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Bridging the Gap Between Rubber Dam Systems and Dental Anxiety: Insights from Pulse Oximetry Monitoring

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Abstract

Introduction: -

"Rubber dam isolation is a fundamental component of **contemporary dental practice**, ensuring an **aseptic and moisture-free working environment.**" However, the conventional system is often time-consuming and may cause patient discomfort and anxiety. To overcome these limitations, newer systems such as the Flexi Dam and Quick Dam have been introduced, aiming to simplify placement, reduce procedural time, and enhance patient comfort."

Materials and methodology: -

A total of 15 patients were included in this comparative observational study. Each patient underwent rubber dam placement using all three systems in separate treatment sessions. Preparation, placement, and removal times were recorded for each system. Patient anxiety was assessed subjectively using the VAS scale and objectively through pulse rate measurements taken before, during, and after rubber dam placement. Data were statistically analyzed using one-way ANOVA and paired t-tests, with $p < 0.05$ considered significant.

Result:

The conventional rubber dam system required significantly longer preparation, placement, and removal times compared to flexi dam and quick dam systems. VAS anxiety scores were highest with the conventional system. Pulse rate increased significantly during placement across all systems but was highest with the conventional technique.

Conclusion:

The study concludes that **Flexi Dam and Quick Dam systems are better alternatives** to the conventional rubber dam, as they provide faster placement and improved patient comfort. Although the conventional rubber dam remains effective but associated with longer procedural time and higher patient anxiety.

Keywords: Rubber dam systems, visual Analogue Scale (VAS), pulse oximeter, procedural time

Introduction

Rubber dam isolation is regarded as one of the most important approach in modern dentistry, particularly in restorative and endodontic procedures, as it ensures a clean and dry operating field. The placement of a rubber dam effectively isolates the teeth from saliva, blood, and other fluids, thereby preventing contamination of the operative site and improving the success rate of dental treatments. In addition, it

enhances visibility for the clinician, reduces the risk of cross-infection, and provides safety by preventing the accidental ingestion or aspiration of small instruments and materials during treatment1. Owing to these benefits, the rubber dam has long been considered the gold standard for isolation procedures in dental practice.

Over time, different rubber dam systems have been introduced in an attempt to improve clinical efficiency and patient comfort. The conventional rubber dam system is the most widely used and traditionally accepted method2. It involves several steps such as selecting and punching the dam, applying clamps, and attaching a frame, all of which can make the procedure time-consuming. "Although this method offers excellent stability and adaptability, it may also cause patient discomfort and heightened anxiety because of the longer placement time and the sensation of clamps. To address these drawbacks, newer alternatives such as the Flexi Dam and Quick Dam have been introduced3. The Flexi Dam, being a pre-framed and flexible rubber dam, simplifies application by eliminating the need for a separate frame. In contrast, the Quick Dam is self-retaining and specifically designed for rapid placement. Both innovations are intended to shorten procedural time and improve overall patient comfort." without compromising on effectiveness.

Despite the proven advantages of rubber dam isolation, patient acceptance still remains a challenge. Many patients report feelings of discomfort or anxiety during placement, which may influence compliance and treatment experience. Anxiety can be assessed using both subjective method, such as the Visual Analogue Scale (VAS), and objective method, such as monitoring physiological changes like pulse rate through a pulse oximeter.4 These tools provide valuable insight into how different rubber dam systems affect patient comfort and stress levels during treatment.

Given these considerations, there is a need to evaluate and compare the effectiveness of various rubber dam systems not only in terms of procedural efficiency but also in relation to patient-centered outcomes such as comfort and anxiety. 1 The present study was designed to compare the conventional rubber dam, flexi dam, and quick dam systems by assessing preparation, placement, and removal time, along with subjective anxiety levels measured through VAS and objective anxiety response measured using pulse rate monitoring. 5

This study aims to comparatively evaluate three different rubber dam systems—conventional rubber dam, Flexi Dam, and Quick Dam—by analyzing preparation, placement, and removal times, along with patient anxiety levels and physiological stress responses measured using a pulse oximeter. 6 Unlike previous studies, this research highlights the inclusion of the Quick Dam system and adopts a combined clinical and physiological assessment approach, providing a more comprehensive evaluation of isolation methods to determine the most favorable balance between clinical efficiency and patient comfort in routine dental practice. 2,7

Material And Methods: -

Study Design

This was a short prospective, randomized clinical study conducted on patients requiring rubber dam isolation for restorative procedures.

The participants were recruited from a pool of patients referred to Dept. of Conservative dentistry and Endodontics, College of dental sciences and research center, Ahmedabad.

Sample Selection

A total of 40 patients were screened for eligibility, out of which 15 patients met the following inclusion criteria and were enrolled in the study. Total three teeth- maxillary and mandibular 2nd premolar and 1st molar were selected for the isolation procedure by simple random sampling. Informed consent was taken from all participants.

Inclusion Criteria:

Maxillary and Mandibular 2nd premolar and 1st molar which required restorative treatment. Patients included in this study were those requiring dental procedures under rubber dam isolation, who were cooperative and willing to participate. Only systemically healthy individuals without any condition that could interfere with pulse rate measurement or anxiety assessment were considered eligible.

Exclusion Criteria:

The study excluded patients with a history of dental anxiety or extreme phobia, as their heightened fear

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could affect anxiety and physiological responses. Those with known latex allergies were also excluded to prevent allergic reactions during rubber dam use. Patients with cardiovascular conditions that could influence pulse rate variability, as well as individuals taking medications such as beta blockers or sedatives that alter heart rate or anxiety levels, were similarly excluded to ensure accurate and unbiased measurements.

Group Allocation

All the 15 recruited patients were randomly allocated to undergo treatment using each of the rubber dam systems:

Group I: Conventional rubber dam system

Group II: Flexi dam system

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Group III: Quick dam system

Each patient underwent dental treatment under one of the above isolation techniques thus, every patient served as their own control, and data from all 15 patients across the three systems were included for final analysis.

Procedure

1. For all patients, standard infection control and operative protocols were followed.
2. Preparation, placement, and removal times were recorded with the help of a digital stopwatch by an independent observer to avoid operator bias.
3. Patient anxiety was assessed immediately after placement using a Visual Analogue Scale (VAS) ranging from 0 (no anxiety) to 10 (extreme anxiety).
4. Pulse rate was measured using a finger pulse oximeter at three different intervals:

1. Before rubber dam placement (baseline)

2. During rubber dam placement

3. After removal of the rubber dam

Outcome Measures

1. Clinical efficiency – measured by mean time required for preparation, placement, and removal of the rubber dam systems.
2. Patient-reported anxiety – recorded using VAS scores.
3. Physiological response – measured by variations in pulse rate at different intervals.

The data from all the groups was recorded in a tabular form and sent for statistical analysis

Result:

Participants And Data Handling

All fifteen participants completed the experimental protocol, and their data were included in the final statistical analysis. The collected information was compiled in Microsoft Excel and processed using SPSS software (Version XX, IBM Corp., Armonk, NY, USA). Descriptive values were expressed as mean ± standard deviation (SD) for continuous parameters. Because each individual was exposed to all three isolation systems, a within-subject comparison framework was employed. For data following a normal distribution, Repeated-Measures ANOVA with Bonferroni correction was used to identify pairwise differences. When normality was not confirmed, the Friedman test followed by Wilcoxon signed-rank analysis was adopted. Differences in categorical anxiety responses were examined using the Chi-square test. Statistical significance was interpreted at $p < 0.05$.

