

## DIABETES MELLITUS AND DENTAL IMPLANT FAILURE: EVALUATING THE INFLUENCE OF THE TYPE OF DIABETES ON IMPLANT LOSS AND LONGEVITY

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### ABSTRACT

Diabetes mellitus is a metabolic condition that influences the osseointegration of dental implants. **Aim of the study:** Our study aimed to evaluate the impact of diabetes on the loss of dental implants, their localization, type of prosthesis, and duration of use. **Material and Methods:** The study sample included 191 patients, of which 29.3% had type 1 diabetes and 70.7% had type 2 diabetes. Patients were evaluated for the number and localization of implants, type of prosthesis, degree of metabolic control and implant duration. **Results:** Patients with type 1 diabetes frequently lost more implants (2 or 4), and the implants were predominantly lost in the mandibular arch. Most of the patients opted for fixed prostheses. The average implant duration was 1-5 years, and implant loss was significantly more frequent in patients with type 1 diabetes. **Conclusions:** The type of diabetes affects the success of dental implants, and proper glycemic control is essential to reduce associated risks.

**Keywords:** Diabetes mellitus, Dental implants, Implant loss, Dental prosthesis.

### INTRODUCTION

Diabetes mellitus is a chronic metabolic condition characterized by elevated blood glucose levels, with multiple implications for both general and oral health. Recent studies highlight a significant association between diabetes and dental implant loss, attributing this phenomenon to both systemic and local factors. In a systematic study, some authors showed that diabetes can significantly influence the success of dental implants, with a higher risk of failure among diabetic patients compared to the general population (1).

Diabetes can promote the development of peri-implantitis, an inflammatory condition of the peri-implant tissues, which significantly contributes to dental implant loss. In this regard, another study demonstrated that diabetes is a risk factor for implant loss, and poor glycemic

control increases the likelihood of peri-implant complications (2). Furthermore, Chrcanovic et al. confirm that inflammation in the peri-implant tissues starts more easily and progresses more rapidly in diabetic patients, which can lead to implant loss (3). In these patients, conditions such as a reduced width of keratinized mucosa and poor oral hygiene can lead to a higher incidence of complications. For example, it has been shown that good oral hygiene and strict glycemic control are essential to prevent dental implant loss in diabetic patients (4, 5).

Poor glycemic control is another determining factor in the success of implants for diabetic patients. Alterman et al emphasized that uncontrolled diabetes can affect the healing and integration of implants, and the risk of complications increases significantly in these cases (6). In conclusion, effective glycemic control and careful

monitoring of oral health are essential for the success of dental implants in diabetic patients (7, 8). Therefore, proper management of diabetes and local factors, such as oral hygiene and the condition of the peri-implant tissues, play a crucial role in preventing implant loss and maximizing the success of dental prosthetic treatment for diabetic patients.

#### AIM OF THE STUDY

The purpose of this study is to analyze the influence of the type of diabetes (Type 1 and Type 2) on dental implant success, investigating factors such as the number of implants lost, their localization, the type of supra-implant prosthesis, and the duration of implant use. The study aims to determine whether diabetes mellitus represents a significant risk factor in the loss of dental implants and to highlight any differences between patients with Type 1 and Type 2 diabetes, thus contributing to improving treatment strategies for this patient category.

#### MATERIALS AND METHODS

This is an observational, retrospective, and analytical study based on the analysis of medical records of diabetic patients in a Dental Clinic. We investigated the relationship between diabetes type, dental implant characteristics, and the risk of implant loss.

The study included a sample of 191 patients diagnosed with type 1 and type 2 diabetes, who received dental implant treatments. Inclusion criteria were: patients diagnosed with type 1 or type 2 diabetes, patients who underwent implant treatment, and patients with complete and updated medical records. Exclusion criteria included patients with serious systemic diseases that could influence the success of dental implants, those with incomplete medical histories, and patients who had recent interventions that could influence implant outcomes.

