

## Clinical Evaluation of Local Drug Delivery Adjuncts During Orthodontic Treatment in Patients with Chronic Periodontitis

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### Abstract

**Background:** Orthodontic treatment in patients with chronic periodontitis requires meticulous control of periodontal inflammation to prevent disease progression. Local drug delivery (LDD) systems have been proposed as an adjunct to conventional periodontal therapy to enhance clinical outcomes.

**Aim:** To clinically evaluate the effectiveness of local drug delivery adjuncts during orthodontic treatment in patients with chronic periodontitis.

**Materials and Methods:** A prospective randomized comparative interventional study was conducted on **60 patients** with Stage II/III chronic periodontitis requiring fixed orthodontic treatment. Patients were randomly allocated into **Group A (SRP + orthodontic treatment; n=30)** and **Group B (SRP + 2% chlorhexidine local drug delivery + orthodontic treatment; n=30)**. Clinical periodontal parameters including Plaque Index (PI), Gingival Index (GI), Bleeding on Probing (BOP), Probing Pocket Depth (PPD), and Clinical Attachment Level (CAL) were recorded at baseline and after six months. Statistical analysis was performed using SPSS version 26.0, with **p<0.05** considered statistically significant.

**Results:** Both groups demonstrated significant improvement after treatment; however, Group B showed significantly greater reductions in PI, GI, BOP, and PPD, along with significantly greater clinical attachment gain compared with Group A ( $p<0.001$ ). Patients receiving local drug delivery also exhibited fewer residual periodontal pockets, improved oral hygiene maintenance, and reduced requirement for additional periodontal intervention.

**Conclusion:** Adjunctive local drug delivery significantly enhances the effectiveness of conventional periodontal therapy during orthodontic treatment by improving periodontal health and maintaining periodontal stability. The combined periodontal-orthodontic approach with local antimicrobial therapy represents an effective strategy for managing patients with chronic periodontitis undergoing orthodontic treatment.

**Keywords:** Chronic periodontitis, Local drug delivery, Orthodontic treatment, Chlorhexidine gel, Periodontal therapy, Clinical attachment level.

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## Introduction

Chronic periodontitis is a multifactorial inflammatory disease characterized by progressive destruction of the periodontal ligament and alveolar bone, ultimately leading to clinical attachment loss and tooth loss if left untreated. The 2017 World Workshop introduced a comprehensive staging and grading system that enables accurate diagnosis, assessment of disease severity, and individualized treatment planning. [1,2]

Orthodontic treatment in patients with chronic periodontitis presents a unique clinical challenge. Although properly planned orthodontic tooth movement can improve occlusal function, aesthetics, and periodontal prognosis by facilitating plaque control and correcting traumatic occlusion, active orthodontic forces may exacerbate periodontal destruction if inflammation is not adequately controlled. Therefore, effective periodontal therapy before and during orthodontic treatment is essential for maintaining periodontal health. [3,4]

Scaling and root planing (SRP) remains the gold standard for non-surgical periodontal therapy; however, mechanical debridement alone may not completely eliminate pathogenic microorganisms from deep periodontal pockets. Local drug delivery (LDD) systems, including chlorhexidine gel, doxycycline gel, and minocycline

microspheres, provide sustained antimicrobial activity directly within periodontal pockets while minimizing systemic adverse effects. Adjunctive use of these agents has been shown to improve clinical periodontal parameters and reduce microbial load. [5–7]

Considering the increasing demand for interdisciplinary management of patients requiring both periodontal and orthodontic treatment, evaluation of local drug delivery as an adjunct to conventional periodontal therapy during orthodontic treatment is of considerable clinical importance. Therefore, the present study was undertaken to clinically evaluate the effectiveness of local drug delivery adjuncts during orthodontic treatment in patients with chronic periodontitis.

## Material and Methodology

### Study Design

A **prospective, randomized, comparative interventional study** was conducted to evaluate the clinical effectiveness of local drug delivery adjuncts during orthodontic treatment in patients with chronic periodontitis.

