

# Evaluation Of Peri-Implant Soft Tissue – A Histopathological Study Of Normal Patients, Prediabetic Patients & Controlled Diabetes Mellitus Patients

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## Abstract

**Background:** The peri-implant health is an critical aspect for guaranteeing the longevity of dental implant. Understanding the cellular & structural alterations that occur in the peri-implant soft tissues by histopathological assessment is crucial for comprehending the biological response to implants, particularly in systemic diseases like diabetes mellitus.

**Aim:** To evaluate peri-implant soft tissue histopathologically in Normal patients, Prediabetic patients & Controlled Diabetes Mellitus patients.

**Methodology:** For Group I, Group II, & Group III, the average of histopathological grading scores were recorded at day 0, 12–14 weeks, & 3 months accordingly.

**Results:** Mean histopathological grading scores were  $0.6 \pm 0.12$ ,  $1.1 \pm 0.21$ ,  $1.65 \pm 0.29$  at day 0;  $0.55 \pm 0.21$ ,  $1 \pm 0.17$ ,  $1.55 \pm 0.29$  after 12-14 weeks &  $2 \pm 0.07$ ,  $0.5 \pm 0.09$ ,  $1.45 \pm 0.24$  post 3 months for Group I, II & III respectively.

**Conclusion:** Comparing the prediabetic & normal individuals, the diabetic patients have more pronounced peri-implant soft tissue alterations.

**Keywords:** Diabetes mellitus, peri-implant mucositis, pre-diabetic, controlled DM peri-implantitis

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## INTRODUCTION

Entire field of dentistry & the fixed prosthodontic solutions offered to patients & practitioners have transformed since the introduction of dental implants. Maintaining the health of the area around the implant is crucial to ensuring its longevity. Peri-implant mucositis & periimplantitis are among the issues that might arise from pathological changes in soft tissue.<sup>1</sup>

With a growing number of people suffering from diseases brought on by contemporary living, it is critical to guarantee that the therapies that are recommended are inclusive & predictable. Understanding the cellular & structural alterations that occur in the peri-implant soft tissues by histopathological assessment is crucial for comprehending the biological response to implants, particularly in systemic diseases like diabetes mellitus.<sup>2</sup>

The prevalence of Diabetes Mellitus within India among the persons aged 15 & older was 9.3%, with notable state-by-state variability. The need for efficient preventive & management measures is highlighted by the projection that this number would increase to around 93 million by 2030 & 125 million by 2045. Diabetes-related chronic hyperglycemia causes extensive microvascular & macrovascular problems that affect many organs, such as the kidneys, eyes, heart, bones, & oral cavity.<sup>3</sup>

The predictable to range for peri-implant mucositis is between the 30-50% implant patients, while peri-implantitis affects almost 10-20% implants.<sup>4</sup> These conditions are exacerbated in individuals with diabetes

due to an exaggerated inflammatory response, impaired immune function, & compromised wound healing.<sup>5</sup> The histopathological examination of peri-implant soft tissues in diabetic patients often reveals increased inflammatory cell infiltrates, decreased fibroblast proliferation, & disrupted collagen integrity, collectively contributing to the heightened susceptibility to the peri-implant related diseases.<sup>6</sup>

In accordance with the importance of peri-implant mucositis, this research has been done to determine the histopathological features of the soft tissue which will be surrounding implants among patients with manageable DM, pre-diabetic patients, & normal people. The results of this research might help to improve clinical decision-making about the treatment of diabetic implant patients & aid in the fabrication of more potent preventative & beneficial measures for peri-implantitis in this population of patients.

## METHODOLOGY

A cross-sectional study was conducted at the Dept. of Oral & Maxillofacial Pathology of Santosh Dental College in Ghaziabad, Uttar Pradesh, India, with 60 participants. Participants in the study were between the ages of 18 & 75. All subjects, regardless of gender, were selected at random. The study was carried out with ethical permission from the Institution's Ethical Committee. The study was conducted between June 2023 & June 2024.

The study had 60 participants in total. Twenty of them were categorized as non-diabetic (Group I) with HbA1c values less than 5.7, twenty were prediabetic (Group II) with HbA1c levels between 5.7 & 6.4, & twenty were managed diabetic patients (Group III) with HbA1c levels between 6.5-7.

### Sample size calculation was carried out by following formula:

$n = 2 (Z\alpha + Z\beta)^2 \sigma^2 / \delta^2$  where  $Z\alpha$  = level of statistical significance (2.326 for 99% level of confidence),  $Z\beta$  = desired power (1.31 for Power= 0.80)  $\sigma^2$  = standard deviation  $(1.06 + 1.2)/2 = 1.13$   $\delta^2$  = difference of 2 group mean  $(X_2 - X_1) = 3.61 - 2.12 = 1.49$ . The sample size of 15 was calculated.

