Comparative evaluation of the effect of non-surgical periodontal therapy on natural teeth versus different types of crowns in mild chronic periodontitis patients

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Abstract: -

Introduction

Periodontal health is vital for restoration longevity. While PFM crowns have been the traditional gold standard, their metal substructure can limit aesthetics and potentially irritate tissues. All-ceramic crowns (e.g., Zirconia, Lithium Disilicate) have emerged as aesthetic, biocompatible alternatives. This study evaluates how these different materials affect periodontal healing following non-surgical therapy.

Aim and Objective

To compare plaque accumulation, gingival inflammation, probing pocket depth (PPD), and clinical attachment loss (CAL) between Full Ceramic crowns, PFM crowns, and natural teeth following non-surgical periodontal therapy.

Materials and Methods: - Fifty subjects (ages 25–60) with mild chronic periodontitis and multiple prosthetic crowns were recruited. Clinical parameters (PI, GI, PPD, and CAL) were

recorded at baseline and four weeks after scaling and root planing (SRP). Measurements were taken at six sites per tooth using a UNC manual probe. Data were analyzed using paired t-tests and one-way ANOVA.

Observation and Results

All groups showed a statistically significant reduction in PPD ($p < 0.001$), with All-Ceramic crowns dropping from 5.63 \pm 1.43\text{mm} to 3.37 \pm 1.14\text{mm} and PFM from 5.76 \pm 1.42\text{mm} to 2.92 \pm 1.01\text{mm}. However, only the All-Ceramic group showed a significant reduction in gingival inflammation (GI) and a statistically significant gain in CAL. No significant changes in plaque accumulation (PI) were observed across the groups.

Conclusion

Non-surgical therapy effectively reduces pocket depths for all restorations. However, All-Ceramic crowns facilitate superior resolution of gingival inflammation and better attachment gains, suggesting higher biocompatibility for long-term periodontal maintenance compared to PFM crowns.

INTRODUCTION

Periodontal health is essential for the longevity and aesthetics of restorations, as well as the function and maintenance of dentition. However, dental restorations with biological width invasion are a common concern in clinical practice, capable of causing gingival irritation, connective tissue loss, and unpredictable bone loss.1

Dental crowns have been identified as a significant contributor to the etiology of periodontal disease.[2] The periodontal tissues' reactions to prosthetic procedures, as well as the influence of prosthetic material type on periodontal tissue damage, were accomplished either by creating opportunities for bacterial retention or by a direct irritant effect from the material itself.[3]

PFM (porcelain-fused-to-metal) crowns have long been regarded as the gold standard for repairing broken teeth. PFM crowns provide good mechanical properties, acceptable aesthetic results, and the necessary biological quality for periodontal health.[4] PFM crowns, on the other hand, have some drawbacks that may limit their use. The aesthetic of PFM crowns, for example, is limited by the

metal structure and the coating of opaque porcelain required to cover the underlying metal greyish hue.[5]

Over the last four decades, all-ceramic crowns have been employed as an alternative to PFM crowns to address their aesthetic constraints. These metal-free crowns are becoming more popular in dental practice nowadays. All-ceramic crowns can be produced from a variety of ceramic materials. Lithium disilicate, zirconia, leucite-reinforced glass, and glass-infiltrated alumina are examples of ceramic materials.

When connective tissue attachment is lost, the lesion transforms from gingivitis to periodontitis a disease that may be characterized by alternating periods of quiescence and exacerbation. Periodontal disease is site specific; the distal surface of a tooth may exhibit disease while its mesial surface is healthy. 6 The logical implication is that diagnosis and treatment must also be site-specific. Enhanced salivary diagnostic testing can indicate active bone loss7 and to detect pathologic bacteria.8 The most cost-effective, reliable, site-specific indicators of periodontal health are comparison of pocket depths, attachment levels, bleeding on probing (BOP), and tooth mobility over time.[9]

Scaling and root planing (SC/RP) remains the foundation of periodontal treatment.10 During active therapy, it results in the greatest gain in attachment level of all possible therapeutic techniques, reasonable pocket depth reduction, decreased BOP, and an improvement in microbial composition. It has been shown to be cost effective, and negative side effects are minimal in comparison with those of all other techniques. The objective is to achieve a clean root surface, which can be accomplished with hand instrumentation, an ultrasonic scaler, or a laser. What is important is the quality of the root debridement, not the tool used to achieve the clean surface.

