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The Effect of Virtual Reality (VR), Audio-analgesia and Combination of White noise with Aromatherapy on pediatric dental patients anxiety and disruptive behaviour who require administration of local anaesthesia.

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Abstract

Introduction: "Pain", the most commonly perceived and utterly feared emotions of all. When adults dread this emotion then why not little children? And who else apart from a pedodontists can understand the importance of providing a pain free environment while treating this little bundle of joys. However, while administering local anaesthesia, despite all the newer advances in today's era, it is still next to impossible for the child to not feel even a subtle amount of pain resulting in elevated anxiety levels. So in such a scenario, the least we can try doing is alleviate the child's anxiety levels so as to provide them with an environment which is more conducive to dental treatment.

Aim: The present study aimed in understanding the effectiveness of modern methods like virtual reality (VR), audio-analgesia and combination of white noise with aromatherapy on patient anxiety and disruptive behaviour in pediatric dental patients who require administration of local anaesthesia.

Materials and Methods: The current study included 60 children from the age group of 6-9 yrs. divided into three groups for the administration of audio and video aids. Group I included distraction using a Virtual Reality experience using Audio Visual Eyeglasses, Group II included White noise in combination with Aromatherapy and Group III Audio-analgesia using the audio of the child's choice. Scores were obtained on the basis of Venhams picture rating scale and facial image scale.

Results: It was found out that aromatherapy and white noise reduced the anxiety levels via Venhams picture rating scale being statististically significant. Also, it was observed that all the distraction aids were enjoyed by the children.

Conclusion: Results suggest that aromatherapy and white noise are one of the useful aids along with the others and can be used in patients with mild to moderate anxiety for good patient compliance.

Introduction

The word anxiety was coined somewhere in the early 16th century and stems from the Latin word anxietas or the French word anxiété, meaning a feeling of worry, or unease about something with an uncertain outcome. In today's complex society, fear or anxiety denotes a normal, useful response to a perceived active or imagined threat. Hence, we can say that anxiety is one of the most prevalent of all human emotions.[1] It includes,

(1) Physical and mental awareness of being powerless

(2) Presence of an impending threat;

(3) A feeling of doom and danger that comes from within, the result of cognitive appraisal;

(4) An irresoluble doubt concerning the nature of the threat, the best means reducing it

Historically, three major etiological models have been postulated to explain anxiety, panic neurosis and disorders.

1. The psychological or psychosocial model
2. The behavioral model
3. The biological model [1]

The psychological model considers anxiety the result of interplay between environmental stressors and internal conflicts, either past or present. The behavioral model holds that anxiety can occur even without conflict. The biological model views anxiety and especially panic disorder as a genetic and/or metabolic disease that is similar to other metabolic disorders. Therefore, the fear/anxiety/panic manifested by patients at any given time during the cycle of visits may stem either from purely psychosocial/emotional factors or as the result of a medical disease. Anxiety bears two distinct components, state and trait. [1] State anxiety is the individual's response to a specific object, event, or situation. It varies in intensity and fluctuates over time, increasing before dental treatment and decreasing afterwards. When anxiety occurs over a prolonged period and characterizes one aspect of the patient's everyday personality and behaviour, it is called trait anxiety. As dental practitioners, we are interested in a patient's trait tendencies and how it affects the appraisal of a given situation that might be considered threatening, and resulting effect on behavior and degree of sensitivity to pain and treatment. [1]

Interest in a phenomenon described as "audio-analgesia" was stimulated originally by the work of Gardner and Licklider. These authors described the use of sound to "suppress" pain produced by dental operation. Years of studies and research from several authors support the proposition that pain or fear of pain is a primary source of dental anxiety and a major obstacle for seeking dental care.[2] There are children who just cannot cope with the

stimuli and behavioral demands associated with dental experience. Such fear ranges from fear of needle to fear of bodily harm to a general fear of the unknown. To assist in the management of a child with anxiety, a wide range of pharmacological and nonpharmacological methods are available to dentists. Recent dental studies have shown that distraction is a common technique used to reduce the pain reaction during short invasive procedures. Distraction techniques such as television watching, use of virtual reality, audio-visual eyeglasses, and listening to music may effectively help to distract the child's attention away from anxiety-provoking stimuli, leading to a relaxing experience for the child. [3]

