Failures in Implantology: Epidemiological Survey of 100 Tunisian Dentists

**Abstract:** Introduction: dental implant failure is a major concern for the clinician and the patient. Objectives: The aim of our study is to investigate the way in which 100 Tunisian dentists carried implant treatment for their patients from early phase of planning and selection of patients to the placement of the implant in order to look for the implant failure factors. Results: significant correlations were found between failure rates > 5 and their corresponding factors as number of implants placed (p = 0.001<0, 05), smoking (0.046 <0.05), unbalanced diabetes (0.03<0.05), aseptic protocol (= 0.004< 0.05) and the drilling speed (0,002<0.05). Conclusion: It seems that number of implant placed, smoking, diabetes, aseptic protocol and the drilling speed may contribute to dental implant failure.

**Keywords:** Failure-implants-osseointegration-Risk.

1. **INTRODUCTION**

Osseointegration is the biological basis and the prerequisite for the success of modern implantology treatment. Professor Bränemark defined it in 1985 as “a direct anatomical and functional junction between the reshaped living bone and the surface of the implant being loaded” (Bra-nemark, P. I. et al., 1986). Albrektsson & al, stated six key criteria for a successful osseointegration:

- The biocompatibility of the implant, the design of the implant, the surface condition, the host site, the surgical technique and the surgical conditions (Albrektsson, T. et al., 1986).

Any implant that does not meet these success criteria will be considered as non- osseointegrated. The non-osseointegration of implants is classified into three categories:

- According to the etiology (caused by systemic factors or surgical complications or prosthetic failure)
- According to the chronology of failure (primary or secondary failure)
- Depending on the type of failure (biological, mechanical iatrogenic, poor patient selection)

The aim of this work is to examine methodically and in detail the implant protocol, using a survey of 100 Tunisian dentists through the different stages of implant implant treatment from the planning and selection of patients to the placement of the implant, in addition to highlighting the risk factors in implant surgery and the correlation between these factors and the increased failure rates.

2. **MATERIALS AND METHODS**

During the period from 20 August 2019 to 20 January 2020, we conducted a transversal study by distributing a survey sheet on a random sample of dentist who place implants in their daily practice (100 dentists) in different cities of Tunisia: Tunis, Sousse, Bizerte, Monastir, Gafsa and Nabeul.

The inclusion criteria included dentists who placed implants and who agreed to answer correctly and honestly the survey.

The non-inclusion criteria excluded incomplete answers and dentists who had less than 6 months of experience.

To study the correlations between the different parameters of the study and the failure rates, we divided
the failure rates into 2 groups:

- **1st group**: low failure rate with a failure rate less than or equal to 5%.
- **2nd group**: critical failure rate with a failure rate greater than 5%.

The statistical analyses were performed by using SPSS software (version 13.0) for Windows.

Chi-Square test was used to compare the variables between the two groups. Correlations were tested between the qualitative variables. For all statistical tests performed, significance was determined for a value of p <0.05.

**RESULTS:**

The sample was divided into two groups according to the practitioner’s specialty:
- The 1st group: General dentists: 77%.
- The 2nd group: Specialists: 23%.

The sample included the two categories of dentists, with a prevalence of general dentists (diagram 1)

1. **The implant failure rate according to the dentist's speciality:**

   Among the first group (general dentists), 35% of them had a critical failure rate. Among the specialists we recorded only 30% with a critical failure rate (table I).

   We applied the Chi-square test, (p = 0.265 > 0.05) p was not significant, meaning there was no correlation between the practitioner's speciality and the incidence of implant failure.

2. **The implant failure rate according to the number of implants placed:**

   - For the 1st group (less than 10 implants placed per year): 40% recorded a critical failure rate.
   - For the second group (between 10 and 30 implants placed per year): 59% among them recorded a critical failure rate.
   - For the third group (more than 50 implants placed per year): 16% of this group presented a critical failure rate. (table II)

   Critical failure rate decreased significantly with the increased number of implants placed (more than 50 implants placed), which was confirmed by the value of p = 0.001 <0.05.

3. **The implant failure rate according smoking:**

   25% of the dentists who opposed placing implants for smoker patients (more than 20 cigarettes / day) recorded a critical failure rate, on the other side, dentist who placed implants for smokers recorded 44% critical failure rate (table III).

   The rate of failure decreased among dentists who considered smoking as an absolute contraindication. The value of p was 0.046 less than 0.05 which is significant.

4. **The implant failure rate according to unbalanced diabetes:**

   27.7% of dentists who contraindicated the placement of implants to unbalanced diabetics patients recorded a critical failure rate. For the second group who indicated the placement of implants to this category of patients: 64.7% among them recorded a critical failure rate. (table IV)

   The failure rate decreased with dentists who contraindicated the placement of implants to unbalanced diabetic patients. The value of p is 0.03; it is less than 0.05 which was considered significant.

5. **Implant failure according to osteoporosis:**

   For the 1st group who contraindicated the placement of implants to patients with osteoporosis: 41.3% recorded a critical failure rate. For the second group who indicated the placement of implants to patients with osteoporosis: 23.8% recorded a critical failure rate. (Table V).