### Study Setting

The study was carried out in the **Department of Periodontology in collaboration with the Department of Orthodontics** at a tertiary care dental teaching institution.

### Study Duration

The study was conducted over a period of **12 months**.

### Sample Size

A total of **60 patients** diagnosed with Stage II or Stage III chronic periodontitis and requiring orthodontic treatment were included in the study.

### Group Allocation

Patients were randomly allocated into two equal groups (30 participants each):

- **Group A (Control Group):** Scaling and Root Planing (SRP) followed by fixed orthodontic treatment.
- **Group B (Test Group):** Scaling and Root Planing (SRP) + Local Drug Delivery (2% chlorhexidine gel) followed by fixed orthodontic treatment.

### Inclusion Criteria

- Patients aged **18–40 years**.
- Stage II or Stage III periodontitis according to the 2017 classification.
- Presence of probing pocket depth (PPD) of **4–6 mm** in at least four teeth.
- Patients requiring comprehensive fixed orthodontic treatment.
- Good general health.
- Willingness to participate with written informed consent.

### Exclusion Criteria

- Smokers or tobacco users.
- Pregnancy or lactation.
- Systemic diseases affecting periodontal health (e.g., uncontrolled diabetes mellitus).
- Antibiotic or periodontal therapy within the previous three months.
- History of orthodontic treatment.
- Allergy to chlorhexidine or other study medications.
- Poor oral hygiene compliance.

### Clinical Procedure

After obtaining written informed consent, detailed medical and dental histories were recorded. Baseline periodontal examination included assessment of:

- Plaque Index (PI)
- Gingival Index (GI)
- Bleeding on Probing (BOP)
- Probing Pocket Depth (PPD)
- Clinical Attachment Level (CAL)

All participants underwent full-mouth scaling and root planing using ultrasonic scalers and Gracey curettes. In **Group B**, **2% chlorhexidine gel** was delivered into periodontal pockets  $\geq 4$  mm using a blunt cannula immediately after SRP. Oral hygiene instructions were reinforced for all participants.

Orthodontic treatment using **0.022-inch MBT prescription fixed appliances** was initiated **2–4 weeks after completion of initial periodontal therapy**. Standardized orthodontic force levels were maintained throughout treatment. Reinforcement of oral hygiene and supragingival prophylaxis was provided during every follow-up visit.

### Follow-up

Clinical periodontal parameters were recorded at:

- Baseline
- 1 month
- 3 months
- 6 months

### Outcome Measures

#### Primary Outcomes

- Reduction in Plaque Index (PI)
- Reduction in Gingival Index (GI)
- Reduction in Bleeding on Probing (BOP)
- Reduction in Probing Pocket Depth (PPD)
- Gain in Clinical Attachment Level (CAL)

#### Secondary Outcomes

- Periodontal stability during orthodontic treatment.
- Rate of orthodontic tooth movement.
- Patient-reported discomfort.
- Requirement for additional periodontal intervention.
- Adverse events associated with local drug delivery.

### Statistical Analysis

Data were entered into Microsoft Excel and analyzed using **SPSS version 26.0**. Continuous variables were expressed as **mean  $\pm$  standard deviation**, while categorical variables were expressed as frequencies and percentages. Intergroup comparisons were performed using the **independent Student's t-test**, and intragroup comparisons were analyzed using the **paired t-test**. Changes over multiple follow-up periods were evaluated using **repeated-measures ANOVA**, followed by Bonferroni post hoc analysis where appropriate. Categorical variables were analyzed using the **Chi-square test** or **Fisher's exact test**. A **p-value  $<0.05$**  was considered statistically significant.

### Results

A total of **60 patients** with Stage II/III chronic periodontitis undergoing fixed orthodontic treatment were included in the study. Patients were equally allocated into **Group A (SRP + Orthodontic treatment, n=30)** and **Group B (SRP + Local Drug Delivery + Orthodontic treatment, n=30)**. Both groups were comparable at baseline with respect to age, gender, and periodontal parameters ( $p>0.05$ ). At 6 months, Group B demonstrated significantly greater improvement in periodontal health, with marked reductions in plaque index, gingival index, bleeding on probing, probing pocket depth, and greater

clinical attachment gain compared with Group A.

