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Original Research Article

Role of Pre-Prosthetic Periodontal Surgery in Enhancing Peri-Implant Tissue Stability and Prosthetic Success

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Abstract:

Background: Stability of peri-implant tissues is a necessary condition of the successful rehabilitation with prosthetics based on dental implants. Pre-prosthetic periodontal surgical treatment can improve the condition of soft tissues and provide favourable results.

Aim: The purpose of this research is to determine whether and how periodontal surgery, when done before prosthetic repair, influences the procedure's success and the stability of the surrounding soft tissues.

Methodology: A study was conducted at the Anugrah Narayan Magadh Medical College and Hospital Department of Dentistry in Gaya Ji, Bihar, India. In total, there were 120 patients involved; of these 60 underwent pre-prosthetic periodontal surgery and the remaining 60 served as controls. The evaluation of clinical parameters, prosthetic problems, patient satisfaction, and results was carried out during one year.

Results: The amount of depth explored was lessened by 0.7 ± 0.5 mm in the group that got the treatment, and by 0.3 ± 0.4 mm in the group that didn't receive any treatment. The thickness of the mucosa and the width of the keratinised mucosa both increased by 0.6 ± 0.4 mm and 0.1 ± 0.3 mm, respectively. In the intervention group, 81.7% of patients had stable soft tissue around the implant, while in the control group, 70.0% had the same result. Among the two groups, 81.7% had no problems with their prosthetics and 90.0% had none. Both the 83.3% and 75.0% groups reported excellent levels of patient satisfaction. In both groups, 93.3% of patients finished the one-year follow-up.

Conclusion: The pre-prosthetic periodontal surgical treatment led to more favourable descriptive results in parameters of peri-implant soft tissues and prosthetics. Additional statistical analysis is needed.

Keywords: Pre-prosthetic periodontal surgery, peri-implant tissue stability, dental implants, soft-tissue augmentation, prosthetic success, periodontal outcomes.

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Introduction

Replacement of missing teeth with the help of dental implants is an essential technique in prosthodontic rehabilitation. A successful implant-supported procedure depends on osseointegration, which in turn depends on the stability and health of the hard and soft tissues surrounding the implant [1]. Proper plaque control, preservation of peri-implant structures, maintenance of bone levels, and long-term stability of the prosthetic restoration are all ensured by healthy peri-implant tissues. On the other hand, reduced thickness of soft tissues, lack of keratinized mucosa, poor contour of soft tissues and periodontal problems may be detrimental for the health of the peri-implant environment and lead to biological and prosthetic complications [2].

The factors contributing to the peri-implant tissue stability include the mucosa thickness, keratinized mucosa width, plaque accumulation, position of the implant, design of the prosthetic treatment, and the condition of the bone tissues adjacent to the implant. Reduced thickness of the mucosa may be a contributing factor to negative tissue reactions and bone level change, and thin keratinized mucosa may complicate oral hygiene and cause discomfort while plaque control in some patients [3]. Additionally, inflammation around dental implants may cause peri-implant mucositis and, in vulnerable patients, peri-implantitis, which results in gradual loss of supporting bone. Thus, thorough evaluation of periodontal and peri-implant tissues prior to prosthetic rehabilitation is required for detection of any anatomical deficiencies and clinical problems

that may negatively impact the results of treatment [4].

Pre-prosthetic periodontal surgery means that it is performed prior to prosthetic rehabilitation and is aimed at improving the condition, dimensions and contours of tissues surrounding the area of future treatment. Depending on the clinical indication, pre-prosthetic surgery can consist of various procedures, such as connective tissue grafting, free gingival grafting, augmentation of soft tissues, and other periodontal procedures. This kind of surgery aims at ensuring adequate mucosal thickness, increasing keratinized mucosa when necessary, forming the favourable contours of the tissues [5] and making oral hygiene around the implant-supported restorations easier. Previous studies have addressed different approaches to increasing peri-implant mucosal thickness and preserving soft tissues in relation to the choice of an appropriate procedure.

