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Original Article

Impact of Rubber Dam Use on Anxiety Levels in Children during Dental Procedures: A Randomized Controlled Study

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ABSTRACT

Effective isolation is essential for high-quality dental treatment. However, many clinicians hesitate to use rubber dams in pediatric patients due to concerns that they may trigger anxiety and negatively impact the dentist-child rapport, ultimately affecting the quality of treatment. This reluctance has led to the limited use of rubber dams in pediatric dentistry. This study aimed to evaluate anxiety levels in children aged 6 to 10 years undergoing dental procedures with and without rubber dam placement using the Animoji scale. A total of 48 children in this age group were selected and divided into 2 groups: group 1 (cotton roll isolation) and group 2 (rubber dam isolation). Anxiety levels were measured using the Animoji scale, which ranges from score 1 (very happy) to score 5 (very unhappy). Data were analyzed using SPSS version 24.0 (IBM corporation, Chicago, USA), using descriptive and analytical statistical methods. An independent t-test was used to compare the anxiety levels between the two groups. The results showed that there was no statistically significant difference in anxiety levels between the two groups ($P > 0.05$). Based on these findings, the use of rubber dams does not appear to cause a significant increase in anxiety among pediatric patients. Given their benefits, rubber dams should be considered a valuable tool in pediatric dentistry to enhance the quality of treatment.

Keywords: Rubber dam, Anxiety, Animoji scale, Pediatric dentistry

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Introduction

Children's lack of cooperation during dental procedures has been studied from various perspectives. Dental fear and anxiety are recognized as early indicators of dental phobia—an excessive or irrational fear that can significantly affect daily life and lead to delayed dental care [1]. Dental anxiety in children has been acknowledged as a public health concern in multiple countries and has been extensively researched [2-4]. In the late 1960s, Norman Corah developed the dental anxiety scale (DAS) as a framework to assess this issue [5].

Dental anxiety refers to a state of apprehension regarding dental treatment, often accompanied by a perceived loss of control. On the other hand, dental fear is a more severe form of anxiety, characterized by persistent distress related to specific dental procedures or objects, such as drills or injections. Lautch [6] explored whether this fear was associated with the nature of dental care and its characteristics. Gale emphasized the importance of assessing a patient's perception of their situation rather than focusing solely on pain levels when evaluating dental fear [7-9]. Research by Moore *et al.* examined demographic trends about the causes and intensity of dental fear [10-12]. Despite advancements in dental health, many

children still exhibit significant fear toward dental treatment [13]. Holtzman *et al*. [14] reported that individuals with dental anxiety frequently miss scheduled appointments due to their fear. Furthermore, several studies have highlighted that dental fear in children can lead to behavioral challenges during treatment [15-17], with injections, drilling, and extractions being among the most anxiety-inducing procedures [18, 19]. In a study of children aged 5 to 11 years, Milgrom *et al*. [20] suggested that conditioning plays a major role in the development of dental fear during childhood and adolescence. Estimates of dental fear prevalence in children vary widely, ranging from 3% to 43% across different populations [21].

Anxiety levels in children tend to rise when they encounter complex dental instruments, leading to hesitation among dentists to use rubber dams, as they believe it may heighten anxiety and weaken their rapport with the child. Additionally, some practitioners assume that rubber dam placement prolongs treatment time. However, studies indicate that many patients perceive procedures as occurring outside their oral cavity once the rubber dam is in place, allowing them to tolerate longer treatments [22]. The use of rubber dams offers several advantages, including enhanced patient safety, better treatment outcomes, improved visibility, and increased comfort during procedures. Another crucial benefit, particularly in the context of the COVID-19 pandemic, is that rubber dams can reduce the spread of infectious droplets and aerosols from saliva or blood by approximately 70% within one minute [23].

A reliable anxiety scale is essential for clinical use—one that is practical, time-efficient, visually engaging, and suitable for young children with limited cognitive and language skills while also incorporating a clear scoring system. Considering these factors, this study utilized a novel anxiety assessment tool known as the animated emoji scale (animoji), which integrates both motion and emotional expressions [24]. This approach was chosen based on the modern generation's preference for digital media and their greater engagement with animated visuals on electronic devices compared to static cartoon images on paper.

