signs, providing fundamental control of blood pressure, heart rate, and oxygen saturation [4].

Dental anxiety and fear can be assessed and measured through various parameters which include physiological parameters (e.g., Pulse rate, basal skin response), psychological/psychometric parameters (e.g., Venham’s picture test, children fear survey schedule-dental subscale, dental anxiety scale), projective parameters (e.g., Children’s dental fear picture test), and behavioural parameters (e.g., Frankel scale) [1].

More recently, virtual reality immersion is a promising technique of distraction which obstructs the dental environment and allows the child to adapt to dental operatory and allows good communication of child and clinician [6].

Hence, this study was done with an aim to evaluate the effectiveness of smartphone applications (virtual distraction technique) in reducing dental anxiety among pediatric patients. The objective of this study was to compare smartphone application (virtual distraction technique) with conventional behavioural techniques in reducing dental anxiety and fear in pediatric patients.

Materials and method

This is a descriptive cross sectional double blinded study conducted in patients attending the dental OPD of Sri Aurobindo College of dentistry, Indore (India).

A sample of 60 patients in the age group of 5-10 years on their first dental visit, who were well oriented to time and place was selected from OPD of Department of Pedodontics by random and purposive sampling. Informed consent was obtained from the parents. Institutional ethical committee clearance was obtained.

The samples were equally divided into 2 groups of 30 patient’s each as follows:

Group I: Conventional behaviour modification group (control group)

Group II: Smartphone application group

Inclusion criteria: Patients visiting the dental clinic for the 1st time with problems of dental origin like pain, swelling, caries and unclean teeth were included in the study.

Exclusion criteria: - Patients suffering from any systemic diseases, psychiatric illness, any drug abuse, traumatic dental history and who did not give informed consent were excluded from the study.

Detailed medical and dental history was recorded. Evaluation and modulation of anxiety levels during the child’s first dental visit were done using Multiray-Multiparameter (Shenzhen Mindray Bio-Medical Electronics Co. LTD, China.) to measure anxiety and haemodynamic parameters. The hemodynamic and ventilatory changes were evaluated by monitoring systolic pressure (SP), diastolic pressure (DP), heart rate (HR), and oxygen saturation (SaO2) by a well-trained and calibrated investigator. Pulse oximetry and a blood pressure cuff (sphygmomanometer) were used to monitor the hemodynamic changes and these instruments were

calibrated before recording in every patient. The facial anxiety scale (Figure 2) was used to measure the anxiety of child by psychological parameters.

Kid dentist (developed by Epic Pixel LLC, version 1.00[1]; Android 2.2+) and Monsters Dentist (developed by Kids Games, version 1.0.2; android 2.2+) were the two smartphone applications used in virtual BMT. (Figure 1A and 1B)

In Group I i.e. the control group (figure 3), the behaviour modification was done using basic behaviour management techniques like tell-show-do, modelling, voice control etc. which are routinely practised in dental clinic. The patients were shown dental instruments and equipment’s like mouthmirror, probes, spoon excavators, 3 way syringe, suction tips, ultrasonic scalers, LA syringes with needles and airtors according to their treatment needs. They were allowed to touch the instruments and were explained about the procedure. Before starting the procedure haemodynamic and ventilatory parameters were recorded. The children were instructed to point the level of anxiety felt by them using the facial anxiety scale (figure 4). Then the procedure was done and after its completion again the haemodynamic and ventilator changes were recorded. The psychological anxiety of child was again evaluated using facial anxiety scale.

In Group II (smartphone application group) the behaviour modification of patients was done by showing them two smartphone application games and were allowed to play the games for 5-10 minutes (figure 5). The smartphone application games demonstrated the use of common dental equipment’s like airtor, ultrasonic scalers, suction tip etc. in form of an animated pictures with visual and sound effects, which were handled by children themselves to get 1st hand experience of their usage, sounds produced and clinical effects obtained. The child was able to be a doctor to treat other children through those games. The haemodynamic and ventilator parameters were noted at three steps, first preoperatively, second after showing them the smartphone application and lastly after operative procedure was done. The facial anxiety scale was used to measure psychological anxiety in all the three steps.



Fig 1: A) Kid dentist application B) Monsters dentist application

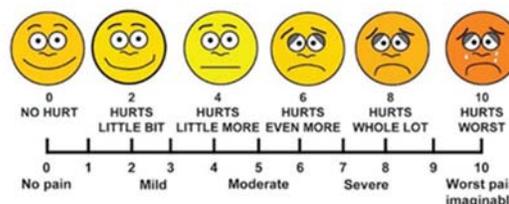


Fig 2: facial anxiety scale



Fig 3: Group 1: Conventional behaviour management technique



Fig 4: group 1: Patient demonstrating level of anxiety through facial anxiety scale



Fig 5: Group 2: Smartphone application group

Statistical analysis

The mean haemodynamic parameters and facial scores within the group were compared using Paired ‘t’ test and between the groups were compared using Unpaired ‘t’ test. A ‘p’ value of < 0.05 was taken as statistically significant. The statistical package MiniTab Version 17.0 was used for statistical analysis.