There have been various studies where authors have evaluated the effectiveness of virtual reality as well as audio distraction. The purpose of this study was to evaluate and compare if modern methods like Virtual Reality (VR), audio-analgesia and combination of white noise with aromatherapy would reduce patient anxiety and disruptive behavior in pediatric dental patients who require administration of local anaesthesia.

Materials and Methods

The present in vivo study was undertaken in the Department of Pedodontics and Preventive Dentistry, Bharati Vidyapeeth (Deemed to be) University and Dental College, Sangli, Maharashtra, India after receiving the ethical approval from the ethical committee of the institute. 60 children were chosen from the patients attending the outpatient department according to the inclusion criteria which comprised of children from 6 to 9 years of age with treatment needs under local anaesthesia in any quadrant either in maxillary or mandibular arch. Children who demonstrated Frankl 1 (definitely negative) type of behaviour and with special needs or emergency treatment needs, such as abscess, cellulitis and space infection were excluded from the study. All parents were informed about treatment procedures and a written consent was obtained. The patients who fulfilled the age criteria were assessed using the Frankl Rating Scale and children who demonstrated a Frankl 1 behaviour rating were excluded. The sample was divided into three equal groups for distraction using:

Group I- A Virtual Reality experience using Audio Visual Eyeglasses

Group II- White noise in adjunct with Aromatherapy

Group III- Audio-analgesia using the audio of the child's choice.

The patients were assigned to one of the three groups randomly on their first visit in the dental office. The same pediatric dentist treated all the patients. Behaviour management techniques of tell-show-do and voice control were used, where necessary, in a conventional manner. No immobilization was used.

Fig.1: Venham's Picture Test

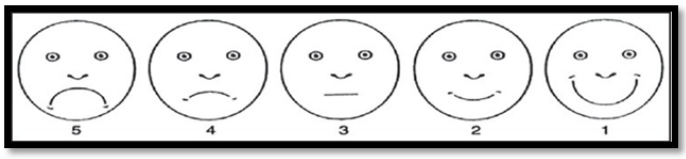

Fig.2 Facial Image Scale

Visit#1

The 1st visit of the child in the dental setting was a baseline session with no audio or video distraction used and just a regular check-up. After that the patient was asked to sit on the dental chair and a pre-op Venham picture test was administered to measure patient-reported anxiety. The patient was also assessed by the dentist simultaneously using the Facial Image Scale. The regular check-up will be then done by the dentist and the patient was then recalled for the further required treatment.

Visit#2

During Visit #2, the children were exposed to audio and video aids according to the category during the required dental treatment under local anaesthesia where the volume of the audio and video aid was such that the dentist's instructions were audible to the child. Post-op Venham picture test was administered and the dentist simultaneously assessed the child using the Facial Image Scale. At the conclusion of visit #2, the dentist asked the patients in each of the music groups the following two questions:

(1) "Did you enjoy to music/video during your visit?"

(2) "Would you like to listen/watch music/video at your next visit?"

Fig. 3. : A) Group 1.Virtual Reality, B) & C) Group 2. White noise and Aromatherapy, D) Audio-analgesia using the audio of the child's choice.

RESULTS:

A total of 60 children, 20 in each group participated in this study. Data obtained was compiled on a MS Office Excel Sheet (v 2010). Data was subject to statistical analysis using Statistical package for social sciences (SPSS v 21.0, IBM). Comparison of scales was done using Kruskall Wallis ANOVA followed by Mann Whitney U tests for scales. Intra group comparison (in each of the 3 groups) has been done using Friedman's test for scales & WSR was used to compare visit 1 & 2 data. For all the statistical tests, $p<0.05$ was considered to be statistically significant, keeping α error at 5% and β error at 20%, thus giving a power to the study as 80%.

