Original Research Paper

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Comparative Evaluation of Acupressure and Virtual Reality Distraction Foranxiety Reduction in Children Aged 8-12 Yrs – A Randomized Control Trial".

Abstract:

Background and Aim: Anxiety is an obstacle during dental treatment. Acupressure and Virtual reality distraction (VRD) are the newer behaviour modification techniques currently gaining popularity in clinical pediatric dentistry. The purpose of this study is to compare the effect of acupressure and VRD on anxiety in children.

Methods: The current study is a single centered, two arm, explanatory study with parallel design and balanced allocation ratio. A total of 60 children aged 8-12 years meeting inclusion criteria were randomly and equally divide into acupressure (group I) and VRD (group II). Acupressure group was further subdivided into three groups with 10 subjects in each subgroup based on the acupoints selected (EX-HN3, Shen Men, P6). Acupressure beads were employed over the selected acupoints for group I and VRD glasses playing cartoons were put on for group II. Anxiety was measured at four different time intervals at baseline, forty minutes after application of acupressure in group I and five minutes after using virtual reality device in group II, five minutes after local anesthesia, lastly fifteen minutes after completion of treatment. Modified child dental anxiety scale faces version (MCDAS[F]) was used for subjective assessment, Venham's clinical anxiety rating scale (VCRS) for objective assessment and pulse rate (PR) for physiologic assessment. Recorded values were subjected to statistical analysis.

Results: Both the groups showed significant reduction in anxiety. VRD reduced anxiety to a greater extent than acupressure.

Conclusion: VRD can be used as a successful behaviour modification technique and acupressure can be a viable alternative.

Key-words: Acupressure, Dental anxiety, Virtual reality

Introduction:

Dental anxiety is the most prevailing obstacle in children,compromising oral health, due to avoidance of professional dental care.[1] Behaviour shaping techniques are effective,but outcomes may vary in their attempts. Pharmacological techniques are risky to some extent and require extensive knowledge, skill and equipment. Hence, it cannot be performed on a regular basis in clinical settings. Furthermore, medication allergies, adverse effects and existing medical condition make it unsafe to use in children.

An alternative way to allay dental anxiety is application of acupressure and virtual reality distraction which does not require expertise and can be used easily by clinician and is well accepted by the child.

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Acupressure, an ancient Chinese therapeutic modality, has gained interest in pediatric dentistry due to its ease of application, non-invasive and painless nature, cost-effectiveness, minimal adverse effects, and good acceptance

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by children. [1] It is based on regulating the flow of Qi, a vital life force, through pressure applied at specific points to stimulate the nervous system and promote natural healing. [2] Acupressure has been used to manage various medical conditions.[3] and, in dentistry, to alleviate pain, treat temporomandibular disorders, manage xerostomia, control gag reflex, and aid in the reversal of nail-biting habits. [4,5]

A technology-based intervention such as virtual reality as distraction tool is gaining popularity in medical and dental setting. This human-computer interface captures child's multiple senses and allows the child to deliberately engage in virtual world. It diverts the attention away from what might seem to be an uncomfortable procedure. The benefits of using virtual reality to reduce dental anxiety during dental procedures have been well documented in the scientific literature.[6]

There are a few studies which evaluated the efficacy of acupressure and virtual reality distraction but there is scarcity of comparative studies in dental scenario. Hence, the current study aims to compare effect of acupressure and VRD on anxiety levels in children receiving local anesthesia in dental setting.

Methods:

Study design: Present study is a single centered, two arm, explanatory, equivalence, randomized control trail with parallel design and balanced allocation ratio.

Study setting and source of data: Subjects visiting OPD (Out Patient Department) of Department of Pedodontics and Preventive Dentistry, A.M.E's Dental College and Hospital, Raichur, Karnatakain

Eligibility criteria: Children aged 8-12 years, requiring administration of local anesthesia irrespective of treatment with a Frankl's rating 2 and 3 and good general health (ASA I) were included and children with special health care needs, medically compromised, history of anxiety disorders and phobia were excluded.

Sample size determination: A power analysis was established by G*power, version 3.0.1(Franz Fauluniversitat, Kiel, Germany). A sample size of 60 (30 per group) yielding 90% power to detect significant differences, with effect size of 0.22 and significance level at 0.05.

