Original Article

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Dentistry Section

Effects of Dental Operating Microscope on Anxiety, Behaviour, and Treatment duration among Children in the 5-7 Year Age Group Undergoing Dental Restorative Procedures: A Randomised Clinical Trial

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ABSTRACT

Introduction: Fear of the unknown causes anxiety in paediatric patients. The use of tell-show-do, along with audiovisual distraction, promotes positive behaviour and reduces anxiety. The use of a Dental Operating Microscope (DOM) as a visual distraction aid provides better cooperation in paediatric patients.

Aim: To evaluate the effects of a DOM on anxiety, behaviour, and treatment time during a restorative procedure in paediatric dental patients.

Materials and Methods: The present study was a parallel-arm, randomised clinical trial conducted at IGIDS, Puducherry, India, in 2022, over a period of four months. Healthy five to seven-year-old children on their first dental visit were selected (n=90) and divided into two groups using simple randomisation. Group A: Restoration of teeth without a DOM, and group B: Restoration of teeth using a DOM. Anxiety and behaviour were measured as soon as the child entered the operatory (T1), after tell-show-do for the procedure (T2), after cavity preparation (T3), and after completion of the restoration (T4). Caries removal efficacy and treatment duration were also assessed. The data obtained were statistically analysed using the Chi-square test and independent sample t-test ($p<0.05$).

Results: Out of the 90 children who participated in the study, 47 (52%) were girls, and 43 (47%) were boys. There was a decrease in anxiety and improved patient behaviour during cavity preparation (T3) and after completion of restoration (T4) in group B ($p<0.001$). The operator also reported higher visual (71.10%) and tactile (95.60%) scores in caries removal, with a shorter treatment duration in groups where DOM was used ($p<0.001$).

Conclusion: The use of DOM reduced anxiety levels and improved the compliance of children during dental procedures. Operator ergonomics and the quality of treatment could be enhanced by recommending DOM in regular paediatric dental practice.

Keywords: Audiovisual aids, Facial image scale, Modified venham scale, Pulse rate

INTRODUCTION

For many paediatric patients, their first dental visit is a stressful event with increased fear and anxiety. These emotions cause behavioural changes that will affect the quality of dental care [1]. To manage behaviour, dentists have a wide variety of techniques available, such as tell-show-do, distraction, modeling, hypnosis, and audio analgesia [2]. Traditionally, the TSD technique is used to familiarise the patient with the dental operatory and instruments to reduce anxiety. The use of audiovisual aids has shown to be an effective distraction technique to manage paediatric patients with anxiety [2]. Optical aids improve the resolution manyfold in comparison to the naked eye, among which DOM precisely assesses the degree of demineralisation and depth of the lesion [3]. DOM seems to offer better ergonomics and a wider range of magnification [4]. The three primary advantages of using a DOM are: 1) enhanced visualisation; 2) improved working posture; and 3) increased referrals [5].

Previous research regarding the use of DOM reported that 95.6% stated accuracy in the restorative procedure, 35.9% reported that DOM can be easily incorporated in paediatric dentistry, and 70.5% reported that the use of DOM will increase apprehension in children. However, 85.2% of paediatric dentists expressed their preference for using DOM as an aid in behaviour management tool because of its live visual output [4]. Although the usefulness of DOM is relatively high in endodontics, there are limited studies assessing its use in paediatric dentistry [3,4]. Hence, the present study aimed to evaluate the effects of a DOM on anxiety, behaviour, and treatment time during a regular restorative procedure in paediatric patients.

MATERIALS AND METHODS

A parallel design randomised clinical trial was carried out with prior approval from the Institutional Ethical Committee (IGIDSIEC2022 NRP34PGPSPPD), and the trial was registered with the Clinical Trials Registry-India (CTRI/2022/10/046330). The protocol is in compliance with the ethical standards of the Declaration of Helsinki [6]. Willing participants with informed consent and who satisfied the eligibility criteria were recruited for the study.

Inclusion criteria: The study participants selected were five to seven-year-old children reporting for the first time to the Outpatient Department (OPD) of Paediatric and Preventive Dentistry with occlusal caries in molars (WHO-D3 lesion) [7], requiring caries excavation followed by Glass Ionomer Cement (GIC) restoration were included in the study.