Comparative Analysis of Isolation Systems

Marked variations were observed in placement and preparation durations among the three rubber-dam systems. The conventional dam technique recorded the greatest mean times for placement (29.11 ± 11.69 s) and preparation (58.11 ± 16.96 s). The Flexi Dam required comparatively less time (20.33 ± 8.36 s for placement and 39.31 ± 12.71 s for preparation), whereas the Quick Dam achieved the most time-efficient performance (12.53 ± 4.85 s and 26.52 ± 7.26 s, respectively). These differences were highly significant ($p < 0.001$). Removal durations were

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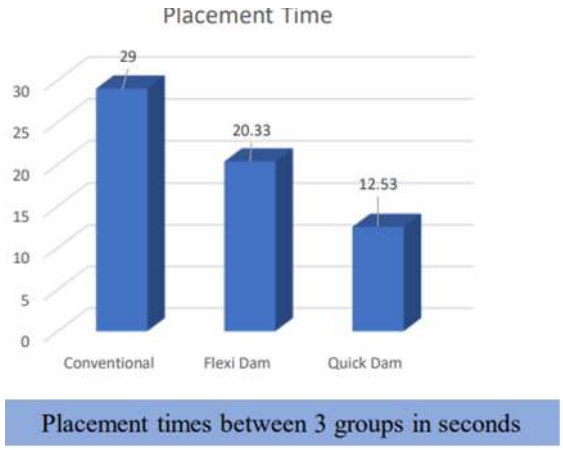
statistically comparable among all groups (p = 0.138), as illustrated in Table 1 and Figure 1.

Table 1- Comparison of Placement Time, Removal Time, Anxiety Levels, and Pulse Rate Fluctuations Among Different Rubber Dam System

	Conventional (N=15) Mean ± SD	Flexi Dam (N=15) Mean ± SD	Quick Dam (N=15) Mean ± SD	F / Welch Statistics (* represents welch test)	P value	Conventional vs Flexi Dam Difference (p value)	Conventional vs Quick Dam Difference (p value)	Flexi Dam vs Quick Dam Difference (p value)
Placement Time	29 ± 11.69	20.33 ± 8.36	12.53 ± 5.54	13.602 *	<0.001	8.67(0.028)	16.47(<0.001)	7.8(0.053)
Removal Time	7.33 ± 3.4	5.93 ± 2.71	5.47 ± 2.26	1.769	0.183	1.4(0.373)	1.87(0.18)	0.47(0.894)
Anxiety level according to VAS scale	62 ± 19.44	55.67 ± 17.61	18.27 ± 19.48	23.542	<0.001	6.33(0.631)	43.73(<0.001)	37.4(<0.001)
Fluctuation of pulse Before	87.27 ± 8.36	84.73 ± 8.5	83.47 ± 9.93	0.7	0.502	2.53(0.721)	3.8(0.482)	1.27(0.921)
Fluctuation of pulse During	87.4 ± 8.37	87.6 ± 9.48	86.4 ± 9.6	0.074	0.929	-0.2(0.998)	1(0.952)	1.2(0.932)
Fluctuation of pulse After	87.33 ± 8.36	85.6 ± 8.88	84.07 ± 9.95	0.485	0.619	1.73(0.861)	3.27(0.591)	1.53(0.889)

Figure 1



Placement times between 3 groups in seconds

Anxiety Evaluation

Assessment through the Visual Analogue Scale (VAS) demonstrated a statistically meaningful difference in patient anxiety across the systems ($p < 0.001$). The conventional dam elicited the highest mean anxiety level (6.2 ± 1.94), followed by the Flexi Dam (5.56 ± 1.76). Participants showed the lowest anxiety response with the Quick Dam (4.87 ± 1.94). These findings are detailed in Table 1 and graphically represented in Figure 2.

Figure 2

Physiologic Response (Pulse Rate)

Monitoring of pulse rate with a pulse oximeter showed transient elevations during rubber-dam placement in all groups compared with baseline readings. However, no statistically relevant differences were found when comparing pulse rate changes among the three systems ($p > 0.05$), as summarized in Table 1 and Figure 3.