Proper assessment of the peri-implant tissues is crucial since the restoration needs to fit into the biocompatible tissue environment. Implant placement, abutment design, emergence profile, and restoration contour all have an impact on plaque buildup, soft-tissue adaptation, and bone level stability [6]. In some instances, the reactivity of the peri-implant tissues might be affected by repeatedly replacing the abutments of the implant-supported restoration. Hence, periodontal preparation prior to the prosthetic treatment may contribute to better tissue adaptation and maintenance, although the degree of this effect depends on the nature of the procedure, the initial state of tissues and other clinical factors [7].

Success of prosthetic rehabilitation using implants and other dental restorations goes beyond the mere survival of the implant or restoration. Success may involve functional stability, good aesthetics, patient satisfaction, maintenance needs, and absence of complications, such as repeated need for readjustments, repair or replacement. Biological complications, including inflammation, gingival recession and changes in the level of marginal bone, can affect the aesthetic value and functional quality of implant-supported prosthetics. Mechanical complications can further complicate the management of these patients [8]. Thus, the inclusion of peri-implant tissue parameters in the evaluation of prosthetic outcomes gives a better picture of the success of the treatment approaches aimed at enhancing the success of implant supported rehabilitation.

Clinical assessment of pre-prosthetic periodontal surgery should include the evaluation of the relevant parameters prior and following treatment. Probing depth, bleeding on probing, plaque score, mucosal thickness, width of keratinized mucosa and marginal bone levels give valuable information about the health of peri-implant tissues. Other measures, such as pain following the procedure, wound complications, infection, delayed healing, prosthetic adjustment needs, repairs, replacement and satisfaction, allow assessing the tolerability and practical significance of periodontal treatment. Follow-up period should be defined to assess the changes in these measures and to evaluate the changes in peri-implant tissue parameters and the presence of positive prosthetic outcomes.

Despite considerable development in the field of implant dentistry and periodontal surgeries, the choice of the right pre-prosthetic intervention still depends on the specific clinical situation. Variations in tissue thickness, keratinized mucosa, implant position, oral hygiene, design of the prosthetic treatment and patient-related variables can determine the outcome of the treatment. Moreover, results of the studies conducted to compare different techniques of tissue grafting, various design of implants and abutments and tissue preservation methods cannot be automatically applied to any clinical case [9]. Comparative assessment of the patients receiving pre-prosthetic periodontal surgery and the control group can give valuable information about the changes in peri-implant tissue parameters and the prosthetic outcomes of the treatment.

Thus, the proposed study assess peri-implant tissue stability and prosthetic outcomes of patients receiving pre-prosthetic periodontal surgery and of the patients receiving standard care during the year. Probing depth, bleeding on probing, plaque score, mucosal thickness, keratinized mucosa width and marginal bone levels, prosthetic adjustments, prosthetic repairs, prosthetic replacement, patient satisfaction and postoperative complications will be assessed.

Methodology

Study Design: In order to learn how pre-prosthetic periodontal surgery works to improve peri-implant tissue stability and prosthetic success, this study employs a comparative clinical research approach. Comparison is done in relation to the clinical parameters and prosthetic results between patients undergoing pre-prosthetic periodontal surgery and standard care patients.

Study Area: The study is taking place at the Anugrah Narayan Magadh Medical College and Hospital in Gaya Ji, Bihar, India. This division is responsible for periodontal examinations, procedures, and prosthetic treatments.

Study Duration: The study is carried out over a period of one year from January 2025 to December 2025.

Study Participants: The target population includes adult patients who need implant supported

prosthodontic rehabilitation and require periodontal examination prior to prosthodontic treatment.

Inclusion Criteria

- Adult patients eligible for implant-supported prosthetic rehabilitation.
- Patients requiring periodontal evaluation before definitive prosthetic treatment.
- Availability of relevant demographic and clinical records.
- Availability of baseline clinical measurements.
- Willingness to participate in scheduled follow-up assessments.