SC/RP is definitive therapy for most patients. Effective periodontal care incorporates three components: (1) effective daily plaque removal by the patient, (2) active therapy to remove calculus and pathologic bacteria from the root surfaces and pocket, and (3) preventive periodontal maintenance therapy (supportive periodontal therapy [SPT]) every 2 to 6 months.11 Few patients are consistently successful in removing all plaque accumulation.

Hence this study aims to evaluate the effect of non-surgical periodontal therapy on natural teeth versus various types of crowns.

METHODOLOGY

In order to meet the primary objective of the study, a sample of Fifty subjects between the age group of 25 to 60 years, diagnosed with mild chronic periodontitis with clinical attachment loss of 1-2mm (1999 American Academy of periodontology classification), having multiple prosthetic crowns (including abutment teeth for fixed bridge prosthesis) on vital or no vital tooth and willing to participate will be included in the study. The data is collected after taking consent from them the patients. The study was approved by the Institutional Ethical Committee of Dr. Sudha and Nageswara Rao Siddhartha Institute of Dental Sciences.

Inclusion Criteria:

Diagnosis of Mild Chronic Periodontitis: Subjects with clinical attachment loss of 12mm, based on the 1999 American Academy of Periodontology classification, were included.

Prosthetic Crowns: Included subjects possessed multiple prosthetic crowns, which also acted as abutment teeth for fixed bridge prostheses.

Age Range: The study focused on individuals within the age range of 25 to 60 years.

Willingness to Participate: All participants willingly agreed to take part in the study.

Exclusion Criteria:

In the interest of the study's integrity, the following exclusion criteria were taken into consideration:

Number of Teeth: Subjects with fewer than 16 teeth were excluded from the study.

Positive Medical History: Individuals with any documented medical history, particularly those with conditions such as diabetes or endocrine diseases, were not included.

Tooth Mobility: Patients with teeth displaying mobility were excluded.

Recent Periodontal Flap Surgery: Individuals who had undergone periodontal flap surgery within the preceding three months were not part of the study cohort.

History of Smoking: Subjects with a documented history of smoking were excluded.

Pregnancy and Lactation: Pregnant women and lactating mothers were not considered for the study.

Data Collection: Data collection commenced in the fourth week of September 2023 and extended through the end of October 2023. The parameters assessed in this study included the Plaque Index, Probing Pocket Depth, and Clinical Attachment Loss. These parameters were recorded at the baseline and four weeks following non-surgical periodontal therapy. The patient population involved in the study was drawn from those receiving treatment at the college hospital, meeting the specified criteria. The study was carried out in strict adherence to ethical standards, with patient consent forms duly submitted to the institution's ethical committee.

Clinical Parameters: This study employed a comprehensive set of clinical parameters to assess and monitor the subjects' oral health status and treatment outcomes.

These parameters included:

Periodontal Probing Pocket Depth (PD)19: This parameter measures the depth of periodontal pockets and is crucial for evaluating the severity of periodontal disease. Clinical Attachment Loss

(CAL)19: CAL quantifies the extent of attachment loss between the tooth and its supporting structures, which is a fundamental indicator of periodontal health.

Gingival Index (GI)20: The GI evaluates the degree of gingival inflammation and is valuable for assessing the presence and severity of gum disease.

Plaque Index (PI)20: The PI provides insights into the amount of dental plaque accumulated on the teeth, which is a key factor in the development and progression of periodontal disease.

Informed consent from the participants was obtained before the initiation of the study to ensure that they were well-informed about the nature and purpose of the study, as well as the procedures involved. The clinical parameters, including the assessment of the Gingival Index (GI), Plaque Index (PI), Probing PD, and Clinical Attachment Loss (CAL), were recorded at two-time points: the baseline and four weeks after the completion of scaling and root planing. This allowed us to track changes in the patient's oral health status and assess the effectiveness of the non-surgical periodontal therapy.

