Effects of Plaque Staining on Oral Hygiene and Outcomes of Initial Periodontal Therapy in Periodontitis Patients: A Postprint

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Abstract

Objective To evaluate the clinical efficacy of plaque staining as an adjunct to conventional oral hygiene instruction. Methods Forty adult periodontitis patients scheduled for periodontal basic therapy were selected and randomly assigned to an experimental group and a control group, with 20 cases in each group. At the initial visit, all patients received systematic periodontal examination, with plaque and calculus percentages, probing depth, and bleeding on probing recorded and calculated, and conventional oral hygiene instruction was implemented. The experimental group additionally received plaque staining and personalized oral hygiene guidance. Both groups completed supragingival scaling and polishing at the initial visit, and subgingival scaling and root planing were completed by sections one week later. Re-evaluation was performed at 6 weeks, and oral hygiene status and periodontal clinical indices were recorded and compared. Results After treatment, the plaque percentage in the experimental group and control group decreased by $(56.21\$\pm14.64)\pm11.01)\pm11.01)\pm11.96)\pm0.96)mmand(0.86\pm0.69)mmrespectivelycomparedwithbeforetreatme$ respectively compared with before treatment, and the differences in probing depth and bleeding on probing percentage before and after treatment within each group and the differences in reduction values between the two groups were statistically significant ($P<0.001$). Conclusion Adjunctive application of plaque staining helps improve the oral hygiene status and efficacy of periodontal basic therapy in periodontitis patients.

Full Text

Effect of Plaque Staining on Oral Hygiene and Clinical Performance of Periodontal Non-Surgical Therapy for Patients with Periodontitis

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Abstract

Objective: To evaluate the clinical effect of plaque staining-assisted routine oral health education on oral hygiene and clinical performance of periodontal non-surgical therapy for patients with periodontitis.

Methods: Forty adult periodontitis patients scheduled for periodontal basic treatment were randomly assigned to the test group and control group, with 20 patients in each group. All patients received systematic periodontal examination at the first visit, recording and calculating the percentage of sites with plaque and calculus, probing depth, and bleeding on probing, followed by routine oral hygiene instructions. The test group received additional plaque staining and personalized oral hygiene guidance. Both groups completed supragingival scaling and polishing at the first visit. Subgingival scaling and root planing were completed segmentally after [weeks], with re-evaluation performed [weeks] after the final subgingival scaling session, recording and comparing oral hygiene conditions and periodontal clinical indicators.

Results: After treatment, the plaque percentage in the test group and control group decreased by ( )% and ( )% respectively compared with before treatment; the calculus percentage decreased by ( )% and ( )% respectively. The differences in plaque and calculus percentages before and after treatment were statistically significant in both groups, and the differences in reduction values between the two groups were also statistically significant (P <). After treatment, the probing depth in the two groups decreased by ( ) mm and ( ) mm respectively; the percentage of bleeding on probing decreased by ( )% and ( )% respectively compared with before treatment. The differences in probing depth and bleeding on probing percentage before and after treatment were statistically significant in both groups, and the differences in reduction values between the two groups were also statistically significant (P <).

Conclusion: The auxiliary application of plaque staining is helpful to improve the oral health status of patients with periodontitis and the clinical performance of periodontal non-surgical therapy.

KEY WORDS: periodontitis; periodontal non-surgical therapy; oral hygiene instruction; plaque staining

Introduction

Periodontitis is a chronic infectious disease that seriously affects oral and systemic health, which is highly prevalent among Chinese populations. According to the Fourth National Oral Health Epidemiology Survey Report, the periodontal health rate among Chinese adults is less than %, and the proportion of periodontitis patients across all age groups reaches as high as %. Dental plaque is the initiating factor of periodontal disease, and good plaque control is a critical component of periodontal treatment and maintenance. In addition to systematic professional periodontal treatment by clinicians, patients must master correct and effective oral hygiene measures to maintain treatment outcomes, reduce disease recurrence, and prevent further destruction of periodontal tissues. Dental plaque itself is colorless; plaque disclosing agents can stain it, facilitating observation of plaque distribution by both doctors and patients and evaluation of tooth cleaning effectiveness. This study aims to assess the effect of plaque disclosing agents combined with conventional oral hygiene education methods on improving patients' oral hygiene status and periodontal basic treatment outcomes.

Materials and Methods

Study Design and Participants

This study enrolled adult periodontitis patients who visited Peking Union Medical College Hospital between [dates] for periodontal basic treatment. Patients were randomly assigned to the test group and control group at a ratio of 1:1. The inclusion criteria were: (1) patients diagnosed with periodontitis according to the [year] classification criteria for periodontal diseases and peri-implant diseases; (2) systemically healthy; (3) patients with at least 20 remaining teeth. Exclusion criteria were: (1) patients with active infectious diseases or contraindications for periodontal basic treatment; (2) patients undergoing orthodontic treatment; (3) allergy to plaque staining agents; (4) patients who had received periodontal basic treatment within six months; (5) refusal to participate in the study.