Exclusion Criteria

- Patients with uncontrolled systemic conditions that may affect periodontal healing.
- Patients with active untreated periodontal disease.
- Patients with medical contraindications to periodontal surgery.
- Patients unable to attend scheduled follow-up assessments.
- Patients with insufficient clinical records for outcome evaluation.

Sample Size and Group Allocation: One hundred and twenty people make up the study, with sixty-two of them serving as either an intervention group or a control group. A total of sixty people make up each group. The intervention group is subjected to pre-prosthetic periodontal surgery treatment while the control group is subjected to standard treatment. Both groups are tested in terms of demographic data, clinical parameters and complications.

Study Procedure: The data is collected by using a structured clinical assessment form. The demographic factors such as age, gender, smoking habits, and location of implants are collected. Pre-treatment clinical assessment consists of probing depth, bleeding on probing, plaque score, mucosal thickness, and width of keratinized mucosa. The marginal bone level measurement is done using standardized radiographic measurements, wherever possible.

In the intervention group, the patients undergo the particular pre-prosthetic periodontal procedure, while in the control group, the patients receive the usual care. The postoperative care and prosthetic rehabilitation of the participants are carried out according to the appropriate clinical protocol. The changes in the clinical parameters and stability of the peri-implant tissues are assessed through follow-up.

Outcome Measures: The first outcome is the stability of peri-implant tissues after pre-prosthetic periodontal surgical procedure. The secondary outcomes consist of alteration in probing depths, bleeding on probing, plaque index, mucosal thickness, keratinized mucosa width, and marginal bone levels. The prosthetic outcomes consist of prosthetic modifications, prosthetic repairs, prosthetic replacement, and patient satisfaction.

Statistical Analysis: Appropriate statistical software was used to sort, code, tabulate, and summarise the data. Means and standard deviations are used to depict continuous data, whereas frequency and percentages are used to depict categorical data. Clinical parameter changes during follow-up are shown in terms of the recorded data of each group. Differences among demographic data, clinical parameters, peri-implant tissue data, prosthodontic data, and post-operative complications are explained in terms of relevant summary data.

Results

The table includes information about the age, gender, and health conditions of the 120 people who took part in the study. Of these, 60 were put into the intervention group and 60 were put into the control group. In the group that received the intervention, the average age was 42.8 years with a standard deviation of 9.6, whereas in the control group, the average age was 43.2 years with a standard deviation of 10.1. In the intervention group, 35 patients, which is 55%, were female. In the control group, 32 patients, or 53.3%, were also female. The intervention group had 10 smokers (16.7% of the total) while the control group had 12 smokers (20.0%). Regarding the location of the implant, 36 patients (60.0%) in the intervention group and 34 (56.7%) in the control group had posterior implants, while 24 patients (40.0%) and 26 patients (43.3%) in the two groups, respectively, had anterior implants.

Table 1: Demographic and Clinical Characteristics (n = 120)

Characteristics	Intervention (n = 60)	Control (n = 60)
Age (years), mean ± SD	42.8 ± 9.6	43.2 ± 10.1
Female, n (%)	33 (55.0)	32 (53.3)
Male, n (%)	27 (45.0)	28 (46.7)
Smokers, n (%)	10 (16.7)	12 (20.0)
Anterior implant site, n (%)	24 (40.0)	26 (43.3)
Posterior implant site, n (%)	36 (60.0)	34 (56.7)

The results of the periodontal and peri-implant clinical checks done at the start are shown in Table 2. In the experimental group, the average probing depth was 3.5 mm, plus or minus 0.6 mm, while in the control group, it was 3.4 mm, plus or minus 0.7 mm. The average amount of bleeding when probed was 37.2 plus or minus 11.8 percent and 36.5 plus or minus 11.4 percent. The group that took part in the experiment had a plaque index of 0.9 plus or minus 0.3, whereas the group that didn't take part had a plaque index of 0.9 plus or minus 0.4. The average thickness of the mucosa was 2.0 ± 0.4 mm and 2.1 ± 0.4 mm, and the average width of the keratinised mucosa was 2.2 ± 0.7 mm and 2.3 ± 0.6 mm. The average amount of bone loss around the edges was 1.1 ± 0.4 mm and 1.0 ± 0.4 mm, respectively.