### Collection of tissue samples:

Tissue samples were obtained from the peri-implant soft tissue using a scalpel, forceps, & scissors under local anesthesia. Each participant provided three tissue samples in total. Three phases were used to collect the peri-implant soft tissues: i) on Day 0 of the implant installation process, ii) 12-14 weeks following the implant placement, & iii) three months after the prosthesis was placed on the integrated implant. For histological examination, they were dispatched.

### Histopathological Analysis:

After being preserved in formalin, the tissue samples underwent paraffin embedding. Hematoxylin & Eosin stain was used to create thin slices from the paraffin blocks. H&E stains show histopathological alterations in peri-implant soft tissues, which mostly show connective tissue alterations & inflammation. H&E staining reveals nuclear alterations, cellular swelling, & inflammatory cell infiltration by highlighting the cytoplasm (pink) & cell nuclei (blue).

### H&E Staining Reveals:

**Inflammatory Cell Infiltration:** When an inflammatory response is present, H&E staining makes it possible to identify different inflammatory cells, such as neutrophils, macrophages, & lymphocytes.

**Edema & Swelling:** H&E can show signs of edema, swelling, & cellular changes, which can be indicative of inflammatory processes.

**Connective Tissue Changes:** The three groups' histological alterations in the soft tissues around the implant were assessed & contrasted. Based on the intensity & composition of the inflammatory exudate & the vascular proliferation, inflammation was assessed by semiquantitative analysis using a scale from 0 to 3: score 0 (absence of inflammatory cells), score 1 (scarce mixed inflammatory cells, mainly T & B cells, corresponding to mild chronic inflammation), score 2 (moderate mixed inflammatory infiltrate composed of T & B cells, with scarce macrophages & polymorphonuclear neutrophils, corresponding to intermediate chronic inflammation, with mild vascular proliferation), & score 3 (numerous T & B cells & some macrophages, with abundant polymorphonuclear neutrophils, corresponding to severe chronic-reactive inflammation, with exuberant vascular proliferation).

At baseline (Day 0), at 12-14 weeks, & again at 3 months, data were collected for Group I, II, a III, respectively. Both intragroup & intergroup comparisons were performed. All data were recorded in a

standardized Proforma, & a comprehensive master chart was prepared. Following data compilation & verification, the results were subjected to statistical analysis.

Statistical evaluations were performed using SPSS Statistics version 23.0 (IBM Corp., USA). A p-value of less than 0.05 has been considered significant. ANOVA was employed for comparing ordinal variables across the groups, while independent t-tests were utilized for pairwise group comparisons.

## RESULTS

60 participants participated in the current study, 20 of whom were in Group I—Normal patients (14 males & 6 females); 20 of whom were in Study Group II—Prediabetic patients (10 males & females each); & 20 of whom were in Group III—Control DM patients (12 males & 8 females)—who had their peri-implant soft tissues histopathologically examined. Study Group I members ranged between 22 - 61 years old, with an average of  $41.8 \pm 5.1$  years, in group II it was  $47.4 \pm 6.6$  years, & they ranged in age from 32- 62. The average age of in the Group III was  $49.6 \pm 6.8$  years, & they ranged in age from 30 to 66.

### Intragroup Comparison

Group I had mean histological grading score  $0.6 \pm 0.12$  at day 0,  $0.55 \pm 0.11$  after 12-14 weeks &  $0.2 \pm 0.07$  after 3 months respectively. The difference between the group at various time interval is statistically significant ( $p=0.026$ ).

Group II had mean histological grading score  $1.1 \pm 0.21$  at day 0,  $1 \pm 0.17$  after 12-14 weeks &  $0.5 \pm 0.09$  after 3 months respectively with a significant statistical different. ( $p=0.016$ ).

Group III had mean histological grading score  $1.65 \pm 0.29$  at day 0,  $1.55 \pm 0.26$  after 12-14 weeks &  $1.45 \pm 0.24$  after 3 months respectively. The difference between the group at various time interval is statistically non-significant ( $p=0.423$ ).

### Intergroup Comparison

Group I had mean histopathological grading score  $0.6 \pm 0.12$ . Group II had mean histopathological grading score  $1.1 \pm 0.21$  & Group III had mean histopathological grading score  $1.65 \pm 0.29$  at day 0, with a statistically significance within the groups ( $p=0.01$ ).

Group I had mean histopathological grading score  $0.55 \pm 0.21$  Group II had mean histopathological grading score  $1 \pm 0.17$  & Group III had mean histopathological grading score  $1.55 \pm 0.26$  after 12-14 weeks. The difference among the groups is statistically highly significant.

