Scholars Journal of Dental Sciences
Abbreviated Key Title: Sch J Dent Sci
ISSN 2394-4951 (Print) | ISSN 2394-496X (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Efficacy of Rubber Dam Isolation as an Infection Control Procedure: A Comparative Study

Dr. Deepika Singla[*1], Dr. Amit Manik[2]

[1]MDS, Reader, Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh, Punjab
[2]MDS, Professor and Head, Department of Oral & Maxillofacial Pathology, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh, Punjab

DOI: 10.36347/sjds.2024.v11i02.002 | **Received:** 03.01.2024 | **Revised:** 06.02.2024 | **Accepted:** 14.03.2024 | **Published:** 29.04.2024

***Corresponding author**: Dr. Deepika Singla
MDS, Reader, Department of Conservative Dentistry & Endodontics, Desh Bhagat Dental College & Hospital, Mandi Gobindgarh, Punjab

Abstract | **Original Research Article**

Background: Infection control in dentistry is critical to prevent cross-contamination. Rubber dam isolation has been proposed as an effective barrier technique; however, its quantitative impact on microbial contamination requires further evaluation. ***Methods:*** A prospective comparative study was conducted on 60 patients undergoing restorative dental procedures. Patients were divided into two groups: procedures performed with rubber dam isolation (Group A, n=30) and without rubber dam (Group B, n=30). Airborne bacterial contamination was assessed using colony-forming units (CFU/m³) collected at standardized distances. Statistical analysis was performed using independent t-test and chi-square test. ***Results:*** Group A demonstrated significantly lower mean CFU counts (48.6 ± 12.4 CFU/m³) compared to Group B (132.8 ± 28.7 CFU/m³) ($p<0.001$). Surface contamination and operator exposure were also significantly reduced in the rubber dam group. ***Conclusion:*** Rubber dam isolation significantly reduces microbial contamination in dental procedures, supporting its role as an essential infection control measure.

Keywords: Rubber dam, Infection control, Dental aerosols, Cross-contamination, Microbial load.

1. INTRODUCTION

Infection control remains a cornerstone of modern dental practice due to the high risk of cross-contamination from saliva, blood, and aerosol-generating procedures. Dental operatory environments are particularly susceptible to microbial dissemination, especially during procedures involving rotary instruments and ultrasonic devices. These procedures produce aerosols and splatter that may carry pathogenic microorganisms, posing risks to both patients and healthcare professionals [1,2].

The global emergence of infectious diseases, including the COVID-19 pandemic, has further emphasized the importance of stringent infection control measures in dental settings. Studies have demonstrated that dental aerosols can remain suspended in the air for extended periods and travel significant distances, thereby increasing the risk of airborne transmission [3,4].

Rubber dam isolation is a well-established technique in dentistry, primarily used to provide a clean and dry operating field. It involves the placement of a latex or non-latex sheet around the tooth being treated, effectively isolating it from the oral environment. Beyond its mechanical advantages, rubber dam isolation has been proposed as a critical infection control barrier that limits the spread of saliva- and blood-borne microorganisms [5].

Previous studies have reported that rubber dam usage can reduce airborne bacterial contamination by up to 70–98%, depending on procedural variables and environmental conditions [6,7]. Additionally, it minimizes direct contact with oral fluids, thereby reducing the risk of transmission of pathogens such as hepatitis B virus, hepatitis C virus, and human immunodeficiency virus [8].

Despite these advantages, the routine use of rubber dam isolation in clinical practice remains inconsistent due to factors such as perceived difficulty, increased chairside time, and patient discomfort. Moreover, there is variability in the existing literature regarding the magnitude of its effectiveness in reducing microbial load under standardized conditions [9].

A key parameter in assessing infection control efficacy is the measurement of colony-forming units (CFU), which provides a quantitative estimate of microbial contamination in the environment. Air sampling techniques allow for objective comparison between different procedural setups, enabling researchers to evaluate the effectiveness of infection control interventions such as rubber dam isolation [10].

In addition to airborne contamination, surface contamination and operator exposure are important considerations. Dental personnel are frequently exposed to aerosols containing microorganisms, which may settle on personal protective equipment and operatory surfaces. The use of rubber dam may significantly mitigate these risks by acting as a physical barrier [11].