   The value of p = 0.067 was greater than 0.05, which means there was no significant difference between the 2 groups.

6. **Implant failure rate according to lack of hygiene and motivation:**

   31.6 % of dentists who contraindicated the placement of implants to unmotivated patients with poor hygiene recorded a critical failure rate. 37.5 % of dentists who indicated the placement of implants to unmotivated patients with poor hygiene presented a critical failure rate (table VI).

   The value of (p = 0.1) is greater than 0.05, meaning there is no significant difference between the 2 groups.

7. **Implant failure rate according to the aseptic protocol:**

   For the 1st group of dentists who used a separated operatory as a specified surgery room didn’t record a critical failure (0.00%), but for dentists who placed implants in an ordinary surgery room, 39.5% presented critical failure rates (table VII).

   The value of p = 0.004 is less than 0.05, meaning there is a significant correlation between the use of a specific operatory for implant surgery and the decrease in failure rates.

8. **Implant failure rate according to the drilling speed:**

   For the 1st group that did not exceed a drilling speed of [value].
speed of 800 rpm, 0% recorded critical failure. For the second group which opted for a drilling speed between 1000 rpm and 1500 rpm, 33.7% recorded a critical failure rate (table VIII).

We just analyzed the correlation between using a drilling speed less than 800 rpm and the failure rate and we found that there was a significant correlation between this parameter and the decrease of failure rate (p=0,002).

**DISCUSSION:**

Our sample consisted of 100 dentists who differ in specialty, experience and the frequency of conducting implant procedures.

In our study, no significant difference between specialists and general practitioners was reported in terms of critical failure results (p = 0.265), we found that 35.1% of general practitioners had critical failure rates, compared to 30% within specialists, which was in concordance with the study of Andersson, B. et al., (1998) who compared the results of 4 general dentists to the results obtained with specialists, in the case of implant replacement of one absent tooth. It concluded that there was no significant radiological difference between the two groups.

The critical failure rate decreased also significantly with the increased number of implants placed per year: 40% of practitioners placing less than 10 implants per year recorded a critical failure rate while 16% of practitioners placing more than 50 implants per year recorded a critical failure rate (p = 0.001). This was consistent with the study of Lambert & al in 1997 who revealed that dental surgeons who placed less than 50 implants per year had a failure rate (between 5.4 and 10.3%) double the professionals failure rate who placed 50 or more implants per year (rate of 2.6% failure) (Lambert, P. M. et al., 1997).

In our study, we found that the failure rate decreased significantly among practitioners who had considered smoking (more than 20 cigarettes / day) as an absolute contraindication to implant placement (The p value is 0.046 less than 0.05). These results were in agreement with the literature. In fact, in a study with a large sample, the parameters for the success of 2016 implants placed in 310 patients were evaluated and smoking was the main factor in the failure of implants (Manzano, G. et al., 2016). This was confirmed by a meta-analysis based on implant and patient data performed by Julia PC and Vanessa R in 2019 (de Carvalho, J. P., & Rossi, V. 2019).

The failure rate increased significantly among practitioners who indicated implant placement to patients with bad diabetes control (p = 0.03). This was confirmed by Kamel Earar & al in 2019 who claimed that the dental implant may have a low chance of success for people with diabetes due to osseointegration problems (Earar, K. et al., 2019). However, the indication or contraindication of dental implants in diabetic patients remains a controversial subject in the case of patients with bad diabetes control. Van Steenberghè & al in a study about 399 patients who received 1263 Bråemark® implants did not find an association between diabetes and early implant failure. The failure rate was 2.2%, which allowed them to conclude that if diabetes is well controlled, implant placement is not contraindicated (Van Steenberghè, D. et al., 2002). This was also confirmed by Javed and Romanos via a literature review on the subject (Javed, F., & Romanos, G. E. 2009).

A significant number of patients have osteoporosis, in particular women over the age of 50. Although the bone quality of these patients is poor (type III and IV according to the Lekholm and Zarb classification), and the cell renewal rate was very slow, implant therapy is not contraindicated (Gaetti-Jardim, E. C. et al., 2011).

In our study we did not record a significant difference between critical failure and the indication of dental implants to osteoporotic patients (p value = 0.067). The results were consistent with the conclusions of Friberg et al., in 2001 and Holahan & et al., in 2008 who recorded an estimated survival rate of 93.8% at 5 years of implants placed to osteoporotic patients (Friberg, B. et al., 2001; & Holahan, C. M. et al., 2008).

No correlation was found between the indication of implant placement to patients with poor oral hygiene and implant failure (p = 0.1). A recent meta-analysis conducted by Rakic & al in 2018, demonstrated that pre-implantitis in 18.5% of cases is patient dependent while it is in 12.8% implant dependent (Rakic, M. et al., 2018).