Demographic data (age, gender), medical history regarding the type of diabetes (type 1 or type 2), and metabolic control (HbA1c) were collected from the medical records. Clinical information included the total number of dental implants per patient, implant location (maxillary arch, mandibular arch, or both arches), type of supra-implant prosthesis (fixed or removable), and implant duration (1-5 years, 6-10 years, over 10 years). The number and location of lost implants were also recorded.

Data analysis was performed using descriptive and inferential statistical methods. Data distribution was expressed as means and standard deviations for continuous variables and percentages for categorical variables. The association between diabetes type and implant loss was assessed using the Chi-square test for categorical variables, and Pearson's (r) and Spearman's (ρ) correlation coefficients were used for correlations. Statistical significance was set at a threshold of  $p < 0.05$ , with results with  $p < 0.001$  considered highly significant.

#### RESULTS AND DISCUSSIONS

The study sample consisted of 191 patients. The mean age of the patients was  $50.46 \pm 4.99$  years, with an age range between 39 and 60 years. The gender distribution shows a slight predominance of females (52.4%) compared to males (47.6%). Regarding the type of diabetes, 29.3% of the patients had type 1 diabetes, while the majority (70.7%) had type 2 diabetes. Concerning the treatment and metabolic control ( $HbA1c < 7\%$ ), 55.5% of the patients were following correct treatment and had a good metabolic control ( $HbA1c$  between 6.5-7%), but a concerning 44.5% had a bad metabolic control ( $HbA1c > 7\%$ ), which could negatively influence the progression of the disease and the success of dental treatments, including dental implants (Table 1).

**Table 1.** Demographic characteristics, type of diabetes, and adequacy of treatment among the analyzed patients.

|                   | No                                                              | %    |
|-------------------|-----------------------------------------------------------------|------|
| Age               | 50.46 ± 4.99 years old<br>(Min. 39 years old; max.60 years old) |      |
| Gender            |                                                                 |      |
| Female            | 100                                                             | 52.4 |
| Male              | 91                                                              | 47.6 |
| Type of diabetes  |                                                                 |      |
| Type 1            | 56                                                              | 29.3 |
| Type 2            | 135                                                             | 70.7 |
| Metabolic control |                                                                 |      |
| HbA1c < 7%        | 106                                                             | 55.5 |
| HbA1c > 7%        | 85                                                              | 44.5 |

The results depicted in Table 2 indicate that patients had, on average,  $3.97 \pm 1.98$  implants, with a minimum of 1 implant and a maximum of 7 implants. The majority of implants were placed in the mandibular arch (52.9%), followed by implants distributed across both arches (33.5%), and a smaller percentage was placed in the maxillary arch (13.6%). Regarding the type of prosthesis, 86.9% of patients opted for a fixed prosthesis, while only 13.1% had removable prostheses, reflecting a clear preference for more stable and functional solutions.

The duration of implant use shows that most patients had implants for 1-5 years (56.0%) and 6-10 years (38.2%), while only 5.8% had implants that lasted more than 10 years, suggesting that long-term implant

maintenance depends on several factors, including general health and oral care.

Regarding implant loss, 35.6% of patients lost a single implant, and 41.9% lost two implants, which was the most common scenario. More severe losses of 3 or 4 implants were rarer (12.0% and 10.5%). The majority of lost implants were located in the mandibular arch (73.8%), indicating a higher risk of failure, although this area is also the most frequently treated with implants. In contrast, 24.1% of lost implants were found in the maxillary arch, and only 2.1% of patients lost implants in both arches. These data highlight the importance of monitoring and proper maintenance of implants, especially in the mandibular arch, where loss seems to be more frequent (Table 2).