Recent guidelines from organizations such as the Centers for Disease Control and Prevention and the World Health Organization recommend the use of barrier techniques, including rubber dam isolation, as part of comprehensive infection control strategies in dentistry [12,13]. However, there is a need for contemporary, clinically relevant studies that provide quantitative evidence supporting these recommendations.

Therefore, the present study aims to evaluate the efficacy of rubber dam isolation as an infection control procedure by comparing microbial contamination levels during dental procedures performed with and without rubber dam isolation.

2. MATERIALS AND METHODS

Study Design

A prospective comparative clinical study was conducted in the Department of Conservative Dentistry over a period of 6 months.

Sample Size

A total of 60 patients were included and equally divided:

- **Group A (Rubber dam):** n = 30
- **Group B (Without rubber dam):** n = 30

Inclusion Criteria

- Patients aged 18–60 years
- Indicated for restorative dental procedures
- No active systemic infection

Exclusion Criteria

- Immunocompromised patients
- Patients with oral infections
- Antibiotic use within the last 2 weeks

Procedure

Standardized restorative procedures were performed using high-speed handpieces. In Group A, rubber dam isolation was applied. In Group B, procedures were performed without isolation.

Microbial Sampling

Air samples were collected using settle plates placed:

- 0.5 m from operative field
- 1 m from operative field
- Exposure time: 30 minutes

Outcome Measures

- Airborne microbial contamination (CFU/m³)
- Surface contamination
- Operator exposure

Statistical Analysis

Data were analyzed using:

- Independent t-test
- Chi-square test
- Significance level: $p < 0.05$

3. RESULTS

3.1 Demographic Distribution

Narrative:

The demographic characteristics between the two groups were comparable. The mean age in Group A was 34.2 ± 8.5 years, while in Group B it was 35.6 ± 9.1 years. Gender distribution was also similar, with no statistically significant difference ($p>0.05$), ensuring homogeneity of study groups.

Table 1: Demographic Distribution

Variable	Group A (n=30)	Group B (n=30)	P value
Mean Age (years)	34.2 ± 8.5	35.6 ± 9.1	0.62
Male	16	17	0.79
Female	14	13	

3.2 Airborne Microbial Contamination

Narrative:

A highly significant reduction in airborne microbial load was observed in the rubber dam group. Group A recorded a mean CFU of 48.6 ± 12.4 CFU/m³, whereas Group B showed substantially higher contamination (132.8 ± 28.7 CFU/m³). This difference was statistically highly significant ($p<0.001$), indicating strong efficacy of rubber dam isolation in reducing aerosolized microorganisms.

Table 2: Airborne Microbial Contamination

Parameter	Group A	Group B	P value
CFU/m³ (mean ± SD)	48.6 ± 12.4	132.8 ± 28.7	<0.001

3.3 Surface Contamination

Narrative:

Surface contamination was markedly lower in the rubber dam group. Only 20% of surfaces showed microbial growth in Group A compared to 73.3% in Group B. This demonstrates that rubber dam not only reduces airborne contamination but also limits deposition of microorganisms on clinical surfaces.

Table 3: Surface Contamination

Contamination	Group A	Group B	P value
Present	6 (20%)	22 (73.3%)	<0.001
Absent	24 (80%)	8 (26.7%)	

3.4 Operator Exposure

Narrative:

Operator exposure to microbial contamination was significantly reduced when rubber dam was used. Contamination of protective equipment occurred in 16.7% of cases in Group A compared to 66.7% in Group B ($p<0.001$), highlighting its protective role for dental professionals.

Table 4: Operator Exposure

Exposure	Group A	Group B	P value
Present	5 (16.7%)	20 (66.7%)	<0.001
Absent	25 (83.3%)	10 (33.3%)	

4. DISCUSSION

The present study provides quantitative evidence supporting the effectiveness of rubber dam isolation as a critical infection control measure in dentistry. The findings demonstrate a statistically significant reduction in airborne microbial contamination, surface contamination, and operator exposure when rubber dam isolation is employed during dental procedures.

4.1 Airborne Contamination and Aerosol Reduction

Aerosol generation during dental procedures represents one of the primary routes of microbial dissemination in clinical settings. The use of high-speed handpieces and ultrasonic scalers generates aerosols containing saliva, blood, and microorganisms. These aerosols can remain suspended for extended periods, thereby increasing the risk of airborne transmission.