Results

60 patients were evaluated preoperatively for mean haemodynamic and facial anxiety parameters, and it was found to be statistically non-significant for both groups, depicting that the patients had equal anxiety levels for both the groups preoperatively.

Reduction in anxiety achieved through various hemodynamic parameters and facial anxiety score for control group are shown in Table 1. It shows that there is significant effect of conventional behaviour modification technique in reduction of anxiety in a child.

Table 1: Reduction achieved in various hemodynamic parameters for control group

	SP(mean mm of Hg)	DP(mean mm of Hg)	Heart Rate	Facial Scale
Pre – intervention	102.77	68.03	94.93	7.03
Post – intervention	99.73	65.67	89.9	5.4
Total reduction achieved	3-4 mm of Hg	3-4 mm of Hg	6-7 Beats	2-3

Reduction in anxiety achieved through various hemodynamic parameters and facial anxiety score for smartphone application group are shown in Table 2. Its

shows that the reduction in anxiety is highly significant statistically and indicates the effectiveness of smartphone application to reduce dental anxiety.

Table 2: Reduction in various hemodynamic parameters achieved in Smartphone application group

	SP(mean mm of Hg)	DP(mean mm of Hg)	Heart Rate	Facial Scale
Pre – intervention	102.97	66.73	95.9	6.87
Post – intervention	89.57	57.67	82.03	2.5
Total reduction achieved	12-13 mm Hg	8-9 mm Hg	13-14 Beats	3-4

Thus when post-operative comparison of haemodynamic parameters is done for both groups it shows that almost twofold reduction in all the parameters were noted

suggesting that smartphones are better when compared to conventional behaviour modification techniques. (Table 3)

Table 3: Difference in pre-operative and post-operative hemodynamic parameters for both groups

Total reduction in anxiety achieved	SP(mean mm of Hg)	DP(mean mm of Hg)	Heart Rate	Facial Scale
Group I	4	4	7	2.5
Group II	13	9	14	5.4

Discussion

Anxiety is a human reaction to any unknown situation and this preoperative anxiety produces far reaching effects like increased postoperative pain, poor behaviour outcomes for the child and increases the treatment challenges when treating a pediatric patient [7].

The pediatric patients with his/ her first visit to dentist are mostly found anxious and apprehensive because of dental equipment's and the newness of the experience [1]. The patients start anticipating the treatment to be performed with a previous mind-set of apprehension and pain which leads to corticoid release, blood pressure changes,

hemodynamic and cardiovascular changes. It is proved that these features directly depict the anxiety levels of the patient which were measured in our study using the multipara meter machine thus denoting the anxiety levels of patient. Studies relate hemodynamic, vascular and respiratory changes to anxiety in adults⁴ and it is proved that the average increase in both the systolic and the diastolic blood pressure was higher in children²¹ than in adults^[22].

In the present study preoperative anxiety readings and facial anxiety scores were recorded for both the groups and it was found to be non-significant, indicating that for both groups, the patients selected were of same anxiety levels, eliminating the selection bias.

Behaviour management techniques (BMT's) have been long sought as a solution for preoperative anxiety. Various behaviour management strategies have been proposed to manage anxiety and distress during dental treatment for children.

A variety of BMT's exist in routine pediatric practise however, distraction appears to be the safe and inexpensive. The application of distraction is based on the assumption that pain perception has a large psychological component in that the amount of attention directed to the noxious stimuli modulates the perceived pain^[8].

A variety of studies have been conducted and based on their results it was found that ideal distraction requires activation of child's various senses such as hearing, vision, touch and active involvement of child's emotion to counteract anxiety causing noxious stimuli^[8] A study by Seyrek *et al.* concluded video distraction as a better method when compared to audio distraction alone^[9].

In recent years there has been immense research in behavioural science pertaining to virtual reality (VR) and virtual world. This VR refers to human interaction with computer generated environment using sophisticated systems. This virtual reality drains the patient's attention from real world to virtual world, allowing the child in dental operatory to focus on virtual world^[8]. Sullivan *et al.* demonstrated that using virtual reality during dental significantly reduced the pulse of the patient^[10]. A significant reduction in the stress levels was achieved in the majority of studies using VR distraction^[11-13].