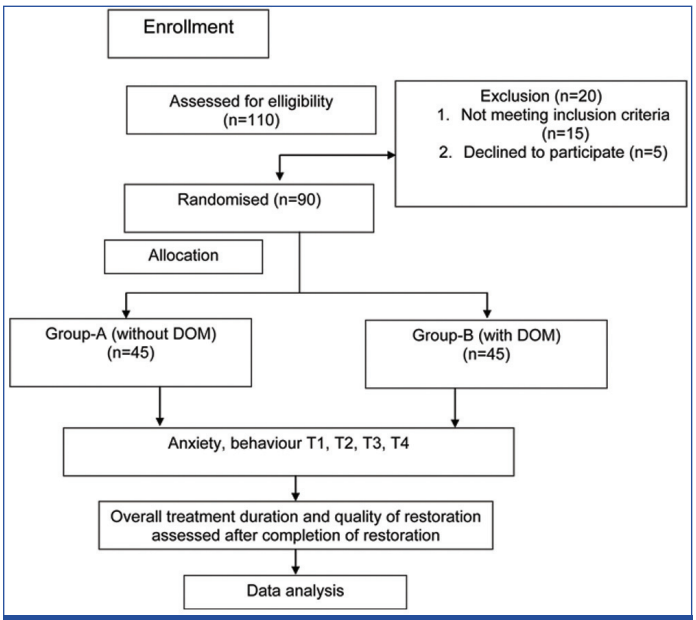
Exclusion criteria: Children with prior exposure to dental treatment and teeth with signs and symptoms of irreversible pulpitis or mobility were excluded from the study.

Sample size calculation: The sample size was calculated based on the data obtained from Sayed A et al., with a significance level of 5%, study power of 80%, alpha=0.05, beta=0.2, expected effect

size (d)=0.6, and ratio (r)=1 [3]. The estimated sample size was 45 per group.

$$n \geq \left(\frac{1+r}{r}\right)\frac{\left(Z_{1-\alpha/2}+Z_{1-\beta}\right)^2}{d^2}+\frac{Z^2_{1-\alpha/2}}{2(1+r)}$$

Participants were randomly allocated by the coin toss method into two groups: Group A (n=45): tell-show-do with rotary and hand caries excavation followed by restoration without a DOM, and the child visualised the procedure using a handheld mirror; and Group B (n=45): tell-show-do with rotary and hand caries excavation followed by restoration under a DOM, with the child viewing the procedure on the live visual output monitor [Table/Fig-1].



[Table/Fig-1]: Consolidated Standards of Reporting Trials (CONSORT) flowchart on patient enrollment and study process.

Study Procedure

The tell-show-do technique of caries excavation procedure using a handpiece, followed by the selection of the restorative material, was shown and explained before the commencement of the restorative procedure. The entire procedure was recorded, and the outcomes were assessed by an independent observer. The assessed outcomes included anxiety, behaviour, treatment duration, and the quality of caries excavation. DOM Seiler IQ was used, and the visual output monitor was positioned in such a way that the participant could view the entire procedure. The restorative procedures performed in all participants adhered to the standard guidelines. The primary outcome measures were anxiety, behaviour, and treatment duration.

Anxiety was scored at various time points: (T1) start of the procedure, (T2) after the tell-show-do procedure, (T3) after cavity preparation, and (T4) after completion of the restoration. The Facial Image Scale (FIS), a pre-validated scale, was used to assess anxiety. The child was instructed to point to the image that best represented how they felt at these various time points. FIS is a state measure of children's dental anxiety and comprises a row of five faces ranging from very happy to very unhappy, with scores ranging from 1 to 5, where 5 indicates the highest anxiety [8].

To overcome the drawbacks of self-reported scales due to the influence of the child's cognitive ability and situational factors on the outcome, behaviour was assessed by an independent assessor using video recordings of the entire procedure at various time points: (T1) start of the procedure, (T2) after the tell-show-do procedure, (T3) during cavity preparation, and (T4) after completion of the restoration. Modified Venham behavior rating scale, a 6-point scale with scale points anchored in objective, specific, and readily observable behaviour, was used. The dentist indicated the patient's behaviour by selecting a number from 0 to 5 according to the scale after the dental visit or at specific time points during the visit [9]. A pulse oximeter was used to measure the pulse rate throughout the procedure, which was clipped to the child's thumb. The duration of the treatment was recorded from the start of cavity preparation until the completion of the restoration using a stopwatch.