**Table 1. Baseline Demographic Characteristics of Study Participants**

| Variable                | Group A<br>(n=30) | Group B<br>(n=30) | p-value |
|-------------------------|-------------------|-------------------|---------|
| Mean age (years)        | 27.8 $\pm$ 5.1    | 28.4 $\pm$ 4.8    | 0.64    |
| Male                    | 14<br>(46.7%)     | 13<br>(43.3%)     | 0.79    |
| Female                  | 16<br>(53.3%)     | 17<br>(56.7%)     |         |
| Stage II Periodontitis  | 18<br>(60.0%)     | 17<br>(56.7%)     | 0.79    |
| Stage III Periodontitis | 12<br>(40.0%)     | 13<br>(43.3%)     |         |

Both groups were comparable regarding age, gender distribution, and severity of chronic periodontitis at baseline, with no statistically significant differences ( $p>0.05$ ).

**Table 2. Comparison of Clinical Periodontal Parameters at Baseline and Six Months**

| Clinical Parameter      | Group A<br>Baseline | Group A<br>6 Months | Group B<br>Baseline | Group B<br>6 Months           | p-value  |
|-------------------------|---------------------|---------------------|---------------------|-------------------------------|----------|
| Plaque Index (PI)       | 2.31 $\pm$ 0.32     | 1.21 $\pm$ 0.24     | 2.28 $\pm$ 0.29     | <b>0.78</b> $\pm$ <b>0.18</b> | $<0.001$ |
| Gingival Index (GI)     | 2.10 $\pm$ 0.31     | 1.08 $\pm$ 0.22     | 2.14 $\pm$ 0.27     | <b>0.70</b> $\pm$ <b>0.16</b> | $<0.001$ |
| Bleeding on Probing (%) | 78.6 $\pm$ 8.2      | 33.8 $\pm$ 6.7      | 79.2 $\pm$ 7.9      | <b>18.9</b> $\pm$ <b>5.2</b>  | $<0.001$ |

| Clinical Parameter             | Group A Baseline | Group A 6 Months | Group B Baseline | Group B 6 Months | p-value |
|--------------------------------|------------------|------------------|------------------|------------------|---------|
| Probing Pocket Depth (mm)      | 5.12 ± 0.56      | 3.62 ± 0.48      | 5.16 ± 0.51      | 2.94 ± 0.41      | <0.001  |
| Clinical Attachment Level (mm) | 5.83 ± 0.63      | 4.82 ± 0.54      | 5.79 ± 0.58      | 4.01 ± 0.47      | <0.001  |

Both groups showed significant improvement after periodontal therapy; however, patients receiving local drug delivery adjuncts (Group B) demonstrated significantly greater reductions in plaque accumulation, gingival inflammation, bleeding, probing depth, and greater clinical attachment gain compared to the control group ( $p < 0.001$ ).

**Table 3. Comparison of Orthodontic and Periodontal Outcomes at Six Months**

| Outcome                                      | Group A (n=30) | Group B (n=30) | p-value |
|----------------------------------------------|----------------|----------------|---------|
| Good oral hygiene maintenance                | 22 (73.3%)     | 28 (93.3%)     | 0.037   |
| Sites with residual pocket depth $\geq 5$ mm | 8 (26.7%)      | 2 (6.7%)       | 0.039   |
| Additional periodontal intervention required | 6 (20.0%)      | 1 (3.3%)       | 0.046   |
| Smooth orthodontic tooth movement            | 27 (90.0%)     | 29 (96.7%)     | 0.30    |

| Outcome                | Group A (n=30) | Group B (n=30) | p-value |
|------------------------|----------------|----------------|---------|
| Adverse drug reactions | 0              | 1 (3.3%)       | 0.31    |

Patients treated with local drug delivery exhibited better periodontal stability during orthodontic treatment, significantly fewer residual periodontal pockets, and reduced need for additional periodontal therapy. Orthodontic tooth movement progressed satisfactorily in both groups without significant differences.