Interventions

All enrolled patients received systematic periodontal examination at the first visit, recording and calculating the percentage of plaque and calculus, probing depth at six sites per tooth for all remaining teeth (excluding wisdom teeth), and bleeding on probing at buccal and lingual sites. Nursing staff implemented oral hygiene education under the guidance of periodontal specialists. The specific content included: (1) explaining the condition and introducing the important influence of oral hygiene status on the occurrence, development, treatment outcomes, and prognosis of periodontal disease; (2) elimination and correction of bad habits (such as smoking, mouth breathing, unilateral chewing, bruxism, etc.); (3) effective tooth brushing: instructing patients to use the Bass method

to clean tooth surfaces through standardized video guidance, to be performed twice daily; (4) interdental cleaning: recommending dental floss and interdental brushes based on the presence of gingival papilla recession, with chairside guidance through standardized videos, to be performed at least once daily.

In addition to the above oral hygiene education, the test group received supplementary plaque staining and further oral hygiene guidance: (1) patients cleaned their teeth according to their own habits; (2) the clinician used a small cotton ball dipped in plaque staining agent (Mira-2-Ton, Hager & Werken Company, Germany), gently applied it to the gingival papilla to allow the staining agent to overflow and disperse evenly on the buccal and lingual tooth surfaces; (3) after patients rinsed thoroughly, the stained tooth surfaces were observed, and nursing staff pointed out deficiencies and omissions in previous oral hygiene cleaning; (4) patients were guided to re-clean the stained areas using correct brushing and interdental cleaning methods, and informed of areas requiring special attention.

Both the test and control groups completed supragingival scaling and polishing at the first visit. Subgingival scaling and root planing were completed segmentally after [weeks], along with reinforced oral hygiene education (the test group received plaque staining again at each follow-up visit using the same method). Re-evaluation was performed [weeks] after the final subgingival scaling was completed, recording oral hygiene conditions and periodontal clinical treatment outcomes.

Outcome Measures

The primary observation indicators were plaque percentage, calculus percentage, probing depth, and bleeding on probing at the first visit and re-evaluation. A periodontal specialist recorded the percentage of calculus and plaque through visual examination: each tooth was examined at four surfaces (buccal, lingual, mesial, and distal), recording the number of surfaces with calculus or plaque, and calculating the full-mouth plaque and calculus percentages. Using a Williams periodontal probe (graduated in mm), the depth from the gingival margin to the bottom of the periodontal pocket was recorded at six sites per tooth (mesial, central, distal, recorded separately for buccal and lingual sides). Bleeding on the buccal and lingual surfaces was observed seconds after probing, and the number of bleeding sites was recorded to calculate the percentage of bleeding on probing.

Statistical Analysis

SPSS software was used for statistical analysis. Measurement data were expressed as mean $\pm$ standard deviation ($x \pm s$) and compared using independent samples t-test (for group comparisons) or paired t-test (for before-and-after treatment comparisons). Count data were described using percentages (%) and compared using ^{2} test. The test level $\alpha = 0.05$ was set, with $P < 0.05$ considered statistically significant.

Results

Patient Characteristics

A total of 40 patients were enrolled in this study, with 20 in the test group and 20 in the control group. In the test group, there were males and females, with a mean age of ( ) years; in the control group, there were males and females, with a mean age of ( ) years. There was no statistically significant difference in age between the two groups. Regarding periodontal disease staging, patients were diagnosed with Stage II (test group: , control group:), Stage III (test group: , control group:), and Stage IV (test group: , control group:). Regarding periodontal disease grading, patients were diagnosed as Grade B (test group: , control group:) and Grade C (test group: , control group:). Regarding smoking status, there were smokers (test group: , control group:). There were no statistically significant differences between the test and control groups in terms of gender, periodontitis staging, grading, or smoking status. The number of missing teeth was ( ) in the test group and ( ) in the control group, with no statistically significant difference between the two groups (P = 0.).

Changes in Oral Hygiene Indicators

Changes in plaque and calculus percentages before and after treatment are detailed in Figure 2. Before treatment, the plaque percentage was ( )% in the test group and ( )% in the control group, with no statistically significant difference between the two groups (P = 0.). After treatment, the plaque percentage was ( )% in the test group and ( )% in the control group, with the difference being statistically significant (P = 0.). Compared with pre-treatment values, the plaque percentage decreased by ( )% and ( )% in the test and control groups, respectively (Figure 2A), with statistically significant differences before and after treatment in both groups (both $P < 0.001$). The difference in reduction values between the two groups was also statistically significant (P = 0.).

Regarding calculus percentage, the test group had ( )% before treatment and the control group had ( )%, with no statistically significant difference between the two groups (P = 0.). After treatment, the calculus percentage was ( )% in the test group and ( )% in the control group, with the difference being statistically significant (P = 0.). Compared with pre-treatment values, the calculus percentage decreased by ( )% and ( )% in the test and control groups, respectively (Figure 2B), with statistically significant differences before and after treatment in both groups (both $P < 0.001$). The difference in reduction values between the two groups was also statistically significant (P = 0.).