In Group 1, where distraction was carried out using the Virtual reality the mean value during the 1st visit for VPRS (Venhams Picture Rating Scale) was 2.20 and the SD was 1.576 which during the Visit 2 was 2.00 and 1.451 respectively but, the p value was 0.102#. Hence the results were statistically non-significant as $p<0.05$. Similarly, the FIS (Facial Image Scale) values during the 1st visit showed a mean of 1.85 and a SD of 0.813. The mean and the SD values during the 2nd visit were 1.70 and 0.733 repectively and the p value was 0.083# and thus, the results were statistically non-significant.

Group 1:

	Mean	N	Std. Deviation	Median	Z value	p value of WSR
VPRS visit 1	2.20	20	1.576	2	-1.633	0.102#
VPRS visit 2	2.00	20	1.451	2		
FIS visit 1	1.85	20	.813	2	-1.732	0.083#
FIS visit 2	1.70	20	.733	2		

Table 1: Group 1 Virtual Reality

There was a statistically non-significant difference seen for all the variables ($p>0.05$)

In Group 2, where distraction was carried out using white noise and aromatherapy the mean value during the 1st

visit for VPRS (Venhams Picture Rating Scale) was 1.90 and the SD was 1.410 which during the Visit 2 was 1.70 and 1.455 respectively. The p value was 0.046*. Hence the results were statistically significant as p<0.05. Similarly, the FIS (Facial Image Scale) values during the 1st visit showed a mean of 1.70 and a SD of 1.031 the mean and the SD values during the 2nd visit were 1.60 and 0.733 respectively and the p value was 0.074# and thus, the results were statistically non-significant.

Group 2

	Mean	N	Std. Deviation	Median	Z value	p value of WSR
VPRS visit 1	1.90	20	1.410	.5	-2.000	0.046*
VPRS visit 2	1.70	20	1.455	1.5		
FIS visit 1	1.70	20	1.031	1	-1.000	0.317#
FIS visit 2	1.60	20	.754	1		

Table 2: Group 2 White noise & Aromatherapy

There was a statistically non-significant difference seen for FIS between visit 1 and 2 (p>0.05) but there was a significant difference seen for VPRS between visit 1 and 2 (p<0.05)

In Group 3, where distraction was carried out using the audio of the child's choice, the mean value during the 1st visit for VPRS (Venhams Picture Rating Scale) was 2.65 and the SD was 1.785 which during the Visit 2 was 2.70 and 1.658 respectively but, the p value was 0.102#. Hence the results were statistically non-significant as p<0.05.Similarly, the FIS (Facial Image Scale) values during the 1st visit showed a mean of 2.10 and a SD of 0.912. The mean and the SD values during the 2nd visit were 2.05 and 0.826 respectively and the p value was 0.564# and thus, the results were statistically non-significant

Group 3

	Mean	N	Std. Deviation	Median	Z value	p value of WSR
VPRS visit 1	2.65	20	1.785	2.5	-0.577	0.564#
VPRS visit 2	2.70	20	1.658	2.5		
FIS visit 1	2.10	20	.912	2	-1.000	0.317#
FIS visit 2	2.05	20	.826	2		

Table 3: Group 3 Audio of the child's choice

There was a statistically non-significant difference seen for all the variables (p>0.05)

The VPRS score during visit 1 for Group 1, Group 2 and Group 3 depicted mean values of 2.20, 1.90, and 2.65 respectively, while the SD values for the groups were 1.576, 1.410, and 1.785 respectively. The mean values during the 2nd visit were 2.00, 1.70 and 2.70 and SD values were 1.451, 1.455, and 1.658. But the p value was 0.410# and hence there was no statistical significance observed.