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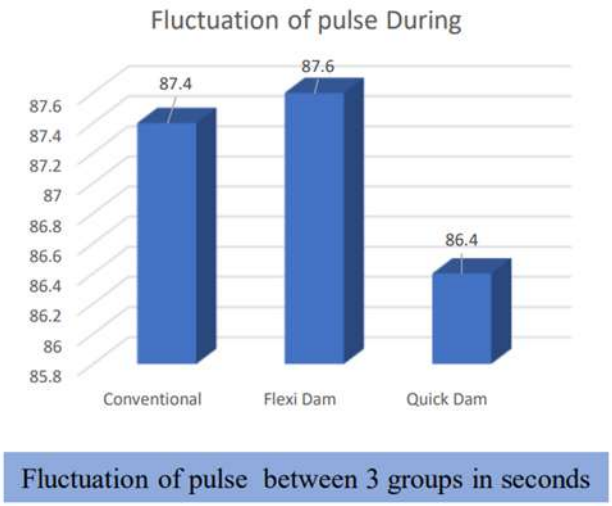
Figure 3



Fluctuation of pulse between 3 groups in seconds

Clinical Interpretation

Considering time efficiency and patient comfort, the Quick Dam demonstrated the most favorable performance. It offered faster clinical workflow and reduced anxiety without compromising procedural stability. Hence, it can be regarded as a clinically advantageous alternative to conventional rubber-dam isolation methods.

Discussion:

Dental anxiety is a common concern in clinical practice and is often heightened during procedures that involve additional isolation devices such as the rubber dam. Patients may perceive rubber dam placement as restrictive, uncomfortable, or anxiety-provoking due to factors like difficulty in breathing, fear of choking, or unfamiliarity with the procedure. Increased anxiety can negatively influence patient cooperation, raise physiological stress responses such as elevated pulse rate, and ultimately affect the overall success of treatment.[4,8] Hence, evaluating patient anxiety and physiological response was an essential part of the present study, along with comparing the clinical efficiency of different rubber dam systems.

The present study compared conventional, flexi, and quick dam systems with respect to efficiency, patient anxiety, and physiological stress responses.[9] The findings demonstrated that the conventional rubber dam required significantly more time for placement compared to the newer systems, corroborating earlier reports that highlighted its technique-sensitive nature and multiple procedural steps. In contrast, the flexi dam and quick dam markedly reduced placement time, with quick dam being the most efficient due to its pre-framed design.

Patient-reported anxiety levels, measured using the Visual Analogue Scale, were highest with the conventional dam. [10] This may be attributed to its longer application time and the more invasive perception associated with clamps and accessories.[11]Flexi and quick dams, particularly the latter, were associated with lower anxiety scores, suggesting that simplified and faster placement enhances patient comfort.[12] These results align with previous studies that have emphasized the role of time efficiency and patient-friendly designs in reducing dental anxiety[13].

Pulse oximeter monitoring showed an increase in pulse rate during placement across all groups, reflecting procedural stress. However, quick dam demonstrated the least fluctuation, indicating that minimal chairside time is advantageous in reducing physiological stress.[6],[14] Although flexi dam showed slightly higher pulse variations compared to quick dam, both newer systems outperformed the conventional dam in promoting patient comfort. [15,16]

Overall, the study highlights those alternative systems like flexi and quick dam not only save time but also contribute to a more positive patient experience,

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making them preferable options in modern restorative and endodontic practice.

Conclusion:

Within the limitations of this study, it can be concluded that the conventional rubber dam system requires longer placement time and is associated with higher patient anxiety compared to flexi and quick dam systems. Both subjective (VAS) and objective (pulse rate) assessments indicated that newer systems provide greater patient comfort, with quick dam being the most time-efficient and least anxiety-inducing. Flexi and quick dam systems therefore represent preferable alternatives for improving clinical efficiency and reducing patient stress during restorative and endodontic procedures.

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