With this in mind, the study aimed to evaluate anxiety levels in children undergoing dental treatment both with and without the use of a rubber dam, using the animoji scale as a measurement tool. The null hypothesis states that there will be no significant difference in anxiety levels between children treated with a rubber dam and those treated without one.

Materials and Methods

This study was conducted in the Department of Pediatric and Preventive Dentistry at Saveetha Dental College and Hospitals, a university hospital in Chennai, India. The research followed a randomized, double-blinded, clinical controlled trial design. Ethical approval for the study was granted by the Institutional Review Board (IHEC/SDC/UG-1721/19/PEDO/568).

To determine the appropriate sample size, calculations were performed using G-Power software version 3.0.10, with a statistical power of 95% and an alpha error set at 0.05. Initially, eighty children who required pit and fissure sealants during their first dental visit were selected using a simple random sampling method. However, after applying the inclusion and exclusion criteria, 32 children were disqualified from the study. The final sample consisted of 48 children, aged between 6 and 10 years, who met the eligibility criteria and provided informed consent along with their parents.

Children included in the study were those aged between 6 and 10 years, requiring pit and fissure sealant application, with fully erupted lower permanent molars and attending their first dental visit after oral prophylaxis. However, children with other dental conditions such as pulpitis and its sequelae, a history of dental pain or phobia, systemic diseases, or medical complications were excluded. Additionally, special-needs children, those who were medically compromised, or had latex allergies were not considered. Participants rated as negative or negative on Frankl's Behavior Rating Scale were also excluded, along with those diagnosed with anxiety disorders or exhibiting altered heart rate or blood pressure before the procedure.

The selected children were divided into two groups. The first group consisted of children who underwent pit and fissure sealant application using the cotton roll isolation method. The second group included children who received pit and fissure sealants with rubber dam isolation.

A total of 48 children between the ages of 6 and 10 years, accompanied by their parents, participated in the study after providing informed consent and meeting the required inclusion and exclusion criteria. Any child who exhibited negative behavior during oral prophylaxis was excluded from the study. To ensure baseline comparability, vital signs, including heart rate and blood pressure, were recorded both after and before the intervention.

For isolation techniques, group 1 underwent pit and fissure sealant application using buccal and lingual cotton rolls, whereas group 2 received treatment under rubber dam isolation. Once the procedure was

completed, anxiety levels were measured using the animoji scale. This scale, developed by Shetty *et al.* [24], utilizes animated emojis ranging from 1 (depicting a very happy expression) to 5 (representing a very unhappy expression) to evaluate emotional responses. The scale consists of five animated emoji graphics that progressively express emotions from extreme happiness and laughter to sadness and crying, reflecting varying degrees of discomfort or anxiety.

Each child was told to observe the animated emojis displayed in a video format on an electronic screen and select the one that best represented their current emotional state. To validate the chosen score, vital signs were reassessed after emoji selection. All treatments were carried out by one operator to maintain consistency. Additionally, an independent examiner was responsible for recording each child's selected emoji score, which was then forwarded to a data analyst. Both the examiner and data analyst remained blinded to the study conditions to prevent potential bias in data interpretation **(Figures 1 and 2)**.