In this study, the mean CFU count in the rubber dam group (48.6 CFU/m³) was significantly lower compared to the non-rubber dam group (132.8 CFU/m³), reflecting an approximate 63% reduction in airborne microbial load. This aligns closely with the findings of Samaranayake *et al*., who reported a reduction of up to 70% in bacterial aerosols with rubber dam usage [6].

Similarly, Cochran *et al*. demonstrated that rubber dam isolation reduces bacterial contamination by limiting saliva exposure to the operative field [7]. The mechanism underlying this reduction is primarily the physical barrier effect, which prevents oral fluids from becoming aerosolized during procedures.

The relevance of these findings has been amplified in the context of respiratory infectious diseases, particularly COVID-19. Dental aerosols have been implicated as potential vectors for viral transmission, making barrier techniques essential components of infection control protocols [3,4].

4.2 Surface Contamination and Environmental Safety

Surface contamination in dental operatories is an often-overlooked aspect of infection control. Microorganisms present in aerosols eventually settle on clinical surfaces, instruments, and equipment, creating reservoirs for indirect transmission.

In the present study, surface contamination was significantly lower in the rubber dam group (20%) compared to the control group (73.3%). This finding is consistent with the observations of Harrel and Molinari, who reported that dental aerosols contribute substantially to environmental contamination and emphasized the role of barrier techniques in mitigating this risk [11].

Rubber dam isolation reduces contamination by limiting the spread of saliva droplets, which are a primary source of microbial load. Furthermore, it decreases splatter generation, thereby reducing the deposition of microorganisms on surrounding surfaces.

From a clinical standpoint, reduced surface contamination translates to decreased risk of cross-infection between patients and improved overall operatory hygiene. This is particularly important in high-volume dental practices where rapid turnover between patients may compromise thorough disinfection.

4.3 Operator Protection and Occupational Safety

Dental professionals are at constant risk of exposure to infectious agents due to their proximity to the operative field. Aerosols and splatter can contaminate personal protective equipment (PPE), including masks, face shields, and gowns.

The present study demonstrated a significant reduction in operator exposure in the rubber dam group (16.7%) compared to the non-rubber dam group (66.7%). This finding underscores the protective role of rubber dam isolation in safeguarding dental personnel.

Bennett *et al*. highlighted that occupational exposure to aerosols is a major concern in dentistry and recommended the use of barrier techniques to reduce risk [14]. Similarly, guidelines from the Centers for Disease Control and Prevention emphasize the importance of minimizing aerosol exposure through engineering controls and barrier methods [12].

Rubber dam isolation acts as an adjunct to PPE by reducing the microbial load at the source, thereby enhancing the effectiveness of other infection control measures.

4.4 Clinical Implications and Practical Considerations

Despite its proven efficacy, the routine use of rubber dam isolation remains inconsistent in clinical practice. Barriers to its adoption include perceived

complexity, increased procedural time, and patient discomfort.

However, several studies have demonstrated that with adequate training, rubber dam placement can be performed efficiently without significantly increasing chairside time [9]. Moreover, patient acceptance of rubber dam has been shown to be generally favourable, particularly when its benefits are explained.

The integration of rubber dam isolation into routine practice offers multiple advantages beyond infection control, including improved visibility, moisture control, and procedural efficiency. These benefits contribute to better clinical outcomes and enhanced patient safety.

In the era of heightened awareness regarding infection control, particularly following the COVID-19 pandemic, the adoption of evidence-based practices such as rubber dam isolation is essential. Regulatory bodies such as the World Health Organization have emphasized the need for strict infection prevention protocols in healthcare settings, including dentistry [13].

4.5 Comparison with Recent Literature

Recent studies continue to support the findings of the present investigation. Al-Amad *et al*. reported significant reductions in bacterial aerosols with the use of rubber dam and high-volume suction [15]. Similarly, Samaranayake and Peiris emphasized the importance of rubber dam in reducing viral transmission risk during dental procedures [16].

A systematic review by Kohn *et al*. highlighted that barrier techniques, including rubber dam isolation, are among the most effective measures for reducing cross-contamination in dental settings [17]. Additionally, Peng *et al*. demonstrated that aerosol control strategies significantly reduce microbial dissemination in dental clinics [18].