Among our sample, only 14% used a separate operatory as a specified surgery room. We noted that there was a correlation between the use of a specified operatory for implant surgery and the reduction in the failure rate (p = 0.04) These results meet the recommendations of the French High Authority for Health (HAS) who admitted that the operatories for implant surgery must be either an operating room or a specified intervention room or an adapted intervention room [https://www.has.sante.fr].

we recorded a drop in the critical failure rate within the group using a reduced drilling speed during implant placement, there was a correlation between the decrease in drilling speed and the decrease in critical failure (p = 0.002). In the used sample none of the practitioners who did not exceed the speed of 800 revolutions per minute, reported critical failure. This is confirmed by the results of Choi & al in 2014 and Chen & al in 2016, which demonstrated that the drilling speed
should never exceed 1500 rpm (Choi, B. H. et al., 2014; & Chen, Y. C. et al., 2016).

Diagram1: The distribution of the sample according to the practitioner's profile.

<table>
<thead>
<tr>
<th>Table I: Failure rate by specialty</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dentist’s speciality</strong></td>
</tr>
<tr>
<td>A general dentist</td>
</tr>
<tr>
<td>A specialist dentist</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table II: The failure rate according to the number of implants placed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Chess</strong></td>
</tr>
<tr>
<td>How many implants</td>
</tr>
<tr>
<td>Between implants</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table III: Failure rate according to the indication or Contraindication of dental implants for smoking patients</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contraindication for Smoking (more than 20 cigarettes / day)</strong></td>
</tr>
<tr>
<td><strong>Contraindication for smoking (more than 20 cigarettes / day)</strong></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Table IV: Failure rate according to the indication or contraindication of dental implants for unbalanced diabetic</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Contraindication for a non-balanced diabetic</strong></td>
</tr>
<tr>
<td><strong>No contraindication for a non-balanced Diabetic</strong></td>
</tr>
</tbody>
</table>
Table V: failure rate according to the indication or contraindication of implant placement in the event of osteoporosis

<table>
<thead>
<tr>
<th>Contraindication in case of Osteoporosis</th>
<th>Weak failure</th>
<th>Critical failure</th>
<th>Total % failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective</td>
<td>34</td>
<td>24</td>
<td>58</td>
</tr>
<tr>
<td>% failures</td>
<td>58.7%</td>
<td>41.3%</td>
<td>58.00%</td>
</tr>
</tbody>
</table>

Table VI: failure rate according to the indication or contraindication of implant placement in the event of lack of hygiene and motivation

<table>
<thead>
<tr>
<th>Contraindication in cases of poor hygiene and unmotivated patients</th>
<th>Weak failure</th>
<th>Critical failure</th>
<th>Total % failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effective</td>
<td>41</td>
<td>19</td>
<td>60</td>
</tr>
<tr>
<td>% failures</td>
<td>68.4%</td>
<td>31.6%</td>
<td>100%</td>
</tr>
<tr>
<td>No contraindication in cases of poor hygiene and unmotivated patients</td>
<td>Effective 25</td>
<td>15</td>
<td>40</td>
</tr>
<tr>
<td>% failures</td>
<td>62.5%</td>
<td>37.5%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table VII: failure rate according to the aseptic protocol

<table>
<thead>
<tr>
<th>Does your aseptic protocol include the specific operating room specification for surgery?</th>
<th>Weak failure</th>
<th>Critical failure</th>
<th>Total % failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>Effective 14</td>
<td>0</td>
<td>14</td>
</tr>
<tr>
<td>% failures</td>
<td>100%</td>
<td>0%</td>
<td>100%</td>
</tr>
<tr>
<td>No</td>
<td>Effective 52</td>
<td>34</td>
<td>86</td>
</tr>
<tr>
<td>% failures</td>
<td>59.50%</td>
<td>39.50%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table VIII: failure rate according to the drilling speed used

<table>
<thead>
<tr>
<th>The speed used for drilling:</th>
<th>Weak failure</th>
<th>Critical failure</th>
<th>Total % failures</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;800 rpm</td>
<td>Effective 11</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>% failures</td>
<td>100.00%</td>
<td>0.00%</td>
<td>100.00%</td>
</tr>
<tr>
<td>Between 1000rpm and 1500rpm</td>
<td>Effective 55</td>
<td>28</td>
<td>83</td>
</tr>
<tr>
<td>% failures</td>
<td>66.30%</td>
<td>33.70%</td>
<td>83.00%</td>
</tr>
</tbody>
</table>

CONCLUSION:

Our study showed that although there is no difference between general dentists and specialists, the number of years of exercise and the number of implants placed are two factors that decrease failure rates; smoking is a considerable risk factor, patients with bad diabetes control are more prone to failure, however we have not reported a correlation between failure and implant placement to patients with osteoporosis. Practitioners who do not consider the risk involved in indicating the implant solution in unmotivated patients with poor hygiene, do not report significant failure rates. Practitioners who respect a drilling speed that does not exceed 1200 revolutions / minute, all have low failure rates.

Implant failure is a major concern for the dentist and the patient. Indeed, the identification of risk factors associated with implant loss is essential to improve and keep the rate of implant failure low over time.

Data Availability: The data used to support the findings of this study are included within the article.

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Conflicts of Interest: The authors declare no conflict of interest.

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REFERENCES: