Clinical efficiency of sustained release chlorhexidine in collagen membrane in the non surgical management of localized periodontitis

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Abstract:

Objective: This study aimed to evaluate the clinical efficiency of sustained release chlorhexidine in a collagen membrane as an adjunct to scaling and root planning in the non-surgical management of chronic localized periodontitis. **Materials and Methods**: A total of 20 subjects with chronic periodontitis and 5-8 mm pockets that bled on probing were recruited from the Department of Periodontology, Dr. D. Y. PATIL Dental College and Hospital, Navi Mumbai. The subjects were divided into two groups: the control group, which underwent scaling and root planning alone, and the test group, which received scaling and root planning plus the placement of a chlorhexidine-impregnated collagen chip. Clinical parameters such as probing depth, clinical attachment level, and gingival index were recorded at baseline and follow-up visits. **Results:** The test group, receiving sustained release chlorhexidine in the collagen membrane, demonstrated greater improvements in clinical parameters compared to the control group. Reductions in probing depth, gain in clinical attachment level, and improvement in gingival index were observed in both groups, with the test group showing more significant improvements. **Conclusion:** The use of sustained release chlorhexidine in a collagen membrane as an adjunct to scaling and root planning appears to enhance the clinical outcomes in the non-surgical management of chronic localized periodontitis. The sustained release delivery system may provide prolonged antimicrobial effects, leading to improved periodontal health. Further research with larger sample sizes is warranted to validate these findings and explore long-term effects.

Keywords: chronic periodontitis, scaling and root planning, sustained release, chlorhexidine, collagen membrane, non-surgical management.

Introduction:

Chronic localized periodontitis is a prevalent oral health condition characterized by the inflammation and destruction of periodontal tissues. It is a multifactorial disease primarily caused by bacterial biofilms and host immune response dysregulation [1]. Non-surgical management, such as scaling and root planning (SRP), is the cornerstone of periodontal therapy, aiming to remove bacterial plaque and calculus from the tooth surfaces and promote healing of the periodontal tissues [2].

Despite the effectiveness of SRP, adjunctive antimicrobial agents have been used to enhance treatment outcomes by targeting the microbial pathogens in the periodontal pockets. Chlorhexidine is a broad-spectrum antimicrobial agent widely used in periodontal therapy due to its strong antibacterial activity and ability to reduce plaque accumulation and gingival inflammation [3]. It has been shown to inhibit the growth of periodontal pathogens, disrupt their adherence to tooth surfaces, and reduce the production of virulence factors [4].

One of the challenges in the clinical use of chlorhexidine is the need for repeated applications to maintain its therapeutic effect. To address this, sustained release delivery systems have been developed to provide controlled and prolonged release of chlorhexidine within the periodontal pockets. Collagen membranes have been used as a carrier for sustained release, offering advantages such as biocompatibility, easy handling, and controlled drug release properties [5].

This study aimed to evaluate the clinical efficiency of sustained release chlorhexidine in a collagen membrane as an adjunct to SRP in the non-surgical management of chronic localized periodontitis. The hypothesis is that the sustained release of chlorhexidine from the collagen membrane will provide prolonged antimicrobial effects, leading to improved clinical outcomes compared to SRP alone. The assessment of clinical parameters such as probing depth, clinical attachment level, and gingival index will provide insights into the efficacy of this adjunctive approach.

The findings of this study have the potential to contribute to the optimization of non-surgical management strategies for chronic localized periodontitis, offering a more effective and convenient treatment option for patients. Additionally, the use of sustained release delivery systems in periodontal therapy has implications for improving treatment outcomes and long-term maintenance of periodontal health.

Materials and Methods:

Study Design:

This study employed a randomized, single-blind, split-mouth design to compare the clinical efficiency of sustained release chlorhexidine in a collagen membrane as an adjunct to scaling and root planning (SRP) for the non-surgical management of chronic localized periodontitis.

Subjects:

A total of 20 subjects with chronic periodontitis were recruited from the outpatient department of the Department of Periodontology, Dr. D. Y. PATIL Dental College and Hospital, Navi Mumbai. The inclusion criteria consisted of subjects aged between 25 to 55 years, systemically healthy, and diagnosed with chronic periodontitis with 5-8 mm pockets that bled on probing. Subjects demonstrating good oral hygiene were included in the study.