Procedure:Before starting the study institutional ethical clearance was obtained from institutional review board (Ref No: AME/DC/378/2023-24) and registered in clinical trial registry-India **(**CTRI/2025/02/080268**).** The procedure, any potential complications, and the risks and benefits were explained to the parents/legal guardians and children. Informed consent from parents/legal guardian and informed assent from the child was obtained. Frankl's behaviour rating scale was used and scores were noted. Block randomization (permuted block randomization) was employed in the study. A table of random numbers was used to generate the random allocation sequence. To prevent selection bias, centralized assignment (by a person not involved in the research) was used for allocation concealment.

Selected 60 children are divided equally into two groups. Acupressure group was further divided into three sub-groups with 10 children in each sub group based on site of acupressure applied

Overall:

- **Group I: Acupressure**

Sub Group IA: Acupressure on **EX- HN3**acupoint(situated halfway between the inner ends of the brows)

Sub Group IB: Acupressure on **Shen Men**acupoint (located at the apex/ lateral third of triangular fossa in external ear)

Sub Group IC: Acupressure on **P6**acupoint(situated on the inner forearm three finger breaths below the wrist, between the tendons)

- **Group II: Virtual reality distraction:**

The anxiety was recorded at four different time frame(TF)and was evaluated by three anxiety indicators, namely physiological indicator i.e. Pulse Rate (PR) recorded by pulse oximeter, subjectively/self reported recorded by modified child dental anxiety scale faces version (**MCDAS[F])** and objectively by Venham's clinical anxiety rating scale (VCRS). For both groups anxiety was recorded at baseline (TF 1).

For group I acupressure beads was applied on selected points and held passively for approximately 10 minutes and left adhered in place for 30 minutes followed by which anxiety scores noted using anxiety indicators (PR, MCDAS[F], VCRS) for second time (TF 2).

In group II Virtual reality distraction device was introduced to children using tell-show-do technique. They were given choice to select their favourite cartoon shows and were asked to view them in dental operatory area for 5 minutes following

which anxiety levels were recorded using anxiety indicators for second time(TF 2). VR device was further continued to be used throughout the procedure.

One of the procedures involved in treatment is administration of local anesthesia. In all the groups after 5 minutes of administering local anesthesia anxiety levels were assessed using anxiety indicators for third time(TF 3).

Furthermore, 15 minutes later after completion of specified treatment (extraction, pulpectomyetc) post treatment anxiety levels evaluated using anxiety indicators for fourth time(TF 4) in all groups. Adhered beads were removed; VR device was retrieved before discharging them from dental operatory. All the recorded data was subjected to statistical analysis.

Statistical analysis:

Study used SPSS version 22 (IBM corp. Armonk, NY, USA) with *P<0.05 is statistically significant and **P<0.001 is highly significant.

For the acupressure and VRD groups, ANOVA with Bonferroni post hoc analysis was used for pairwise comparison of MCDAS [F] and pulse scores, while the Friedman test with Wilcoxon signed-rank test was applied for intragroup and pairwise comparisons of VCRS. Intergroup comparisons used the unpaired t-test for MCDAS [F] and pulse scores and the Mann–Whitney U test for VCRS.

For acupressure subgroups, ANOVA with Tukey post hoc analysis was used for intergroup comparison of MCDAS [F] and pulse scores, and repeated-measures ANOVA with Bonferroni post hoc analysis for intragroup comparisons. VCRS scores were analyzed using the Kruskal–Wallis test with Mann–Whitney U test for intergroup comparisons and the Friedman test with Wilcoxon signed-rank test for intragroup and pairwise analyses.

Results:

A cupressure and VRD as well as three subgroupsshowed highly significant decrease in **MCDAS [F]**, VCRS and pulse score indicating overall decrease of anxiety in both the groups and subgroups (Table1, 2 , 3).

Table 1: Comparison of mean MCDAS (F), VCRS, and PR of acupressure and its subgroups at different time intervals

Outcome measure	Time frame	Acupressure		P Value	EX HN3		Shen Men		P6		P Value
		Mean	SD		Mean	SD	Mean	SD	Mean	SD	
MCDAS	TF1	25.53	3.36	0.000**	25.80	3.48	27	2.74	23.80	3.29	0.096
	TF2	22.20	3.36		21.40	2.36	24.60	2.27	20.60	3.97	0.014*
	TF3	20.20	3.04		18.20	1.68	24.60	2.27	19.40	3.02	0.000**
	TF4	16.46	5.83		18.20	1.68	23	2.58	19.40	3.02	0.000**
VCRS	TF1	2.33	0.47	0.000**	2.60	0.51	2.4	0.51	2.00	0	0.017
	TF2	1.40	0.49		1.60	0.51	1.60	0.51	1.00	0	0.008*
	TF3	1.13	0.34		1.00	0	1.40	0.51	1.00	1.00	0.012*
	TF4	0.53	0.62		0.40	0.51	1.20	0.42	1.00	1.00	0.000**
PR	TF1	106.2	9.67	0.000**	112.6	7.32	109.4	8.93	96.60	2.95	0.000**
	TF2	95.93	9.32		102.0	6.56	99.20	8.87	86.60	2.95	0.000**
	TF3	95.93	9.32		102	6.56	99.20	8.87	86.60	2.95	0.000**
	TF4	88.06	9.39		79.2	2.78	90.20	9.24	94.80	6.97	0.000**

*P <0.05 is statistically significant and **P <0.001 is highly significant.

Table 2: Pairwise analysis of three subgroups of acupressure at same timeframes

OUTCOME MEASURE	SUBGROUPS	TF1	TF2	TF3	TF4
MCDAS Tukeys Post Hoc analysis	IA vs IB	0.682	0.059	0.000**	0.000**
	IA vs IC	0.355	0.821	0.486	0.000**
	IB vs IC	0.082	0.015*	0.005*	0.000**
VCRS Mann Whitney U test	IA vs IB	0.383	1.000	0.029*	0.003*
	IA vs IC	0.029*	0.004*	0.029*	0.000**
	IB vs IC	0.004*	0.004*	1.000	0.029
PR Tukeys Post Hoc analysis	IA vs IB	0.559	0.615	0.615	0.309
	IA vs IC	0.000**	0.000**	0.000**	0.000**
	IB vs IC	0.001*	0.001*	0.001*	0.004*

* y significant.

Table 3: Comparison of mean MCDAS (F), VCRS and PR scores at different timeframes for virtual reality distraction

Outcome measure	Timeframe	mean	Standard deviation	p Value
MCDAS	TF1	20.20	5.39	0.000**
	TF2	13.60	3.94	
	TF3	9.86	2.28	
	TF4	8.13	0.50	
VCRS	TF1	2.66	0.47	0.000**
	TF2	1.33	0.47	
	TF3	1.23	0.43	
	TF4	0.46	0.50	
PR	TF1	102.46	10.57	0.000**
	TF2	95.96	7.62	
	TF3	93.06	10.13	
	TF4	91.76	9.95	

*P <0.05 is statistically significant and **P <0.001 is highly significant.

On comparing the three subgroups of acupressure, there was highly significant decrease in **MCDAS [F]** and VCRS scores for EX-HN3 group followed by P6 group and Shen Men. However pulse score shows that highly significant decrease was seen in EX-HN3 group followed by Shen Men and P6 (Table 1).

On comparing acupressure and VRD, VRD showed greater reduction in anxiety on with **MCDAS [F]** and VCRS scales than acupressure and were highly significant however pulse score of acupressure was reduced significantly than VRD acupressure (Table 4).Intragroup comparison between different timeframes of both the groups also showed statistically highly significant difference (Table 5)

Table 4: Comparison of mean MCDAS (F), VCRS, PR between the acupressure and VRD at different time intervals

Outcome measure	Timeframe	Acupressure		VRD		P value
		Mean	SD	Mean	SD	
MCDAS	TF1	25.53	3.36	20.20	5.39	0.000**
	TF2	22.20	3.36	13.60	3.94	0.000**
	TF3	20.20	3.04	9.86	2.28	0.000**
	TF4	16.46	5.83	8.13	0.50	0.000**
VCRS	TF1	2.33	0.47	2.66	0.47	0.010*
	TF2	1.40	0.49	1.33	0.47	0.595
	TF3	1.13	0.34	1.23	0.43	0.321
	TF4	0.53	0.62	0.46	0.50	0.010*
PR	TF1	106.20	9.67	102.46	10.57	0.159
	TF2	95.93	9.32	95.96	7.62	0.988
	TF3	95.93	9.32	93.06	10.13	0.259
	TF4	88.06	9.39	91.76	9.95	0.144

*P<0.05 is statistically significant and **P<0.001 is highly significant.