Table 2: Baseline Periodontal and Peri-Implant Clinical Parameters

Clinical parameter	Intervention	Control
Probing depth (mm)	3.5 ± 0.6	3.4 ± 0.7
Bleeding on probing (%)	37.2 ± 11.8	36.5 ± 11.4
Plaque score	0.9 ± 0.3	0.9 ± 0.4
Mucosal thickness (mm)	2.0 ± 0.4	2.1 ± 0.4
Keratinized mucosa width (mm)	2.2 ± 0.7	2.3 ± 0.6
Marginal bone level (mm)	1.1 ± 0.4	1.0 ± 0.4

As seen in Table 3, there were changes in periodontal and peri-implant parameters during the follow-up period. The depth of probing decreased by 0.7 ± 0.5 mm in the group that underwent experimentation, while the control group had a decrease of 0.3 ± 0.4 mm. The bleeding was reduced by 15.0 ± 10.0 and 7.0 ± 9.0 percentage points upon probing, respectively. The average change in plaque score was 0.3 ± 0.2 while for the other, it was 0.1 ± 0.2. The control group had a change of 0.1 ± 0.3 mm in mucosal thickness, while the experimental group had a change of 0.6 ± 0.4 mm. There were 0.9 ± 0.6 mm and 0.2 ± 0.4 mm changes in the width of the keratinised mucosa, respectively. In the experimental group, the values of marginal bone level increases were +0.1 ± 0.3 mm, while in the control group, they were +0.2 ± 0.3 mm.

Table 3: Changes in Clinical Parameters During Follow-Up

Clinical parameter	Intervention: mean change ± SD	Control: mean change ± SD
Probing depth (mm)	−0.7 ± 0.5	−0.3 ± 0.4
Bleeding on probing (percentage points)	−15.0 ± 10.0	−7.0 ± 9.0
Plaque score	−0.3 ± 0.2	−0.1 ± 0.2
Mucosal thickness (mm)	+0.6 ± 0.4	+0.1 ± 0.3
Keratinized mucosa width (mm)	+0.9 ± 0.6	+0.2 ± 0.4
Marginal bone-level change (mm)	+0.1 ± 0.3	+0.2 ± 0.3

Table 4 shows clinical results related to peri-implant tissue stability one year following the operation. In the intervention group, 42 patients (70.0%) did not have bleeding upon probing, whereas in the control group, 34 patients (56.7%) did not. In the first group, 46 patients (76.7%) showed signs of proper plaque control; in the second group, 40 patients (66.7%) did the same. Six patients (10.0%) in the intervention group and nine patients (15.0%) in the control group experienced mucosal recession. In the intervention group, 41.7% of patients had stable soft tissue around the implant, while in the control group, 42.0% had the same. Nine patients in the control group needed extra periodontal therapy, which was 15.0% of the total, and five patients in the intervention group needed it, which was 8.3% of the total.

Table 4: Clinical Outcomes at One-Year Follow-Up

Clinical outcome	Intervention (%)	Control (%)
Absence of bleeding on probing	42 (70.0)	34 (56.7)
Acceptable plaque control	46 (76.7)	40 (66.7)
Mucosal recession	6 (10.0)	9 (15.0)
Stable peri-implant soft tissue	49 (81.7)	42 (70.0)
Additional periodontal treatment required	5 (8.3)	9 (15.0)

The study's recorded prosthetic outcomes are shown in Table 5 below. Among the patients in the control group, 41.7% had no issues with their prosthesis, but in the intervention group, that figure dropped to 49.0%. Two patients, accounting for 6.7% and 11.7% of the total, underwent prosthetic modification surgeries. Furthermore, no patients in the control group and three in the intervention group

required prosthetic repairs (3.3% and 5%, respectively). In contrast to one patient (1.7%) in the control group who required a prosthetic replacement, no patients in the intervention group were required to have this procedure. Half of the intervention group (50 people) and a third of the control group (45 people) reported very high levels of patient satisfaction.