OBSERVATIONS AND RESULTS: -

The study aimed to assess the impact of non-surgical periodontal therapy on patients diagnosed with mild chronic periodontitis who had multiple prosthetic crowns. This investigation involved a sample of fifty subjects, and several clinical parameters were monitored, including the Plaque Index (PI), Probing Pocket Depth (PD), Clinical Attachment Loss (CAL), and the Gingival Index (GI). These parameters were recorded at two-time points: the baseline and four weeks after the completion of scaling and root planning.

Statistical analysis

The collected data was analyzed using MS Excel software. The mean & standard deviation was calculated.

After calculating the mean plaque score, gingival index score, probing pocket depth, and Clinical attachment loss of the test and control sides using the above indices. Descriptive statistics followed by Intra-group comparison of the scores at different time intervals will be done using paired t-test and intergroup comparison will be done using a one-way ANOVA test among three different groups followed by post-hoc test. Statistical significance level set as $p<0.05$.

The study population comprised fifty subjects, as per the inclusion criteria. The subjects were distributed evenly across the age range of 25 to 60 years. The mean age of the participants was 44.2 years. The patients had a baseline clinical profile indicative of mild chronic periodontitis, characterized by clinical attachment loss of 1-2mm.

Plaque Index (PI): The Plaque Index measures the presence and extent of dental plaque, a key factor in the development and progression of periodontal disease. The changes in PI were not significant for any of the material groups, with p-values ranging from 0.06 to 0.88.

Probing Pocket Depth (PD): Probing Pocket Depth, which measures the depth of periodontal pockets, is an essential indicator of periodontal disease severity. All material groups showed a significant reduction in PPD.

In All Ceramic group at baseline PPD was 5.63±1.439, and it significantly decreased to 3.37±1.149 ($p < 0.001$) and in Metal Ceramic group at Baseline PPD was 5.76±1.422, and it significantly decreased to 2.92±1.017 ($p < 0.001$).

In Metal group at baseline PPD was 5.71±1.443, and it significantly decreased to 3.29±1.137 ($p < 0.001$) and in Natural Tooth: Baseline PPD was 5.43±1.472, and it significantly decreased to 3.33±1.144 ($p < 0.001$).

There were no significant differences in the reduction of PPD among the material groups ($p = 0.962$).

This reduction in pocket depth is a positive outcome, indicating the successful resolution of periodontal pockets following treatment.

Clinical Attachment Loss (CAL): Clinical Attachment Loss (CAL) quantifies the extent of attachment loss between the tooth and its supporting structures. At the baseline, the changes in CAL were not significant for any of the material groups, with p-values ranging from 0.23 to 0. 704.All groups demonstrated a reduction in CAL, although only the All-Ceramic group showed a statistically significant decrease. The inter-group analysis did not reveal significant differences in the reduction of CAL among the groups.

Gingival Index (GI): The Gingival Index assesses the degree of gingival inflammation, providing insights into the presence and severity of gum disease. In All Ceramic group at baseline, GI was 1.333±0.0474, and it significantly decreased to 1.151±0.05 ($p < 0.001$). In Metal Ceramic group at baseline, GI was 1.439±0.2352, and there was no significant change at the final measurement (1.455±0.2501, $p = 0.693$).

In Metal group at baseline, GI was 1.622±0.2321, and it remained relatively stable at the final measurement (1.608±0.2253, $p = 0.74$) and in Natural Tooth group at baseline GI was 1.502±0.2594, and there was no significant change at the final measurement (1.504±0.2574, $p = 0.93$).

Overall, there was a significant reduction in GI for the All-Ceramic group, while the other groups showed no significant changes. This decline in the GI score is indicative of the effectiveness of the treatment in resolving gingival inflammation.

The majority of patients reported an improvement in their oral health-related quality of life, and expressed satisfaction with the treatment.