The secondary outcome, caries removal efficacy, was assessed using visual and tactile criteria as given by Bjørndal L and Thylstrup A [10]. The criteria monitored clinical changes in the dentin after caries excavation. Clinical recordings of dentin colour and consistency were made. The colour of the demineralised dentin in the central part was classified as light yellow, yellow, light brown, dark brown, or black. The consistency of dentin was classified as very soft, soft, medium hard, or hard. The criteria assessed the changes in the dentin after proper excavation, providing information about the arrest of further lesion progression and facilitating the final and complete excavation without exposing the pulp [10].

STATISTICAL ANALYSIS

The obtained data were subjected to statistical analysis using Statistical Package for the Social Sciences (SPSS) software version 16.0. Descriptive statistics used were mean and standard deviation for treatment time, pulse rate, and frequency for anxiety, behaviour, and caries removal efficacy. The Chi-square test was used for anxiety, behaviour, and caries removal efficacy, and the independent t-test was used for pulse rate and duration. For all tests, the level of significance was set at p<0.05.

RESULTS

Out of the 90 children who participated in the study, 47 were girls (52%) and 43 were boys (47%). A statistically significant reduction in anxiety level (p<0.001*) [Table/Fig-2] and improved behaviour (p<0.001*) [Table/Fig-3] was observed at T3 and T4 in group B.

Variable		Score	Groups A n (%)	Groups B n (%)	Chi-square	p-value
Anxiety	T1	1	44.4	40.0	7.5	0.058
		2	58.7	60.0		
		3	0	0		
	T2	1	72.9	75.6	28.9	0.053
		2	21.8	24.4		
		3	5.3	0		
	T3	1	11.1	93.3	61.5	<0.001**
		2	48.9	6.7		
		3	40.0	0		
	T4	1	8.9	95.6	67.9	<0.001**
		2	53.3	4.4		
		3	37.8	0		

[Table/Fig-2]: Comparison of anxiety scores at different time intervals among two groups.
**Statistically significant

The pulse rate at the start of the procedure was high in both groups, but it was not statistically significant (p=0.067). The average pulse rate, expressed as Mean±SD, was significantly lower (p<0.001) during caries excavation among participants in Group B (92.6±3.1) compared to group A (100.8±3.5) [Table/Fig-4]. When cavity preparation was completed, participants in Group B (with DOM) recorded a stable pulse rate of 93.2±2.68 beats/min. The mean treatment time was also found to be significantly shorter (p<0.001**) when DOM was used (5.07±0.7 minutes) compared to group A (5.67±0.8 minutes) [Table/Fig-4]. Caries excavation based on visual (71.1%) and tactile (95.6%) sensation was found to be significantly efficient (p<0.001**) when DOM was used [Table/Fig-5].

Variable		Score	Groups A n (%)	Groups B n (%)	Chi-square	p-value
Behaviour	T1	0	31.9%	47.0%	49.542	0.071
		1	62.2 %	44.4%		
		2	5.9%	8.6%		
	T2	0	38.8%	41.5%	46.625	0.067
		1	61.2%	58.5%		
		2	0%	0%		
	T3	0	8.9%	88.9%	58.580	<0.001**
		1	60.0%	11.1%		
		2	31.1%	0%		
	T4	0	6.7%	84.4%	56.322	<0.001**
		1	64.4%	15.6%		
		2	28.9%	0%		

[Table/Fig-3]: Comparison of behaviour scores at different time intervals among two groups.
**Statistically significant

Variables	Mean (SD) Group A	Mean (SD) Group B	t-value	p-value
Pulse rate (beats/min) (during caries excavation)	100.89 (3.5)	92.60 (3.1)	12.035	<0.001**
Duration (minutes)	5.67 (0.8)	5.07 (0.7)	3.434	<0.001**

[Table/Fig-4]: Comparison of pulse rate and treatment duration among two groups.
**Statistically significant

Variables	Score	Group N (%) A n (%)	Group N (%) B n (%)	Chi-square test	p-value
Tactile code (consistency)	Medium hard	22 (48.9%)	43 (95.6%)	24.425	<0.001**
	Hard	23 (51.1%)	2 (4.4%)		
Visual code (colour)	Light yellow	1 (57.8%)	32 (71.1%)	66.312	<0.001**
	Yellow	8 (17.8%)	13 (28.9%)		
	Light brown	26 (2.2%)	0 (0%)		
	Dark brown	10 (22.2%)	0 (0%)		