Table 5: Pair-wise comparison of MCDAS (F), VCRS and pulse values at different time frames

Parameter	Groups	TF1 v/s TF2	TF1 v/s TF3	TF1 v/s TF4	TF2 v/s TF3	TF2 v/s TF4	TF3 v/s TF4
MCDAS	EX HN3	0.006*	0.000**	0.000**	0.000**	0.000**	0.001*
	Shen Men	0.003*	0.001*	0.017*	0.007*	0.268	1.000
	P6	0.000**	0.000**	0.001*	0.221	0.109	0.097
	acupressure	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
	VRD	0.000**	0.000**	0.000**	0.001*	0.000**	0.004*
VCRS	EX HN3	0.002*	0.004*	0.004*	0.014*	0.010*	0.014*
	Shen Men	0.005*	0.002*	0.003**	0.157	0.046*	0.157
	P6	0.002*	0.002*	1	0.002*	0.002*	0.002**
	acupressure	0.000**	0.000**	0.000**	0.005*	0.000**	0.000**
	VRD	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
PR	EX HN3	0.001*	0.001*	0.000**	0	0.002*	0.002*
	Shen Men	0.000**	0.000**	0.000**	0	0.000**	0.000**
	P6	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
	acupressure	0.000**	0.000**	0.000**	0.000**	0.000**	0.000**
	VRD	0.000**	0.000**	0.000**	0.237	0.019*	0.109

* y significant.

Discussion:

Dental anxiety is a significant concern, ranking as the fifth most common cause of anxiety, with approximately 58% of individuals delaying or avoiding dental care. [7,8] Managing anxiety is particularly challenging in children, as dental settings, instruments, and odours can provoke fear, leading to uncooperative behaviours such as crying, kicking, and refusal to open the mouth, thereby compromising treatment efficiency. [9,10] Children with high dental anxiety exhibit higher decayed, missing, and filled teeth scores, are less likely to accept preventive care, and often seek dental treatment only during emergencies, which may necessitate more invasive procedures and further intensify anxiety. [11,12]

Recently there has been extensive research on alternative techniques such as hypnosis, biofeedback, relaxation exerciseswhich have been proved to be effective in managing anxiety. These did not challenge dentist's psychotherapeutic skills nor raised any safety concerns. One such technique chosen was acupressure which was compared with virtual reality distraction.

The participants in the current study were school-aged (6-13 years old). This is because pre-schoolers have higher levels of fear and anxiety than school-aged children, implying that they are not physically or mentally ready for any type of intervention. Moreover, they have improved cognitive ability which is required for comprehending and understanding anxiety scale.[13]Psychological and behavioral results show that administering local anesthetic injection, rubber dam placement, and tooth preparation using a high-speed handpiece are the three most frightful dental treatments that cause anxiety in children.[14] Hence, patients requiring LA have been included in the study.Self-report scale [MCDAS (F)] and VCRS was used due to its proven reliability and validity,[15]lesser complexity and reduced time to document. Heart rate is a useful tool and has been used behavioral research for assessing acute stress, as adrenaline is released which increases heart rate.[16]Anxiety triggers neurochemical and electrical transmission promoting changes in cardiac receptors thereby affecting heart rate.[17]Hence it was used as physiological measure.

Acupressure is an ancient Chinese treatment method a non-invasive form of acupuncture.[4]Both methods stimulate acupoints along the meridian, believed to correct Qi (vital force) imbalances and treat ailments. Acupressure triggers endorphin release, neurotransmitter changes, harmone regulation and analgesic peptide release, interrupting stress signals and causing relaxation.[18]

The acupointsextra one point (EX-HN3), Shen Men and pericardium 6 (P6) were selected in the current study due to reported ability to reduce anxiety.[19]Acupressure bead with a piece of adhesive tape was used for constant pressure

application as it is not technique sensitive and does not require constant supervision.In the current study treatment began 40 minutes after the acupressure was applied as it was proved beneficial in the trial done byAvisa et al.[1]

In the acupressure group, mean MCDAS [F], VCARS, and pulse scores showed a progressive and statistically significant reduction from TF1 to TF ($p < 0.001$), indicating a consistent decrease in anxiety levels. Among the acupoints, EX-HN3 demonstrated the greatest anxiolytic effect, followed by P6, with Shen Men showing the least reduction (Table 1).