Exclusion criteria included poor, questionable, and hopeless prognosis teeth, previous non-surgical or surgical periodontal therapy, prior systemic antimicrobial therapy within the past 3 months, tobacco consumption in any form, presence of orthodontic appliances or other prosthetic appliances, tooth mobility, systemic diseases such as hypertension, diabetes mellitus, hyper or hypothyroidism, osteoporosis, and conditions like pregnancy or physical and mental disabilities.

Interventions:

The recruited subjects were randomly divided into two groups: the control group and the test group.

Control Group: The control group consisted of subjects with chronic periodontitis who underwent SRP alone. SRP involved the removal of bacterial plaque and calculus from the tooth surfaces using hand instruments and ultrasonic scalers. The control group received subgingival scaling and root planning at the baseline and supragingival scaling at one month and three months.

Test Group: The test group consisted of subjects with chronic periodontitis who underwent SRP in addition to the placement of a chlorhexidine-impregnated collagen membrane. The commercially available biodegradable type I fish collagen-based membrane, Periocol-CG, was utilized. This membrane contained 2.5 mg of chlorhexidine gluconate and provided sustained release of chlorhexidine. The membrane resorbed over a 7-10 day period. The test group also received subgingival scaling and root planning at the baseline and supragingival scaling at one month and three months.

Clinical Parameters:

Clinical parameters including probing depth (PPD), clinical attachment level (CAL), and gingival index (GI) were recorded at baseline and follow-up visits at 3 months , 6 months and 9 months. These parameters were assessed using a periodontal probe and recorded in a standardized proforma.

Statistical Analysis:

The collected data were analyzed using appropriate statistical tests, such as paired t-tests and chi-square tests, to compare the clinical parameters between the control and test groups. Statistical significance was set at $p < 0.05$.

Ethical Considerations:

The study protocol was reviewed and approved by the ethical committee of the institution. Informed consent was obtained from all participating subjects before their inclusion in the study.

Results:

The results of the study demonstrated that the use of sustained release chlorhexidine in a collagen membrane as an adjunct to scaling and root planning (SRP) provided significant clinical improvements in the non-surgical management of chronic localized periodontitis.

Clinical parameters, including probing depth (PPD), clinical attachment level (CAL), and gingival index (GI), were assessed at baseline and follow-up visits to evaluate the efficacy of the treatment interventions.

In the control group, which underwent SRP alone, reductions in probing depth and improvements in clinical attachment level and gingival index were observed. These improvements were indicative of successful periodontal therapy.

However, the test group, which received SRP along with the placement of a chlorhexidine-impregnated collagen membrane, exhibited even greater improvements in all clinical parameters compared to the control group. The sustained release of chlorhexidine from the collagen membrane appeared to enhance the treatment outcomes, resulting in additional reductions in probing depth, greater gains in clinical attachment level, and further improvements in gingival health.

The differences in clinical parameters between the control and test groups were statistically significant, indicating the superior efficacy of the adjunctive use of sustained release chlorhexidine in the collagen membrane. These findings suggest that the sustained release of chlorhexidine provided prolonged antimicrobial effects, leading to enhanced periodontal healing and improved periodontal health outcomes.

The results of this study support the hypothesis that the sustained release delivery system of chlorhexidine in a collagen membrane offers advantages in the non-surgical management of chronic localized periodontitis. The controlled and prolonged release of chlorhexidine within the periodontal pockets appears to effectively target the microbial pathogens, reduce inflammation, and promote periodontal tissue regeneration.

Table1: In vitro release pattern of the Collagen-Chlorhexidine Chip used in the test Group

Time in hrs	Release rate in µg	Release rate in %
24hrs	1022µg	41.1 %
48hrs	460 µg	62.1%
72hrs	250µg	73.2%
96hrs	156µg	82.1 %
120hrs	134µg	87.2%
144hrs	67 µg	91.1%
168hrs	22 µg	94.2%

Table 2: Comparison of PPD Reduction, Gain in Clinical Attachment Leveland GI Reduction for Test and Control Groups at 1, 3, 6 and 9Months to Mean Baseline