[Table/Fig-5]: Caries removal efficacy among two groups using Visual-Tactile criteria.
**Statistically significant

DISCUSSION

There is only one study in the literature that measured anxiety and psychophysiological responses using DOM, hence sufficient comparison of the present study results is limited. The TSD technique of behaviour management is a gold standard method for managing paediatric patients experiencing dentistry for the first time [11]. Only five to seven-year-old children were included in this study as they can overcome their anxiety about dental procedures as the dentist uses logical reasoning to explain what is being done [12]. The present study used a self-reported anxiety scale (FIS) to assess anxiety in the participants. Although the FIS is a good tool to assess anxiety in children, a pulse oximeter, which is a reflection of physiological changes that occur in the body in response to stress and anxiety during dental treatment, was used as an adjunct to assess anxiety [2].

The findings of this study report that anxiety scores decreased significantly and behaviour improved at T3 (cavity preparation) in Group B, which could be attributed to the child being distracted by viewing the visual output monitor that masked the sight of the handpiece, and therefore, the authors reported greater acceptance of the treatment. Sayed A et al., in their study, found that a greater percentage of patients in the group treated under DOM had improved anxiety scores along with improved overall behaviour in children, while an increase in pulse rate was noted [3].

At the start of the procedure and during the procedure, the pulse rate was found to be high in both groups, possibly due to the sight and/or sound of the dental handpiece and/or DOM [13]. But after cavity preparation was completed, participants in Group B (with DOM) recorded a stable pulse rate of 93.2±2.68 beats/min. In group A, the handheld mirror, although serving as a good distraction technique, resulted in unstable body movements as the child got fatigued holding the mirror or started using the mirror to observe things other than what is being carried out in their mouth. Behaviour significantly improved in group B during cavity preparation and even after the completion of the procedure. The DOM's visual output demonstrates the exquisite detailing of intraoral treatments. It has been demonstrated that using DOM helps with intraoral caries detection [4]. An intriguing finding from the present study was that children in Group B were more focused on the video output, which resulted in fewer body movements. They also inquired about any lingering questions concerning the carious tooth or the course of treatment as a whole. The improved behaviour is brought on by a better understanding of the procedure after watching the visual output, which also served as a distraction tool [3].

The length of treatment has a significant impact on how a paediatric child responds. It is well known that children get restless and exhibit uncooperative behaviour when the dental procedure goes beyond 30 minutes [14]. In the current study, the mean treatment time was shorter in group B where DOM was used compared to group A. Watching caries excavation on the monitor may provide more credibility to the child and could have been the reason for fewer body movements in the present study. With reduced anxiety and improved behaviour, the operator was able to complete the procedure in a shorter duration when using DOM. The shorter treatment duration creates a positive impact on the child's behaviour and cooperation throughout the treatment and thereby reduces operator fatigue [15]. Similar findings were reported by Anusree et al., when magnifying loupes were used for pulpectomy procedures [15].

A precise controlled excavation can be achieved through the use of appropriate magnifying tools, and DOM is one of them. DOM provides a precise and accurate assessment during the course of excavation [16]. The observation from the present study reported increased caries removal efficacy in group B because of the enhanced vision provided to the operator by using DOM. In addition, patient compliance also contributed to the shorter treatment duration. Mehrabian A and Ferris SR stated that only 7% of comprehension in communication comes from words used, while 55% of understanding that occurs in verbal communication is through visual cues [17]. The authors of the present study made an attempt to determine the feasibility of DOM to be introduced for routine paediatric practice. Future studies on a larger sample size and other paediatric procedures are required to validate the effectiveness of DOM in reducing anxiety in children.

Limitation(s)

A crossover trial, instead of a parallel design, could have been a more justifiable research approach for validating anxiety and behaviour levels.

CONCLUSION(S)

The overall behaviour was improved by projecting the DOM's visual output since it acted as a distraction aid. When DOM was utilised, there was a reduction in anxiety levels, and the pulse rate remained stable during cavity preparation and after completion of the procedure. Under DOM, the length of the treatment was significantly shortened, and the efficacy of caries excavation was increased due to precise and accurate assessment.

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