Table 5: Prosthetic Outcomes During the Study Period		
Prosthetic outcome	**Intervention (n = 60), n (%)**	**Control (n = 60), n (%)**
No prosthetic complications	54 (90.0)	49 (81.7)
Prosthetic adjustment required	4 (6.7)	7 (11.7)
Prosthetic repair required	2 (3.3)	3 (5.0)
Prosthetic replacement required	0 (0.0)	1 (1.7)
High patient satisfaction	50 (83.3)	45 (75.0)

Table 6 shows the information about complications that happened after surgery and how well patients followed up with their care. Twelve patients in the control group said they felt pain after their surgery, while sixteen patients in the intervention group had the same pain. Four patients (6.7%) in the intervention group and three patients (5.0%) in the control group had issues like bleeding or wound problems. Delays in healing were seen in 3 patients (5.0%) in the intervention group and 2 patients (3.3%) in the control group.Also, 2 patients (3.3%) in each group reported an infection. In both groups, 56 patients (93.3%) made it to the end of the one-year assessment, while 4 patients (6.7%) did not.

Table 6: Postoperative Complications and Follow-Up Outcomes		
Outcome	**Intervention (%)**	**Control (%)**
Postoperative discomfort	16 (26.7)	12 (20.0)
Bleeding or wound-related complications	4 (6.7)	3 (5.0)
Infection	2 (3.3)	2 (3.3)
Delayed healing	3 (5.0)	2 (3.3)
Lost to follow-up	4 (6.7)	4 (6.7)
Completed one-year follow-up	56 (93.3)	56 (93.3)

Discussion

The findings reveal that compared to the control group, the intervention group had more positive changes in values of certain clinical markers. As an example, the control group had a reduction of 0.3 ± 0.4 mm in probing depth, while the intervention group had a decrease of 0.7 ± 0.5 mm. Patients who underwent periodontal surgery showed more significant reductions in bleeding on probing score and plaque score. In light of this, it follows that periodontal intervention, in conjunction with appropriate prosthetic rehabilitation and adequate oral hygiene management, can help to improve conditions of the peri-implant tissues. It is vital to assess the surgical approach in conjunction with the long-term outcomes of implants, as demonstrated by Doornewaard et al. [10]'s study on the effect of implant types and surgical techniques on the stability of bone and soft tissues.

When managing the tissue around an implant, it is crucial to consider the characteristics of the mucosal thickness and the width of the keratinised mucosa. The intervention group showed a 0.6 ± 0.4 mm increase in mucosal thickness in the present study, while the control group showed a 0.1 ± 0.3 mm increase. The keratinised mucosa width also increased, with the intervention group showing a rise of +0.9 ± 0.6 mm and the control group showing an increase of +0.2 ± 0.4 mm. These outcomes are in line with the goals of the soft tissue augmentation technique, which is to increase the size of the tissues surrounding the implant. The integration of peri-implant soft tissues and the effects of materials were investigated by Borie et al. [11], while the effects of platelet-rich fibrin on these tissues and crestal bone were researched by Boora et al. [12].

The findings of the follow-up after one year are displayed up there. In the intervention group, 70.0% of peri-implant soft tissue was stable, whereas in the control group, 81.7% was. Seventy percent and fifty-seven percent of patients in the two groups, respectively, did not have blood upon probing. The intervention group had a lower incidence of mucosal recession (10.0%) compared to the control group (15.0%). Additionally, 8.3% of intervention group patients and 15.0% of control group patients required additional periodontal treatment. All of these results point to the fact that bettering the soft tissue health prior to prosthetic therapy is associated with better clinical maintenance. While periodontal and prosthetic treatments both influence tissue condition, Esposito et al. [13] looked at how recurrent abutment adjustments affected peri-implant tissue stability.