Changes in Periodontal Indicators

Changes in probing depth and bleeding on probing percentage before and after treatment are detailed in Figure 3. Before treatment, the probing depth was ( ) mm in the test group and ( ) mm in the control group, with no statistically significant difference between the two groups (P = 0.). After treatment, the

probing depth was ( ) mm in the test group and ( ) mm in the control group, with the difference being statistically significant (P = 0.). Compared with pre-treatment values, the probing depth decreased by ( ) mm and ( ) mm in the test and control groups, respectively (Figure 4A), with statistically significant differences before and after treatment in both groups (both $P < 0.001$). The difference in reduction values between the two groups was also statistically significant (P = 0.).

Regarding bleeding on probing percentage, the test group had ( )% before treatment and the control group had ( )%, with no statistically significant difference between the two groups (P = 0.). After treatment, the bleeding on probing percentage was ( )% in the test group and ( )% in the control group, with the difference being statistically significant (P = 0.). Compared with pre-treatment values, the bleeding on probing percentage decreased by ( )% and ( )% in the test and control groups, respectively (Figure 4B), with statistically significant differences before and after treatment in both groups (both $P < 0.001$). The difference in reduction values between the two groups was also statistically significant (P = 0.).

Discussion

Periodontal basic therapy is the cornerstone of treatment for periodontitis patients, aiming to eliminate pathogenic factors, reduce inflammation to a minimum, and lay the foundation for subsequent treatment stages (such as surgical therapy, restorative treatment, or orthodontic therapy). Dental plaque is the initiating factor of periodontal disease, therefore, the efficacy of periodontal basic therapy largely depends on thorough plaque removal and prevention of plaque re-formation. During the basic therapy phase, successful outcomes require not only professional treatment but also patient compliance: patients must perform daily plaque removal and control, using appropriate cleaning tools to achieve maximum plaque control, with effective removal of plaque at the cervical margin and interdental areas being particularly important.

Jiao et al. analyzed the long-term efficacy of basic treatment for chronic periodontitis and aggressive periodontitis patients (the 2018 new classification no longer considers them as independent diseases but both within the scope of periodontitis), finding that after treatment, the probing depth decreased by an average of mm in both groups. Multifactor analysis showed that patient compliance had a statistically significant effect, while good patient compliance was mainly reflected in effective plaque control and timely follow-up examinations.

This study aimed to use plaque staining to allow patients to visually identify plaque accumulation resulting from incomplete cleaning, and to identify key areas and blind spots in daily oral hygiene, while also facilitating clinicians in developing personalized cleaning strategies for patients, providing targeted guidance, more effectively achieving plaque control, improving periodontal treatment outcomes, and preventing periodontitis recurrence.

The results showed that after treatment, the plaque and calculus percentages in the test group were significantly lower than those in the control group (Figure 2), and the reduction in plaque and calculus percentages was also significantly greater in the test group than in the control group, suggesting that the application of plaque disclosing agents in oral hygiene education helps improve patients' plaque control and oral hygiene status. Good oral hygiene is also a guarantee for effective periodontal basic therapy. In this study, the efficacy of periodontal basic therapy was significantly better in the test group than in the control group: after treatment, the probing depth and bleeding on probing percentage in the test group were significantly lower than those in the control group (Figure 3), and the reduction in these indicators was also significantly greater in the test group than in the control group (Figure 4).

Similar findings have been reported by other domestic research teams. Zhou et al. evaluated the application of plaque disclosing solution combined with conventional oral hygiene education in elderly periodontitis patients, finding that plaque index improvement was significantly better in the test group than in the control group during the -month observation period after treatment, and the reduction in probing depth and improvement in gingival bleeding index were also significantly better than in the control group. He et al.' s study evaluated the effect of personalized oral health education (including plaque staining) on treatment efficacy in adult periodontitis patients, finding that after treatment, the reduction in probing depth and bleeding percentage in the test group was significantly better than that in the control group.

As oral health educators, dental hygienists should actively provide personalized chairside health education, collaborate with clinicians to address factors affecting oral health, introduce easy-to-master oral hygiene methods to patients, and encourage patients to develop good oral hygiene habits. This is the duty and responsibility of oral health professionals. Therefore, the authors recommend that in the care of periodontitis patients, plaque staining should be incorporated as an important adjunct to conventional oral hygiene education, according to the resources of each clinical unit, in order to improve patients' plaque control effectiveness, enhance periodontal treatment efficacy, and promote patients' periodontal health, oral health, and even systemic health, thereby improving patients' quality of life.

In conclusion, the adjunctive use of plaque staining in conventional oral hygiene education improves the oral hygiene status of periodontitis patients and the short-term efficacy of periodontal basic therapy. Further studies with longer observation periods are needed to confirm its effect on the long-term efficacy of basic therapy.

Conflict of Interest Statement: The authors declare no conflict of interest in this article.

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Note: Figure translations are in progress. See original paper for figures.