The present findings are consistent with Avisa et al. [1], who reported reduced dental anxiety in children following acupressure at EX-HN3 and Shen Men during scaling and restorative procedures. Similarly, Soares et al. [20] observed reductions in heart rate using the same points during restorative treatment. Lidhar et al. [21] demonstrated decreased VCRS scores with EX-HN3 acupressure during local anesthesia administration, indicating reduced post-treatment anxiety. Sisodia et al. [22] also reported significant anxiety reduction and improved behaviour 20 minutes after three-point acupressure (EX-HN3, Shen Men, and relaxation point). Although dental literature on the P6 point is limited, Dehghanmehr et al. [19] showed that repeated P6 acupressure significantly reduced anxiety and depression. In contrast, Moosavi et al. [23] found no significant anxiety reduction, which differs from the present findings.

There have been reports of side effects on using acupressure on occasion such as headache, dizziness, palpitation, muscle ache and fatigue which could result in the intervention being discontinued.[3]Howeverin the current study, no adverse effects were reported which is consistent with research by Avisa et al[1]indicating that this practise is beneficial as a self-care strategy.

Virtual reality distraction was selected as an intervention, as distraction is one of the most commonly used approaches in medical and dental procedures [24]. Various distraction techniques, including watching television, listening to music, counting objects, and engaging in conversation, have been successfully used in dentistry, particularly during local anesthesia administration. Recent advances in behavioural research have expanded the application of virtual reality across clinical fields, including pain management and psychiatric care. Hence this intervention was chosen which has a wide scope in future. Participants selected the cartoon programmes in the current study as allowing them to choose the audiovisual material gives them a sense of control over the dentist's actions, lowering their stress levels.

MCDAS [F], VCRS, and pulse scores showed a progressive and statistically significant reduction from TF1 to TF4 ($p < 0.001$), indicating a decrease in anxiety levels over time (Table 3).

Similar findings have been reported by Aminabadi et al. [25], who observed a significant reduction in anxiety scores in children using VR goggles. Shetty et al. [26] demonstrated a significant decrease in salivary cortisol levels, indicating reduced stress with VR use. Ram et al. [27] suggested that VR could potentially serve as an alternative to nitrous oxide sedation. In contrast, Sullivan et al. [28] reported no significant effect of VR on children's anxiety or behaviour. Nevertheless, a systematic review and meta-analysis by Lopez-Valverde et al. [29] concluded that VR is an effective distraction strategy for reducing pain and anxiety during dental treatment.

"Simulator Sickness," according to Wismeijer et al[30]is the result of close proximity and poor image quality projected by VR equipment, and this is likely to produce nausea. This is in contrast to the present study were no child developed nausea. Few cases of head ache were reported because of long dental procedures and continued use of VR device which is in accordance with the study by Shetty et al.[26]

Intergroup comparison showed a greater mean reduction in MCDAS-F and VCRS scores in the virtual reality distraction group, indicating superior anxiety reduction compared to acupressure. Pulse rate findings did not align with these measures, consistent with Aartman et al. [31]who suggested that heart rate reflects general arousal rather than specific anxiety. Therefore, based on self-reported and observational scales, virtual reality distraction appears more effective than acupressure in reducing dental anxiety.

Anxiety is a product of coordinated activity across several brain regions. It occurs when input from the emotional brain, especially the amygdala, overrides regulation by the cognitive brain in the frontal lobe. Exposure to fearful stimuli activates the amygdala, and this response is intensified by the dorsal anterior cingulate cortex (dACC), while the ventromedial prefrontal cortex acts to inhibit these signals. Functional MRI studies demonstrate activation of these areas during anxiety, though the precise mechanisms of their interaction are still under investigation. The site of fearful

object may trigger the amygdala, which is further amplified by dACC, giving rise to anxiety.[32]

Virtual reality is more effective because it immerses the child and blocks exposure to anxiety-provoking sights and sounds, such as airotor noise. This reduced sensory input limits amygdala stimulation, leading to greater anxiety reduction, while 3D visuals enhance engagement and enjoyment. In contrast, acupressure does not prevent exposure to fearful stimuli and is generally more effective when multiple acupoints and repeated sessions are used rather than a single session.

Limitations:

The study did not screen for Childhood Anxiety Disorder, used a single acupressure session, anxiety after removal of acupressure beads was not measured, blinding was not possible, use of sham points was not considered.

Conclusion:

Acupressureand VRD can both be used for successful management of anxiety in children in dental office. However, VRD was more effective than acupressure.

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