The consistency of these findings across multiple studies strengthens the evidence base supporting rubber dam isolation as a critical infection control measure.

4.6 Strengths and Limitations

Strengths:

- Prospective study design
- Standardized methodology
- Objective quantitative measurement (CFU)
- Clinically relevant outcomes

Limitations:

- Single-center study
- Limited sample size (n=60)
- Did not evaluate viral contamination specifically
- Environmental variables not fully controlled

Future studies with larger sample sizes and multicentric designs are recommended to further validate these findings. Additionally, evaluation of viral load reduction would provide more comprehensive insights into infection control efficacy.

5. CONCLUSION

The present study conclusively demonstrates that rubber dam isolation is an effective infection control measure in dental practice. The use of rubber dam significantly reduces airborne microbial contamination, surface contamination, and operator exposure during dental procedures.

Quantitative analysis revealed a substantial reduction in colony-forming units (CFU) in procedures performed with rubber dam isolation, highlighting its role in minimizing aerosolized microorganisms. Furthermore, the decreased surface contamination and operator exposure emphasize its importance in enhancing environmental safety and occupational protection.

Given the increasing emphasis on infection control in the post-pandemic era, rubber dam isolation should be considered a standard practice rather than an optional adjunct. Its integration into routine dental procedures can significantly reduce the risk of cross-contamination and improve overall clinical safety.

Clinical Significance

- Rubber dam isolation significantly reduces dental aerosol contamination
- Enhances infection control in routine dental procedures
- Protects both patients and dental professionals
- Should be incorporated as a standard clinical protocol

REFERENCES

1. Micik RE, Miller RL, Mazzarella MA, Ryge G. Studies on dental aerobiology. J Dent Res. 1969;48(1):49–56.
2. Harrel SK, Molinari J. Aerosols and splatter in dentistry. J Am Dent Assoc. 2004;135(4):429–437.
3. Peng X, Xu X, Li Y, Cheng L, Zhou X, Ren B. Transmission routes of COVID-19 in dental practice. Int J Oral Sci. 2020;12:9.
4. Zemouri C, de Soet H, Crielaard W, Laheij A. Aerosols in dental practices. PLoS One. 2017;12:e0178007.
5. Cochran MA, Miller CH, Sheldrake MA. The efficacy of the rubber dam. J Am Dent Assoc. 1989;119(1):141–144.
6. Samaranayake LP, Reid J, Evans D. The efficacy of rubber dam isolation. Int Dent J. 1989;39:181–188.
7. Cochran MA *et al*. Aerosol reduction by rubber dam. J Dent Res. 1989.

8. Cleveland JL *et al*. Transmission of blood-borne pathogens. J Am Dent Assoc. 2016;147(9):729–738.
9. Ahmad IA. Rubber dam usage for endodontic treatment. Int Endod J. 2009;42:963–972.
10. Pasquarella C *et al*. Air microbiological sampling. Ann Ig. 2000;12:443–456.
11. Harrel SK. Contamination from dental aerosols. J Am Dent Assoc. 2004.
12. Centers for Disease Control and Prevention. Guidelines for Infection Control in Dental Health-Care Settings. 2003.
13. World Health Organization. Infection prevention and control guidance. 2020.
14. Bennett AM *et al*. Microbial aerosols in dentistry. Br Dent J. 2000; 189:664–667.
15. Al-Amad SH *et al*. Effect of rubber dam on aerosol contamination. J Infect Public Health. 2017; 10:195–200.
16. Samaranayake LP, Peiris M. Severe acute respiratory syndrome. J Am Dent Assoc. 2004; 135:1292–1302.
17. Kohn WG *et al*. Guidelines for infection control. MMWR. 2003;52(RR-17):1–61.
18. Peng X *et al*. Aerosol control strategies in dentistry. Int J Oral Sci. 2020.
19. Veena HR, Mahantesha S, Joseph PA, *et al*. Dissemination of aerosol and splatter. J Infect Public Health. 2015; 8:260–265.
20. Bentley CD, Burkhart NW, Crawford JJ. Evaluating spatter and aerosol contamination. J Am Dent Assoc. 1994; 125:579–584.