Similarly, the FIS score during visit 1 for Group 1, Group2 and Group 3 depicted mean values of 1.85, 1.70, and 2.10 respectively, while the SD values for the groups were respectively. The mean values during the 2nd visit were 1.70, 1.60 and 2.05. But the p value was 0.410# and hence there was no statistical significance observed.

	Groups	N	Mean	Std. Deviation	Median	Chi square value	p value of KW ANOVA
VPRS visit 1	1	20	2.20	1.576	2	1.728	0.410#
	2	20	1.90	1.410	1.5		
	3	20	2.65	1.785	2.5		
	Total	60	2.25	1.601			
VPRS visit 2	1	20	2.00	1.451	2		
	2	20	1.70	1.455	1.5	3.929	0.140#
	3	20	2.70	1.658	2.5		
	Total	60	2.13	1.556			
FIS visit 1	1	20	1.85	.813	2		
	2	20	1.70	1.031	1	2.934	0.231#

	3	20	2.10	.912	2		
	Total	60	1.88	.922			
FIS visit 2	1	20	1.70	.733	2		
	2	20	1.60	.754	1	3.522	0.172#
	3	20	2.05	.826	2		
	Total	60	1.78	.783			

There was a statistically non-significant difference seen for all the variables ($p>0.05$)

Discussion

It is well known to any pediatric dentist that the most feared and anxiety stricken procedures in the dental office are the injection of local anaesthesia, application of rubber dam, and initiation of tooth preparation with the high speed handpiece. Also, stimulus of an unpleasant strange environment producing large noises and bright lights also produce the most unconcealed expressions of anxiety.[3]

The effects of anxiety have been shown to persist into adulthood, which can often lead to dental avoidance and the subsequent deterioration of oral health. Assessment of children based on their behaviour is one of the most important skills for pediatric dentists. During the administration of a local anaesthetic injection, an anxious patient might perceive more pain of longer duration as compared to less anxious patients.[4] This study was aimed at understanding and helping this difference of perception offered to the operator by every child patient included in this study. Behaviour management and shaping of a child has been one of the most documented and talked about subject in literature as well as in the clinic for obvious reasons and owing to all of them many authors have come up with new innovative distraction techniques that help gain an anxious child's compliance easily. These techniques vary from the use of tell-show-do to the use of tell-play-do to using a variety of music with a variety of electronic devices to using various media interfaces. Recently, considering the technological savvy world that we live in have such famous attractive modalities like the use of audio-visual eyeglasses which work on the principle of a virtual reality. Authors have also described the use of video games, TV and many other technological advancements in their dental clinic for providing a better environment during treatment.[5]One such example, of a better environment also stems from the old practices that focus the use of natural essential oils for providing a soulful and an unexpectedly pleasant experience is aromatherapy.[6]

The current study aimed on using these popular non-aversive techniques of distraction so as to compare and evaluate the effectiveness of every aid individually as well as comparatively. We presumed that all the three distraction conditions offered to the child differed in the demand for attention from the patient.[7] Our results indicate a statistically insignificant difference between all the three groups, except, for group II where aromatherapy was administered in combination with white noise there was a statistically significance difference seen only according to the VPRS scale while the FIS depicted no significant difference. Davis in 1991 defined aromatherapy as "the art and science of using essential plant oils in treatments a truly holistic therapy taking in to account mind, body and spirit.[7,8] The definition of Clinical aromatherapy (as used in nursing) is more specific: "The use of essential oils for outcomes that are measurable".[8,9] This word aromatherapy rose from the term "aromathe´ rapie" was coined by the French chemist Rene´ Maurice Gattefosse´ who later wrote book on the same. This study used the ylang ylang essential oil and an aroma air diffuser which helped in creating the fragrant atmosphere required for the therapy.[8] Ylang ylang oil is extensively used in aromatherapy applications, because of its expertise in soothening stress, anxiety, sadness, tension, and sleeplessness. This perfumed oil is extracted from the