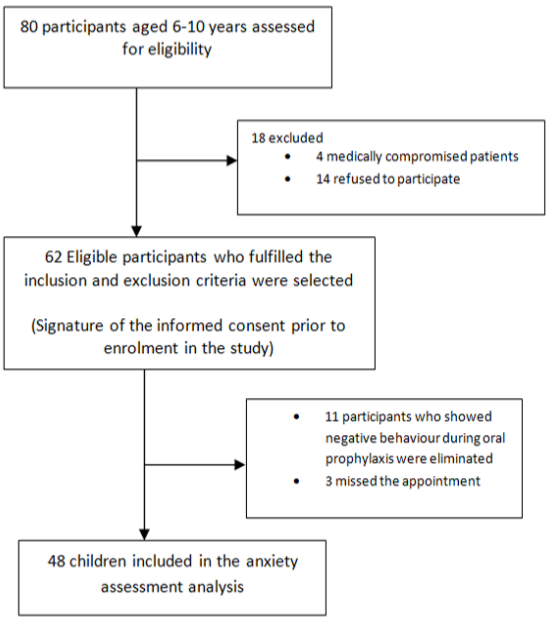

Figure 1. Flow diagram showing patient selection for the study

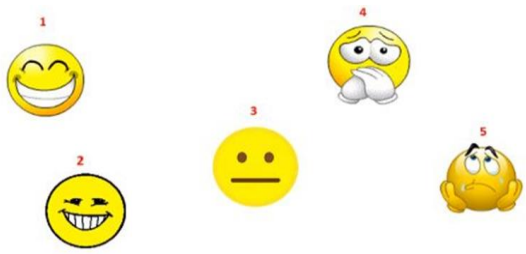

Figure 2. Animoji scale representing score 1 to score 5 (very happy to very unhappy)

The collected data were subjected to statistical analysis using SPSS (Statistical Package for Social Sciences) version 24.0 (IBM Corporation, Chicago, USA). Both descriptive and analytical statistical methods were applied. To evaluate the differences in anxiety levels between the two groups, an independent t-test was conducted. A significance threshold of $P < 0.05$ was established for statistical interpretation.

Results and Discussion

Out of the 48 children included in the study, the sample was evenly distributed between genders, with 24 males (50%) and 24 females (50%). The comparison of anxiety score distribution between the two groups is presented in **Table 1**. In the cotton roll isolation group, 87.5% of participants recorded a score of 1 (very happy), while 12.5% received a score of 2. Similarly, in the rubber dam group, 79.2% of children scored 1, whereas 20.8% were assigned a score of 2. A majority of participants in both groups reported a score of 1, indicating minimal anxiety. The statistical analysis revealed no difference in anxiety levels between the groups, with a t-value of 0.763 and a P-value of 0.449 ($P > 0.05$) **(Figure 3)**.

When evaluating anxiety scores based on gender, findings in the cotton roll group showed that most male participants exhibited low anxiety, with 84.6% scoring 1 and 15.4% scoring 2. Among females, 90.9% reported a score of 1, while 9.1% scored 2. Statistical analysis confirmed no significant difference between genders, as indicated by a chi-square value of 0.216 and a P-value of 0.642 ($P > 0.05$). In the rubber dam group, 69.2% of female participants scored 1, while 30.8% scored 2. Among male participants, 90.9% recorded a score of 1, with only one child (9.1%) scoring 2. However, the chi-square test demonstrated no significant difference in anxiety levels between males and females ($P = 0.193$, $P > 0.05$) **(Table 2)**.

In terms of age-related differences in anxiety levels, no significant association was observed between the 2 groups. In the cotton roll group, children aged 6 to 8 years showed 81.25% with a score of 1 and 18.95% with a score of 2. Among children aged 9 to 10 years, all participants (100%) reported a score of 1, signifying a very happy response. No significant difference was found, as reflected by a chi-square value of 1.174 and a P-value of 0.190 ($P > 0.05$). Similarly, in the rubber dam group, 84.62% of children aged 6 to 8 years received a score of 1, while 15.38% scored 2. Among those aged 9 to 10 years, 90.9% scored 1, and 9.1% scored 2. Again, no statistically significant difference was noted, with a chi-square value of 0.216 and a P-value of 0.642 ($P > 0.05$) **(Table 3)**.

Based on these findings, the study confirmed the null hypothesis, demonstrating that there was no difference in anxiety levels between children treated with rubber dam isolation and those treated with cotton roll isolation.