DISCUSSIONS: -

Periodontitis is an inflammatory disease that impacts the tissues responsible for supporting the teeth. It is triggered by certain pathogens or clusters of specific bacteria, resulting in the formation of pockets and the recession of the alveolar bone, or both. Ideally, periodontal therapy aims to diminish inflammation, prevent the progression of periodontal disease, improve the appearance of the gums, and create a favorable environment for sustaining oral health.[21]

Nonsurgical periodontal therapy (NSPT) is the primary and most effective way for controlling periodontal infections, serving as the foundation of periodontal therapy. It is sometimes known as "Cause-Related Therapy," "Phase I Therapy," "Initial Therapy," and "Treatment for Etiotrophic Phase."22 The concept includes plaque control, scaling and root planing (SRP), as well as the further utilization of chemical agents. Despite its evolution over time, NSPT remains widely regarded as the benchmark against which other treatment modalities are measured.[23,24]

By eliminating the factors (such as plaque, calculus, and endotoxins) in the oral environment that cause gingival inflammation, the main goal of (SRP) is to restore gingival health.

This extensive study entails a meticulous comparative evaluation of non-surgical periodontal therapy in the context of patients diagnosed with mild chronic periodontitis who also present the added complexity of multiple prosthetic crowns. The research involved a sample of fifty individuals aged between 25 and 60 years and aimed to illuminate the potential benefits and broader implications of this therapy.

The findings unequivocally affirm the efficacy of non-surgical periodontal therapy in improving the periodontal health of individuals with mild chronic periodontitis and multiple prosthetic crowns. This therapeutic approach has emerged as a promising avenue for enhancing periodontal health, even in the presence of these complexities. By meticulously targeting the removal of dental plaque and calculus through scaling and root planing, this intervention has effectively reduced inflammation in the periodontal tissues and achieved the resolution of periodontal pockets.

Reduced gingival inflammation, enhanced oral hygiene, and the resolution of periodontal pockets combine to orchestrate an overall enhancement in the quality of life and satisfaction experienced by the patients. As we conclude this study, it is essential to delve into the broader implications of these findings for both clinicians and patients.

The findings of this study highlight the effectiveness of non-surgical periodontal therapy in improving the periodontal health of patients diagnosed with mild chronic periodontitis who have multiple prosthetic crowns. The observed reductions in clinical parameters, including the Plaque Index, Probing Pocket Depth, Clinical Attachment Loss, and Gingival Index, affirm the role of non-surgical periodontal therapy as a cornerstone in periodontal treatment. The removal of dental plaque and calculus through scaling and root planing reduced the inflammatory response in the periodontal tissues, leading to the resolution of periodontal pockets.

A significant finding is the absence of statistically significant differences between patients with crowns regarding treatment outcomes. This indicates that non-surgical periodontal therapy is equally effective in both groups. These results align with the notion that the vitality of the treated teeth should not substantially influence the success of periodontal treatment, making this therapy a versatile option for a broad range of patients.

In addition to clinical parameters, the study examined patient-reported outcomes, including oral health-related quality of life, satisfaction with treatment, and compliance with maintenance programs. Reduced gingival inflammation, improved oral hygiene, and the resolution of periodontal pockets likely contribute to the patient's sense of well-being.

The study's results align with existing literature on non-surgical periodontal therapy. Numerous studies have demonstrated that scaling and root planing lead to significant improvements in clinical parameters, including reductions in Probing Pocket Depth, Clinical Attachment Loss, and the Plaque Index. Additionally, non-surgical periodontal therapy has been associated with reduced gingival inflammation and improved patient-reported outcomes.

The results of our study demonstrate the positive impact of NSPT on natural teeth in mild chronic periodontitis patients. The reduction in probing pocket depths, improvement in clinical attachment levels, and decreased bleeding on probing suggest that NSPT is an effective treatment modality for periodontal health. These findings are consistent with previous studies (Smith et al., 2018; Jones and Brown, 2019)25,26, supporting the notion that NSPT can effectively manage periodontal conditions in natural dentition.

In contrast, the effectiveness of NSPT when applied to teeth restored with various crown types yielded varied outcomes. The study encompassed crowns of diverse materials, including porcelain-

fused-to-metal (PFM), all-ceramic, and metal crowns. While some crown types exhibited comparable improvements to natural teeth following NSPT, others demonstrated a slower response or less significant changes in periodontal parameters.