ylang ylang flower tree commonly known as the fragrant cananga, Macassar-oil plant, or perfume tree. Aromatherapy was further combined with administration of white noise, one of the most soothing audio therapies which acts as a stress buster and gives a calming effect. Noise, in accoustics is defined as any unpleasant sound that interferes with audible voices. Shapiro and Berland recommended that the noise level should lie in the range of 55 to 86 dB and is not supposed to be exceeded. The frequency and signal of white noise generally resembles the sound of waterfalls, ocean waves, or wind sweeping through trees. White noise is prepared by digitally mixing sounds of equal frequencies in a laboratory. Then, all frequencies contained in this sound are calibrated to form a white noise that is pleasant to the senses.[10,11] White noise encompasses all characteristics of sounds within the range of human hearing. It has been used in the treatment of tinnitus, insomnia, masking unwanted sounds, and provision of relaxation. Taking into consideration all the good factors of white noise and also and the fact that white noise not being used as a distraction method we thought of incorporating this asset into our study.[10]

Group I of this study included distraction using of VR eyeglasses. According to our results there was no statistical significant difference seen between any of the groups. Al- Hababi and Bshara et al in 2018 have found out a significant difference in using the VR set during pulpal procedures. However, the study was carried out in three appointments and there is a possibility that the comfort level between the subject and the operator had increased over the subsequent appointments. Our study aimed to measure the patient reported anxiety just after the administration of local anaesthesia and not throughout the entire procedure. They have also mentioned that using a tablet device attached to the dental chair proved to be the superior most device while administering nerve blocks as compared to the VR eyeglasses. They noted that older children, mostly above 10 years of age respond better to the use of VR set and the main reason as mentioned by the author was their cognitive development.[12] Another study by Niharika and Reddy et al in 2018 suggested similar finding to Bshara et al in terms of good patient compliance and their study was also carried out over a period of three appointments.[13] It was observed in the current study that since VR has to be a 360 degree experience and in contradiction to it while depositing local anaesthetic solution the child is not supposed to move. Which does take away the child's fun momentarily and it's the same moment when the child experiences pain. Also since they are blinded, the mere thought of not being able to see the entire procedure makes the child restless. Their curious minds immediately place their calculations which are directly related to fear of injections where they feel that they are being given the device since the procedure is painful. It was also observed that most of the kids perceived that distraction techniques were handed over to them on purpose because the procedure is painful and which results in a disruptive behaviour. The group III of the study was based on the audio distraction where audio of the child's choice was administered. The results were statistically insignificant and similar to those reported by Aitkin et al.[14] It was also observed that the children despite of having aids that they would find attractive had their curiosity intact regarding the dental procedure and wanted to see it for themselves. It was also realised that due to the newer generation being in contact with technology more the newness of the aid of was not felt as expected and effectiveness might have been decreased. Hence, according to these results audio and video aids were not as effective as distraction aids. Aitkin et al in 2002 suggests that music is ineffective as a distraction during dental procedures however, further studies and

investigation is required.[14] Bagattoni et al suggested that audio-visual distraction could be used but cannot replace the conventional behaviour management technique.[15] Hence, we can say that every aid has some good and a certain level of distraction to be offered. If not for the anxiety levels, depending upon the child's age, mood, personal preference of technology, upbringing, socio-economic background audio and video aids can be administered to the child for making their appointment enjoyable and pleasant.

Conclusion

Audio and video distractions prove to be a fun loving experience for the child. Despite a lack of an effect on anxiety levels, patients had an overwhelmingly positive response to the music and video aid and would choose to listen to it at subsequent visits. They also loved the ambience created during the aromatherapy and administration of white noise. We can say that the unpleasantness of a certain anxiety-filled procedure can be masked by the fun gadgets given to the kids so as to gain a better patient compliance. It is always better to treat a smiling kid than treating a grumpy kid who feels that the environment is extremely cold for him. However, more research is required in this area for guaranteed better patient compliance.

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