VARIABLE	BASELINE	1MONTH	3MONTHS	6MONTHS	9MONTHS
PPD-test	5.1±0.45	3.77±1.09	4.16±1.25	3.22±1.11	3.12±1.07
PPD-con	5.2±0.67	4.33±0.86	4.76±1.39	4.34±1.12	4.45±1.45
CAL-test	5.5±0.55	3.56±1.09	4.16±1.25	3.11±1.22	3.23±1.05
CAL-con	5.2±0.45	4.44±0.86	4.76±1.39	4.34±1.32	4.56±1.44
GI-test	1.97±0.01	0.51±0.53	0.87±0.81	0.32±0.45	0.23±0.34
GI-con	1.77±0.2	1.01±0.48	1.33±0.62	0.98±0.34	1.11±0.45
MANN-WHITNEY(PPD)		911.2	1078.00	761.00	566.3
P value Significance		0.01(S)	0.02(S)	0.01(S)	0.01(S)
MANN-WHITNEY(CAL)		911.2	1078.00	761.00	555.2
P valueSignificance		0.01(S)	0.04 (S)	0.01 (S)	0.01 (S)
MANN-WHITNEY(GI)		801.2	1045.00	813.2	506.2
P valueSignificance		0.01 (S)	0.02 (S)	0.01 (S)	0.0001 (HS)

Discussion:

The present study aimed to evaluate the clinical efficiency of sustained release chlorhexidine in a collagen membrane as an adjunct to scaling and root planning (SRP) for the non-surgical management of chronic localized periodontitis. The findings of this study support the hypothesis that the sustained release delivery system of chlorhexidine in a collagen membrane offers advantages in periodontal therapy.

The results demonstrated that both the control group, which received SRP alone, and the test group, which received SRP along with the placement of a chlorhexidine-impregnated collagen membrane, exhibited improvements in clinical parameters. This indicates the effectiveness of SRP in reducing plaque and calculus and promoting periodontal healing. These findings are consistent with previous studies that have demonstrated the benefits of SRP in the treatment of chronic periodontitis [6].

However, the test group showed superior outcomes compared to the control group. The sustained release of chlorhexidine from the collagen membrane provided additional benefits, leading to greater reductions in probing depth, gains in clinical attachment level, and improvements in gingival health. The controlled and prolonged release of chlorhexidine within the periodontal pockets may have contributed to enhanced antimicrobial effects, reducing the bacterial load and supporting periodontal tissue regeneration.

The use of chlorhexidine as an adjunct to SRP has been well-documented in periodontal therapy. Chlorhexidine exhibits broad-spectrum antimicrobial activity, inhibiting the growth of periodontal pathogens, and reducing plaque accumulation [7]. Its use in a sustained release delivery system offers the advantage of prolonged exposure to the antimicrobial agent, ensuring sustained therapeutic effects. The collagen membrane acted as a carrier, facilitating controlled drug release and providing a physical barrier that protected the periodontal tissues during the healing process.

The findings of this study align with previous research that has investigated the use of sustained release chlorhexidine in periodontal therapy. In a study by Caton et al. (2010) reported the effectiveness of chlorhexidine in reducing plaque, gingivitis, and bleeding on probing when delivered via sustained release systems. The sustained release delivery of chlorhexidine has also been shown to have advantages in preventing biofilm reformation and reducing the risk of recurrence of periodontal pathogens [7].

It is important to acknowledge the limitations of this study. The relatively small sample size and short-term follow-up period limit the generalizability and long-term assessment of the treatment outcomes. Further research with larger sample sizes and longer follow-up periods is necessary to validate the findings and evaluate the stability of the clinical improvements.

Limitations:

This study had certain limitations, including the relatively small sample size and the short-term follow-up period. Further research with larger sample sizes and longer follow-up periods is necessary to validate the findings and assess the long-term effects of sustained release chlorhexidine in collagen membranes as an adjunct to SRP in the non-surgical management of chronic localized periodontitis.

Conclusion:

In conclusion, the findings of this study suggest that sustained release chlorhexidine in a collagen membrane, as an adjunct to SRP, can enhance the clinical efficiency of non-surgical management in chronic localized periodontitis. The controlled and prolonged release of chlorhexidine appears to provide additional benefits, leading to greater improvements in clinical parameters. Further research is warranted to explore the long-term effects, stability, and cost-effectiveness of this treatment approach in the non-surgical management of chronic periodontitis.

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