Table 1. Comparison of anxiety score distribution between the two groups

Group	Score 1	Score 2	95% CI		SE	t-value	P-value#
Cotton roll (n = 24)	87.5%	12.5%	-0.303	0.136	0.109	0.763	0.449
Rubber dam (n = 24)	79.20%	20.80%	-0.303	0.136			

#P-value was derived from an independent t-test significant at the level of 0.05

Table 2. Comparison of anxiety score between gender

Groups	Gender	Score 1 n (%)	Score 2 n (%)	Total	x^2-value	P-value#
Cotton roll	Male	11 (84.6%)	2 (15.4%)	13 (100%)	0.216	0.642
	Female	10 (90.9%)	1 (9.1%)	11 (100%)		
Rubber dam	Male	10 (90.9%)	1 (9.1%)	11 (100%)	1.698	0.193
	Female	9 (69.2%)	4 (30.8%)	13 (100%)		

#P-value derived from chi-square test

Table 3. Comparison of anxiety score between age groups

Groups	Age group	Score 1 n (%)	Score 2 n (%)	Total	x^2-value	P-value#
Cotton roll	6-8 years	13 (81.25%)	3 (18.95%)	16 (100%)	1.174	0.190
	9-10 years	8 (100%)	0 (0%)	8 (100%)		
Rubber dam	6-8 years	11 (84.62%)	2 (15.38%)	13 (100%)	0.216	0.642
	9-10 years	10 (90.90%)	1 (9.1%)	11 (100%)		

#P-value derived from chi-square test

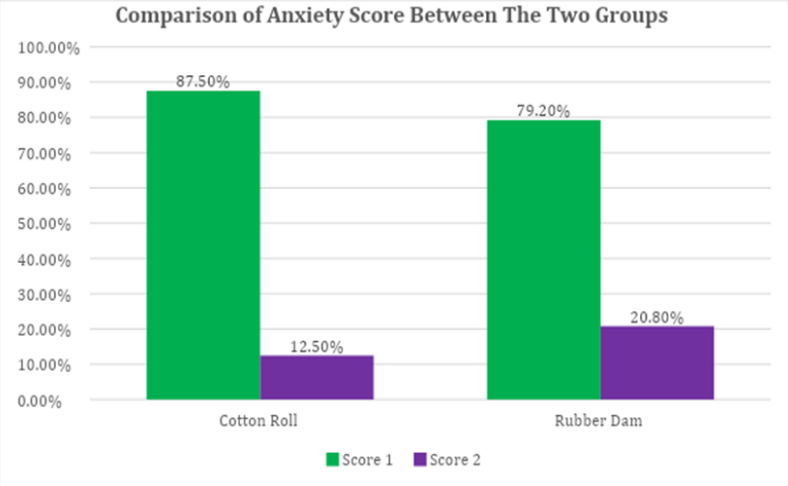

Figure 3. Comparison of anxiety score distribution between the two groups

Proper isolation plays a vital role in ensuring the effectiveness and longevity of dental restorations. Maintaining a well-isolated working field is essential for enhancing the durability of restorations. One of the key advantages of using a rubber dam, apart from improving patient safety, optimizing treatment outcomes, and enhancing the dentist's field of vision, is its ability to make the patient feel more at ease during procedures. Research has demonstrated that fissure sealants show significantly higher retention rates one year after application when rubber dams are used compared to relative isolation techniques [25].

Beyond isolation, rubber dams offer multiple additional benefits, as highlighted in previous studies. These include preventing accidental aspiration of dental instruments, maintaining a clean working area, protecting soft tissues, and significantly reducing the presence of infectious aerosols [26-28]. Some

researchers have suggested that patients often perceive treatment as occurring outside their oral cavity when a rubber dam is applied, which may allow children to endure longer procedures more comfortably [29]. Furthermore, experienced clinicians report that using a rubber dam can save time, as it eliminates the need for frequent cotton roll replacements. Given that many restorative materials are hydrophobic, maintaining a dry field through proper isolation is crucial for ensuring the quality and durability of restorations [30].