**Table 2.** Distribution of dental implants and analysis of their loss based on location, type of prosthesis, and duration of use.

|                         | No                                                             | % |
|-------------------------|----------------------------------------------------------------|---|
| No of implants/ subject | 3.97 ± 1.98 implants<br>(Min.no.1 implant – max no.7 implants) |   |
| Implants situs          |                                                                |   |

|                           |     |      |
|---------------------------|-----|------|
| Maxillary arch            | 26  | 13.6 |
| Mandibular arch           | 101 | 52.9 |
| Both arches               | 64  | 33.5 |
| Type of prosthetic        |     |      |
| Fixed prosthesis          | 166 | 86.9 |
| Removable prosthesis      | 25  | 13.1 |
| Years Since Implantation  |     |      |
| 1-5 years                 | 107 | 56.0 |
| 6-10 years                | 73  | 38.2 |
| More than 10 years        | 11  | 5.8  |
| No of lost implants       |     |      |
| 1.00                      | 68  | 35.6 |
| 2.00                      | 80  | 41.9 |
| 3.00                      | 23  | 12.0 |
| 4.00                      | 20  | 10.5 |
| Location of Lost Implants |     |      |
| Maxillary arch            | 46  | 24.1 |
| Mandibular arch           | 141 | 73.8 |
| Both arches               | 4   | 2.1  |

The data analysis points out a significant difference between the type of diabetes and the number of lost implants. Patients with type 1 diabetes have a higher rate of losing multiple implants, especially 2 implants (48.2%) or 4 implants (35.7%), while patients with type 2 diabetes more frequently lose a single implant (45.2%). The Pearson correlation test ( $r = -0.443$ ,  $p = 0.000$ ) and Spearman's ( $\rho = -0.388$ ,  $p = 0.000$ ) confirm a moderate negative association, meaning that patients with type 1 diabetes are more prone to losing a greater number of implants compared to those with type 2 diabetes. This association is statistically significant ( $p < 0.001$ ) and suggests that type 1 diabetes may negatively affect the success of dental implants (Table 3).

Regarding the location of the lost implants, there is a clear difference between the two types of diabetes. In patients with type 1 diabetes, the majority of lost implants are located in the mandible (57.1%), while in patients with type 2 diabetes, the percentage is even higher (80.7%). Conversely, implant loss in the maxillary arch is more frequent in patients with type 1 diabetes (42.9% vs. 16.3% in type 2 diabetes). The moderate positive correlation between maxillary localization and diabetes type ( $r = 0.291$ ,  $\rho = 0.292$ ,  $p = 0.000$ ) indicates that patients with type 1 diabetes have a higher risk of implant loss at this level.

The type of supra-implant prosthesis does not show a significant association with the type of diabetes. Patients with type 1 and

type 2 diabetes have similar rates of fixed prosthesis (78.6% vs. 74.1%) and removable prosthesis (21.4% vs. 25.9%). The Pearson and Spearman correlations are very low ( $r = 0.048$ ,  $\rho = 0.048$ ,  $p = 0.511$ ), suggesting that the type of prosthesis is not influenced by the type of diabetes. This result indicates that both type 1 and type 2 diabetic patients have the same treatment options regarding supra-implant prostheses.

Regarding the duration of implant use, most patients fall within the 1-5 years interval (42.9% for type 1 diabetes, 48.9% for

type 2 diabetes) and 6-10 years (57.1% for type 1 diabetes, 47.4% for type 2 diabetes). Only a very small percentage of type 2 diabetic patients had implants that lasted more than 10 years (3.7%). The Pearson and Spearman correlations ( $r = -0.019$ ,  $\rho = -0.035$ ,  $p = 0.209$ ) do not show a significant relationship between the duration of implant use and the type of diabetes, suggesting that implant survival is not directly influenced by the type of diabetes, but rather by other factors such as oral hygiene, glycemic control, and the surgical technique used.

Table 3. Association between diabetes type and dental implant loss based on location, type of prosthesis, and duration of use.