Mobile phones are ubiquitous in distribution all over the world being extremely versatile and function as personal computers, playing an important part in day to day life.¹⁸ Owing to the increasing spread of mobile technologies throughout the world, the World Health Organization (WHO) has coined a new term: mobile Health (mHealth), a component of eHealth, and is defined as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants (PDAs), and other wireless devices"^[19]. One recent review by (Fiordelli *et al.*, 2013) concluded that "the potential of smartphones does not seem to have been fully exploited yet" and shows the potential and scope of evolution of smartphones and its use in treatment of patients^[18]. India is the 3rd largest Smartphone market in the world^[25]. A study done on use of mobile phone showed penetration of mobile phone in India to be 68.6 % and rate of usage by children being 56.6 %^[23]. Looking at trends in mobile phone usage rates by children of different ages, around 40% children in India use smartphones by age of 10 years and it increases progressively with increase in age. By 16 years of age around 70-80% children use mobile phones^[23]. it was not surprising to know that among those who purchased

smartphone apps, nearly three out of five users (58%) paid for games making it the most popular paid category. Other popular paid app categories among smartphone users include chat and instant messaging (53%) and streaming music (45%)^[24].

Literature suggests a variety of mobile applications use for management of diabetes, mental illness and obesity^[20]. however there is paucity of information regarding use of smartphones for reduction in anxiety levels and so this study was conducted to notify the connection of smartphone applications and reduction in dental anxiety if achieved.

The study demonstrates that reduction in anxiety parameters like blood pressure, pulse and facial anxiety scores was almost double with smartphone applications as compared to those of conventional behaviour management techniques. However interpretation of such data should be done cautiously as it is technique sensitive and a larger sample size should be used to validate the results of this study.

More recently, Corah and associates used video ping pong game as a distraction tool during dental treatment and showed significant anxiety reduction in patients^[14].

Lee HJ *et al.* hypothesised the use of smartphone applications as a part of distraction in behaviour management technique. Their study indicated smartphones were a simple and effective way to reduce preoperative anxiety in children^[15].

DAYA, a system consisting of a tooth- brushing game for was designed to enhance the efficacy and experience of tooth-brushing in children, thus helping the parents to monitor child's dental health and his behaviour towards oral hygiene^[16].

Another study was conducted by Nicholas Lane *et al* and they discussed the design, implementation and evaluation of BeWell, a personal health application for smartphones capable of automatically monitoring a user's overall wellbeing^[17].

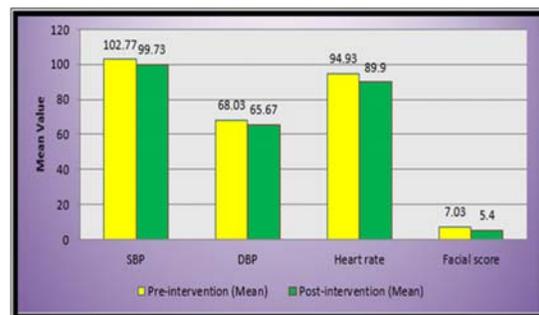


Chart 1: Reduction achieved in various hemodynamic parameters for control group

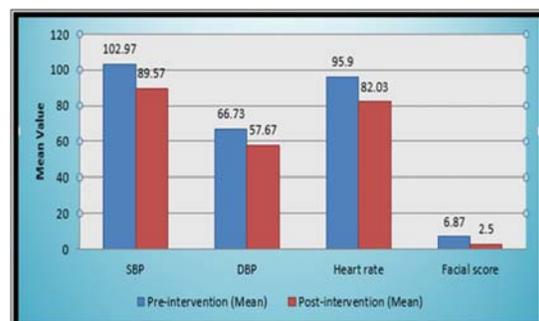


Chart 2: Reduction in various hemodynamic parameters achieved in Smartphone application group

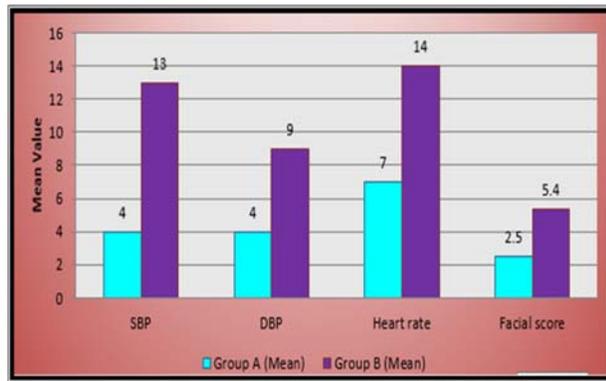


Chart 3: Difference between pre-operative and post-operative comparison of hemodynamic parameters for both groups

Conclusion

Through the present study there was a statistically significant difference between the pre-operative and post-operative haemodynamic parameters and facial score for both the groups. However greater reduction in anxiety was achieved by using 'Smartphone Application' intervention when compared to conventional behaviour modification techniques.

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