A study conducted by Al-Sabri *et al*. [31] revealed that dental students demonstrated limited use of rubber dams, emphasizing the need for increased awareness and education regarding their benefits. Similarly, research by Leal *et al*. [32] suggested that the use of dental instruments, including rubber dams, may contribute to increased anxiety levels in pediatric patients, which could explain some dentists' reluctance to use them in pediatric dentistry. This concern provided the foundation for the present study. However, the findings of this study indicated no significant difference in children's anxiety levels regarding the use of rubber dam isolation, suggesting that it does not contribute to additional stress in young patients. These results align with those of Amman *et al*. [29] and Vijaynath [33], who reported similar findings. Vijaynath [33] employed both the FLACC (Face, Legs, Activity, Cry, Consolability) scale and a facial image scale to assess children's anxiety levels both objectively and subjectively. In another study, Saha *et al*. [34] found that children between the ages of two and seven exhibited lower levels of dental anxiety compared to older children. Research conducted by Arshid Khanday *et al*. [35] also supports the notion that children experience reduced stress when a rubber dam is used for isolation. Likewise, Vanhée *et al*. [36] concluded that rubber dam application helps minimize stress in young patients during dental treatment, consistent with the findings of the present study.

Additional research by Pol *et al*. [37] suggested that patients experienced less stress when rubber dams were used compared to cotton rolls and saliva ejectors. Brandstetter [38] noted that dentists working with rubber dams exhibited lower heart rate and circulatory stress, which was interpreted as a sign of relaxation. Meanwhile, McKay *et al*. [39] observed that while most pediatric patients found rubber dams physically and psychologically acceptable, some expressed concern about the visibility of the rubber dam to others. A study by Orafi and Hammad [40] also reported a positive attitude toward rubber dam use among participants. Regarding age-related variations in anxiety, the present study found that children aged 6 to 8 years exhibited mild anxiety levels compared to those aged 9 to 10 years. These results are consistent with the findings of Vlad *et al*. [41], who identified a higher prevalence of dental anxiety among children aged 6 to 9 years.

When examining gender differences in anxiety levels, the results of this study indicated that female participants were more likely to score 2 on the anxiety scale, suggesting mild anxiety, in comparison to male participants. This aligns with the research conducted by Gaber *et al*. [42], which concluded that girls tend to experience greater dental anxiety than boys. Similarly, studies by Vlad *et al*. [41] also found that girls had a higher likelihood of experiencing dental anxiety compared to their male counterparts [41, 43].

Existing research highlights multiple methods for evaluating dental anxiety, yet each comes with its own set of limitations. To overcome these challenges, the present study utilized the animated emoji scale developed by Shetty *et al*. [24], which incorporates motion and emoticons to assess anxiety levels. This scale was selected due to its ease of clinical application, time efficiency, and engaging nature. Given the increasing preference of the younger generation for multimedia content [44], this tool effectively captures children's emotional responses to dental anxiety in an individualized manner.

The animated emoji scale offers several advantages, making it highly suitable for pediatric patients. It is visually engaging, child-friendly, and particularly useful for children with limited linguistic and cognitive abilities. The scale allows children to easily relate to emotions, eliminates the need for language-based questionnaires, provides an immediate anxiety score, and can be applied universally across both genders. These benefits justified its use in the current study.

Previous studies assessing anxiety levels related to rubber dam application have relied on tools such as the visual analog scale, facial image scale, and Venham's anxiety scale. However, this research marks the first attempt to evaluate anxiety associated with rubber dams using the animoji scale. Pit and fissure sealant application was chosen as the dental procedure in this study because it is associated with minimal anxiety in pediatric patients. More invasive procedures, such as restorative treatments, tend to vary in complexity and could introduce bias, making them less suitable for standardization in this study.

The findings demonstrated that rubber dam isolation did not result in heightened anxiety, as none of the participants selected the most negative (very unhappy) score. One possible explanation for the children's overall acceptance of rubber dam application may be

the cognitive phenomenon of 'centration,' which is commonly observed at this developmental stage. However, further large-scale research is necessary to deepen the understanding of anxiety assessment in children undergoing dental procedures.

Conclusion

Based on the findings of this study, the use of rubber dams does not lead to a significant increase in anxiety levels among children, as measured by the Animoji Scale. Given the numerous benefits associated with rubber dam isolation, it should be integrated into routine pediatric dental procedures to enhance the quality of care provided to young patients.

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Conflict of Interest: None

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Ethics Statement: None

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