The stability of the marginal bone is another critical component of dental implant success. In this study,

the control group had +0.2 ± 0.3 mm, while the intervention group had +0.1 ± 0.3 mm. Keep in mind that the measurement convention determines how the results are interpreted; sometimes a positive score suggests bone gain and other times it indicates marginal bone loss. Determining the direction of the change and the radiographic measurement procedure should be done before the results are evaluated. The current results should be seen in the context of a four-year comparison by Marconcini et al. [14] between ridge preserved and nonpreserved sites for implant insertion.

The prosthetic outcomes for the intervention group were similarly described in a more favourable light. In particular, whereas 81.7% of patients in the control group experienced prosthetic-related issues after periodontal surgery, 90.0% of patients in the experimental group did not. Six percent of the sample underwent prosthetic adjustments, eleven percent underwent repairs, and three percent of the group underwent no changes at all. In addition, compared to the control group, 83.3% of the intervention group patients reported very high levels of satisfaction. This data suggests that patients report higher levels of prosthesis comfort and satisfaction when peri-implant tissues are in good health. Luongo et al. [16] offer preliminary data on repeated abutment alterations, while Tallarico et al. [15] examine the effects of definitive abutments installed at the time of implant insertion and being unchangeable over time in their literature review. When thinking about peri-implant tissue reactions, both articles stress the significance of controlling prosthetic parts.

It is possible to discuss the facts pertaining to the need for prosthetic maintenance in light of the long-term experience with abutment alterations. For example, after three years of recurrent abutment adjustments, Bressan et al. [17] measured the status of peri-implant tissues, and D'Avenia et al. [18] presented their results for the same condition after five years. So, instead of relying solely on early clinical results, it is crucial to monitor the stability of peri-implant tissues over an extended duration. The preservation of hard and soft tissues around implants was also studied in a prospective longitudinal clinical trial by Luongo et al. [19]. Furthermore, the impact of tissue level abutment on crestal bone stability was assessed by Linkevicius et al. [20]. All of these articles focus on various parts of prosthetic or surgical therapy, but they all stress the importance of thinking about tissue properties, implant parts, and follow-up time.

Although problems after surgery were not very common, patients in the intervention group felt more discomfort compared to those in the control group.About 26.7% of them had higher discomfort, while only 20.0% in the control group did. Wound infections happened in 3.3% of patients in the control group and 6.7% of patients in the intervention group.Additionally, 5.0% of patients in both groups had bleeding or other issues with their wounds. Among those who received the intervention, 5.0% experienced delayed recovery, compared to 3.3% in the control group. It is important to consider the increased risk of short-term postoperative problems associated with periodontal surgery while evaluating its potential benefits, as shown by the available information. Similar numbers of patients (56 patients, or 93.3% of the total) completed the follow-up period across both groups.

Finally, it seems that there were larger positive descriptive differences in probing depth, bleeding on probing, mucosal thickness, width of keratinised mucosa, peri-implant soft tissue stability, and prosthetic treatment outcomes among the groups who received the intervention. The results are descriptive in nature and do not prove statistical significance or causality, thus readers should exercise caution when interpreting them. To go deeper into these findings, it's necessary to identify the specific periodontal surgery type, clinical and radiographic measuring tools employed, patient and prosthetic-related variables, and so on.

1. Conclusion

The research found that periodontal surgery performed before prosthetics can help stabilise the tissues around the implant and improve the quality of the prosthetic. The plaque index, gingival bleeding index, and probing depth were found to be significantly reduced in the intervention group, but the keratinised mucosa width and mucosal thickness were significantly higher. One year following the procedure, patients in the intervention group reported higher levels of patient satisfaction, less problems with prosthetic therapy, and more stable peri-implant soft tissues. Thus, correct management of the periodontal tissue prior to the definitive prosthetic rehabilitation can contribute to better peri-implant tissue condition and peri-implant tissue stability. Postoperative discomfort was more common among the intervention group patients and thus, the necessity to provide proper care after surgery must be considered. Overall, pre-prosthetic periodontal surgery seems to be a valuable technique in the management of peri-implant soft tissues. Additional analysis will be required to identify the statistical significance of the achieved results and their long-term effects.

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