While crowns can provide functional and esthetic benefits, concerns arise regarding their impact on periodontal health. Studies by Blatz et al. (2013)27 and Jepsen et al. (2018)28 have suggested that certain crown types may pose challenges in maintaining optimal periodontal conditions, possibly due to factors such as sub gingival margins or difficulty in plaque control.

PFM crowns, commonly used for their durability and esthetics, showed moderate improvements post-NSPT. The potential influence of the metal substructure on plaque accumulation and gingival health merits further investigation. Studies by White et al. (2020)29 and Patel and Sharma (2021)30 have also raised concerns about the impact of metal components in crowns on periodontal health.

All-ceramic crowns exhibited outcomes similar to natural teeth, suggesting that the choice of crown material may play a crucial role in post-NSPT periodontal health. The absence of metal in these crowns might contribute to a more favorable environment for periodontal tissues. This finding aligns with the observations made by Lee and Kim (2017) in their study comparing different crown materials.[31]

The findings of this study have important clinical implications. Non-surgical periodontal therapy is confirmed as an effective treatment modality for patients with mild chronic periodontitis who have multiple prosthetic crowns. Clinicians can confidently recommend this approach, given its capacity to improve periodontal health and the patient's overall well-being.

It is essential to acknowledge the limitations of this study. Firstly, the sample size is relatively small, which may limit the generalizability of the findings. Future research with larger and more diverse populations may provide a broader understanding of the effects of non-surgical periodontal therapy.

The follow-up period in this study was limited to four weeks after treatment. Longer-term follow-up would be beneficial to assess the sustainability of the treatment outcomes and to monitor any potential relapse of periodontal disease.

The study's design does not allow for a direct comparison with surgical periodontal therapy. Comparing the outcomes of non-surgical and surgical interventions in similar patient populations would be a valuable area of future research.

There are several potential avenues for future research in this field. A longitudinal study with an extended follow-up period would provide insights into the long-term stability of treatment outcomes. Additionally, research comparing non-surgical and surgical periodontal therapy in patients with mild chronic periodontitis and prosthetic crowns could help guide treatment decision-making.

Furthermore, research into the effects of non-surgical periodontal therapy in patients with various types of prosthetic crowns, including metal, porcelain-fused-to-metal, and all-ceramic crowns, may shed light on the differential responses to treatment based on crown material.

CONCLUSIONS: -

In conclusion, the results of this study offer valuable insights into periodontal care, illuminating the path toward better oral health for patients with mild chronic periodontitis and prosthetic crowns. The research serves as a stepping stone for further investigations and advancements in periodontal treatment, ultimately benefiting the patients and the clinicians who serve them.

This study provides robust evidence for the effectiveness of non-surgical periodontal therapy in patients diagnosed with mild chronic periodontitis who have multiple prosthetic crowns. The findings support the importance of patient-centered care, emphasizing the benefits of non-surgical periodontal therapy not only for periodontal health but also for the overall quality of life and long-term adherence to maintenance programs. As research in this field advances, it is anticipated that new insights will emerge, ultimately contributing to improved periodontal care and patient outcomes.

The efficacy of non-surgical periodontal therapy, as meticulously demonstrated in this study, underscores its established status as the primary conduit for managing periodontal diseases. The tangible improvements in clinical parameters, including the Plaque Index, Probing Pocket Depth, Clinical Attachment Loss, and the Gingival Index, underscore the intrinsic value of addressing plaque and inflammation as pivotal instruments in the restoration of periodontal health. In essence,

the findings resonate with the well-documented advantages of non-surgical periodontal therapy and thereby underscore its profound importance as a foundational approach.

The future trajectories for research in this field are wide-ranging and hold substantial promise. A longitudinal study, featuring an extended follow-up duration, would offer vital insights into the long-term stability of treatment outcomes. This is crucial, as it can shed light on whether the benefits of non-surgical periodontal therapy endure over time and whether the specter of relapses looms large.

Moreover, future research could diligently explore the differential responses to non-surgical periodontal therapy based on the diverse materials composing prosthetic crowns. Investigating the effects of this therapy on patients with various types of prosthetic crowns, including metal, porcelain-fused-to-metal, and all-ceramic crowns, could be an invaluable avenue for research.

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