|                                  |                      | Type of diabetes |        | p     | r      | $\rho$ |
|----------------------------------|----------------------|------------------|--------|-------|--------|--------|
|                                  |                      | Type 1           | Type 2 |       |        |        |
| Number of Lost Implants          | 1.00                 | 12.5%            | 45.2%  | 0.000 | -0.443 | -0.388 |
|                                  | 2.00                 | 48.2%            | 39.3%  |       |        |        |
|                                  | 3.00                 | 3.6%             | 15.6%  |       |        |        |
|                                  | 4.00                 | 35.7%            |        |       |        |        |
| Location of Lost Implants        | Maxillary arch       | 42.9%            | 16.3%  | 0.000 | 0.291  | 0.292  |
|                                  | Mandibular arch      | 57.1%            | 80.7%  |       |        |        |
|                                  | Both arches          |                  | 3.0%   |       |        |        |
| Type of Supra-implant Prosthesis | Fixed prosthesis     | 78.6%            | 74.1%  | 0.511 | 0.048  | 0.048  |
|                                  | Removable prosthesis | 21.4%            | 25.9%  |       |        |        |
| Years Since Implantation         | 1-5 years            | 42.9%            | 48.9%  | 0.209 | -0.019 | -0.035 |
|                                  | 6-10 years           | 57.1%            | 47.4%  |       |        |        |

|  |                    |  |      |  |  |  |
|--|--------------------|--|------|--|--|--|
|  | More than 10 years |  | 3.7% |  |  |  |
|--|--------------------|--|------|--|--|--|

The results of our study indicate a significant association between the type of diabetes and the number of lost implants. Specifically, patients with type 1 diabetes have a higher rate of losing multiple implants compared to patients with type 2 diabetes. These findings are supported by the literature, which shows that patients with type 1 diabetes, having a weaker immune response, are more susceptible to infections and implant loss (1, 3, 9, 10). Additionally, recent studies suggest that type 1 diabetes may lead to a more pronounced inflammatory process that negatively affects the osseointegration of implants (7, 9, 11, 12).

Regarding the localization of lost implants, our study found a significant difference between patients with type 1 and those with type 2 diabetes. In patients with type 1 diabetes, the majority of lost implants were located in the mandible, while patients with type 2 diabetes showed a higher rate of implant loss in the mandibular arch. This difference suggests a higher risk of implant loss in the mandibular area, which can be explained by lower bone density in this region, further exacerbated by the negative impact of diabetes on bone regeneration (13, 14, 15). Moreover, in our study, patients with type 1 diabetes had a higher tendency to lose implants in the maxillary arch compared to those with type 2 diabetes. This difference suggests a correlation between the type of diabetes and the location of implant loss, which is supported by a recent study by Salvi et al., which showed that patients with type I diabetes have a higher risk of implant loss in areas with weaker bone (4).

Our study did not find a significant association between the type of supra-implant prosthesis (fixed vs. removable) and the type of diabetes, which is in line with the literature. Both patients with type 1 and type 2 diabetes chose fixed prostheses at a similar rate, and removable prostheses were more frequently found in patients with type 2 diabetes. This observation suggests that the

choice of prosthesis type is not directly influenced by the type of diabetes but rather by patient preferences and clinical recommendations. Furthermore, previous studies, have shown that regardless of the type of diabetes, patients tend to choose fixed prostheses due to superior stability and comfort, which may explain the results observed in our study (6, 16, 17, 18).

Regarding the duration of implant use, our study results indicate that most implants were used for 1-5 years, and only a small percentage of patients had implants that lasted more than 10 years. These data suggest that the survival duration of implants is not directly influenced by the type of diabetes, but may be affected by factors such as glycemic control, oral care, and comorbidities associated with diabetes. Previous studies suggest that although diabetes can influence the long-term success of implants, other factors, such as oral hygiene and proper monitoring of overall health, play an important role in maintaining implants over the long term (19, 20, 21).

Our research emphasizes that the type of diabetes points a significant impact on dental implant loss, its localization and other factors associated with implant treatments. The obtained results correlate with previous studies that highlighted that patients with type 1 diabetes have a higher risk of implant loss and associated complications, especially due to more difficult glycemic control and immune risks (7, 14, 22). Additionally, this study suggests that although the duration of implant use is not significantly influenced by the type of diabetes, proper implant care and rigorous glycemic control can significantly contribute to extending long-term success.

## CONCLUSIONS

The study highlights that diabetes mellitus significantly affects the favorable outcome of dental implants, type 1 diabetes patients being on a higher risk of implant loss, particularly in the maxillary arch. This

underscores the need for rigorous monitoring and appropriate management of implant

treatment for subjects with diabetic condition.

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