**Table 4. Overall Clinical Improvement from Baseline to Six Months**

| Parameter                | Group A Improvement (%) | Group B Improvement (%) | p-value |
|--------------------------|-------------------------|-------------------------|---------|
| Plaque Index             | 47.6                    | 65.8                    | <0.001  |
| Gingival Index           | 48.6                    | 67.3                    | <0.001  |
| Bleeding on Probing      | 56.9                    | 76.1                    | <0.001  |
| Probing Pocket Depth     | 29.3                    | 43.0                    | <0.001  |
| Clinical Attachment Gain | 17.3                    | 30.7                    | <0.001  |

Adjunctive local drug delivery resulted in significantly greater overall clinical improvement compared with scaling and root planing alone. The greatest benefit was observed in reduction of gingival inflammation and bleeding on probing, followed by improvement in probing pocket depth and clinical attachment level. These findings suggest that local antimicrobial therapy enhances periodontal

stability during fixed orthodontic treatment in patients with chronic periodontitis.

### Discussion

The present study evaluated the clinical effectiveness of local drug delivery (LDD) as an adjunct to scaling and root planing (SRP) during fixed orthodontic treatment in patients with chronic periodontitis. Both treatment groups showed significant improvement in periodontal health; however, patients receiving adjunctive local drug delivery demonstrated significantly greater reductions in plaque accumulation, gingival inflammation, bleeding on probing, probing pocket depth, and greater clinical attachment gain after six months. These findings indicate that adjunctive antimicrobial therapy provides additional clinical benefits in maintaining periodontal stability during orthodontic treatment.

The results are in agreement with **Reddy et al.**, who reported that local drug delivery systems provide sustained antimicrobial action within periodontal pockets, resulting in improved periodontal healing and reduced need for repeated periodontal intervention when used as an adjunct to conventional therapy. [8] Likewise, **Krishnan and Davidovitch** emphasized that successful orthodontic tooth movement depends on a healthy periodontal environment, and adequate control of periodontal inflammation is essential for achieving favorable orthodontic outcomes without compromising periodontal support. [9]

In the present study, orthodontic treatment progressed satisfactorily in both groups; however, the test group demonstrated superior periodontal stability throughout treatment. Similar observations were reported by **Melsen**, who suggested that controlled orthodontic forces applied after

successful periodontal therapy contribute to favorable tissue remodeling while minimizing further periodontal destruction. [10] Furthermore, **Ristic et al.** demonstrated that fixed orthodontic appliances increase plaque retention and gingival inflammation, reinforcing the importance of meticulous plaque control and adjunctive periodontal therapy during orthodontic treatment. [11]

The findings also support the clinical recommendations of **Zachrisson**, who emphasized that interdisciplinary management involving periodontists and orthodontists is essential for maintaining periodontal health throughout orthodontic treatment. [12] In addition, the European Federation of Periodontology (EFP) clinical practice guideline by **Sanz et al.** recommends adjunctive antimicrobial therapy in selected periodontitis patients to enhance clinical outcomes when combined with conventional periodontal treatment, particularly in patients with persistent periodontal pockets. [13-15]

Overall, the present study demonstrates that adjunctive local drug delivery significantly enhances periodontal healing and helps maintain periodontal stability during orthodontic treatment, thereby improving the predictability of interdisciplinary management in patients with chronic periodontitis.

### Conclusion

Adjunctive local drug delivery combined with scaling and root planing provided significantly better periodontal outcomes than conventional periodontal therapy alone during orthodontic treatment. Patients receiving local antimicrobial therapy showed greater reductions in plaque index, gingival index, bleeding on probing, probing pocket depth, and greater clinical attachment gain. Periodontal stability was

better maintained throughout orthodontic treatment, with fewer residual periodontal pockets and reduced need for additional periodontal intervention. Incorporating local drug delivery into the interdisciplinary management of chronic periodontitis patients undergoing orthodontic treatment may improve both periodontal health and treatment success.

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