After three months, the average histopathological grading score for Group I was  $0.2 \pm 0.07$ . After three months, the mean histopathological grading scores for Group II & Group III were  $0.5 \pm 0.09$  &  $1.45 \pm 0.24$ , respectively. The groups' differences were found to be statistically significant. ( $p=0.031$ ).

## DISCUSSION

Diabetes mellitus comprises a group of metabolic disorders characterized primarily by chronic hyperglycemia resulting from defects in insulin secretion, insulin action, or both. The condition is broadly classified into two main types: Type 1 & Type 2 DM. Type 1 DM is an autoimmune disorder marked by the complete destruction of pancreatic beta cells, leading to an absolute deficiency of insulin. In contrast, the later one accounts for 90% - 95% of all the diabetes cases, is a complex metabolic & endocrine disorder characterized by insulin resistance along with relative insulin deficiency, where pancreas fails to produce optimum amount of insulin to overcome the resistance.<sup>4</sup>

Implant prostheses are associated with inflammatory complications affecting the surrounding soft & hard tissues, commonly referred to as peri-implant mucositis & peri-implantitis. Research indicates that inflammation of the peri-implant soft tissues can lead to pathological alterations at the implant-tissue interface, potentially resulting in peri-implant bone resorption. Peri-implant diseases typically manifest as either peri-implant mucositis, characterized by inflammation of the peri-implant mucosa with minimal bone loss, or peri-implantitis, a more advanced condition involving progressive bone loss. If left untreated, peri-implant mucositis may advance to peri-implantitis, underscoring the importance of early diagnosis & management.<sup>6,7</sup>

Our research's findings were in agreement with a trial undertaken by Berglundh T et al.<sup>8</sup>, discovered statistically significant differences between normal & diabetic patients in the average histological grading

score for peri-implant soft tissue inflammatory alterations. In individuals with diabetes, the inflammatory alterations were more noticeable. Another research by Sharma A et al.<sup>9</sup> found that the mean histopathological grading score for the group of DM patients was significantly greater than the prediabetic participants. These findings align with those of the current investigation.

According to Aldahlawi S et al.<sup>10</sup>, uncontrolled diabetics had noticeably higher mean histopathological grading scores for peri-implant soft tissue than non-diabetics. According to Zhang Z et al.<sup>11</sup>, the reason why diabetic & non-diabetic patients have different peri-implant soft tissue is because diabetic patients have abnormal wound healing processes, gingival immune inflammation, overactive matrix metalloproteinases (MMPs), pathogenic bacterial infestation, & excessive oxidative stress.<sup>4</sup>

DM is an confirmed pre-disposing factor for the peri-implantitis, according to Qian W et al.<sup>12</sup> Persistent hyperglycemia can cause peri-implant illnesses by compromising the soft tissues' ability to act as a barrier. Furthermore, poor soft tissue sealing surrounding implants may be caused by enhanced pathogenic bacterial infections, increased inflammatory cytokine activity, as well as decreased wound healing in diabetes circumstances.<sup>6</sup>

According to a study by Gomez-Moreno G et al.<sup>13</sup> which examined peri-implant soft tissue modification in patients with T2DM & varying glycemia levels, implantation for diabetic patients are potentially predictable as long as the patients' glycemia levels remained in the controlled ranges for longer period time, as determined using the tracking of glucose levels.

Another research by Abduljabbar T et al.<sup>14</sup> examined & contrasted the periimplant & periodontal inflammatory markers of people with T2DM, prediabetes, & healthy controls. It has been shown that retinal implants among thepeople suffering from T2DM can maintain their functional & cosmetic stability in a way comparable to that of healthy people providing the glycaemic levels were well controlled & maintained.

In contrast to the outcomes of the research done by Lorean et al.<sup>15</sup> & Mistry R et al.<sup>16</sup>, our investigation revealed no discernible variation in the mean histopathology grading score of peri-implant soft tissue inflammation between individuals with & without diabetes.

Subjects from a single demographic group & a very limited sample size were the study's limitations. To confirm our findings for a wider population, a bigger sample bulk comprising of participants from other fields should be included.

## CONCLUSION

Compared to prediabetic & normal individuals, diabetic patients have more pronounced peri-implant soft tissue alterations. As blood glycosylated haemoglobin (HbA1c) levels rise, so does the level of severity of histopathological alterations. Better prevention & treatment plans for diabetes patients' peri-implant soft tissue issues are being developed as a result of the findings. However, to validate this idea, more study needs to be done using a larger population estimate .

**FINANCIAL SUPPORT & SPONSORSHIP:** Self-financed

**CONFLICTS OF INTEREST:** None

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