SURFACE CHARACTERIZATION OF A NEW CERAMIC DENTAL IMPLANT

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ABSTRACT  
This research compares the polished and rough surface of three commercially available dental implants, made of zirconia, titanium grade IV and titanium zirconium. The analysis was done on a Confocal Profilometer at 50x. Results from this analysis show a similar average roughness over the polished surface (Sa value) of the titanium (0.1290µm), titanium zirconium (0.1642µm) and zirconia implant (0.1523µm). However, the results of the analysis of the rough surface show a lower average roughness of the zirconia implant (1.5835µm) compared to titanium (3.5986µm) and titanium zirconium implant (3.0878µm).

Keywords: dental implant, zirconia, titanium, surface characterization, roughness.

INTRODUCTION

Success or failure of dental implants are directly related to the degree of integration of the implant material by surrounding soft and hard tissue (Zhao, 2014). The so-called rough dental implant surfaces have become an important issue mainly because experimental reports have pointed to a more rapid bone response to roughened surfaces then to smoother polished or turned surfaces (Wennerberg, 2000). According to the literature, 3D evaluations like average roughness over a surface (Sa value) are preferable than 2D measurements. This Sa value presents information about average height deviations from a given surface area. This parameter provides a considerably more consistent and reliable value and it is not influenced by the measurement direction. In general, a positive correlation is found between an increasing Sa value and stronger bone or tissue integration, at least up to a certain level of roughness. According to Wennerberg (2009) there is a stronger bone response to the sandblasted/acid-etched surface.

Dental implants are usually made of titanium. However, due to biological and esthetic issues, dental implant manufactures have recently developed implants made in a ceramic material, mainly zirconia. This material is believed to promote a better biological response of the surrounding tissues (bone and gingiva).

In this context, the research here presented consisted on a surface test (with a Confocal Profilometer, 50x) of the polished and rough part of three types of commercial implants:

- Titanium implant, type 4, Straumann SLA® (sandblasted, large-grit, acid-etched)
- Titanium zirconium implant Straumann SLA® Roxolid® Loxim™
- Zirconia implant Straumann Pure Ceramic ZLA™ (MIC: 4.1mm; 8mm; AH 4mm).
RESULTS AND CONCLUSIONS
The results of the profilometer analysis, comparing titanium, titanium zirconium and zirconia polished surfaces, are presented in Fig. 1 where higher roughness is visualized in reddish colour. The filter used was 65x65µm.

These analyses were done on the polished part of the implants. The results show that this area is not absent of roughness. Table 1 presents the Sa values for titanium, titanium zirconium and zirconia implants.

Table 1 - Sa values of titanium, titanium zirconium and zirconia dental implants of the polished area

<table>
<thead>
<tr>
<th></th>
<th>Titanium implant</th>
<th>Titanium Zirconium implant</th>
<th>Zirconia implant</th>
</tr>
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<tbody>
<tr>
<td><strong>Sa Values</strong></td>
<td>0,1290 µm</td>
<td>0,1642 µm</td>
<td>0,1523 µm</td>
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The results of the profilometer analysis, comparing titanium, titanium zirconium and zirconia rough surfaces, are presented in Fig. 2. Higher roughness is visualized in reddish colour. The filter used was 150x150µm.
Fig. 2 - a) Confocal Profilometer results of titanium implant (rough part); b) Confocal Profilometer results of titanium zirconium implant (rough part); c) Confocal Profilometer results of zirconia implant (rough part)

Table 2 - Sa values of the titanium, titanium zirconium and zirconia dental implants of the rough area

<table>
<thead>
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<th>Titanium Zirconium implant</th>
<th>Zirconia implant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sa Values</td>
<td>3,5986 µm</td>
<td>3,0878 µm</td>
<td>1,5835 µm</td>
</tr>
</tbody>
</table>

It can be concluded from the results presented that the roughness of the polished titanium zirconium implants (slightly higher) is similar to that of the titanium and zirconia implant. In the study of the rough part it can be concluded that the value of the roughness of titanium implant is higher than titanium zirconium and zirconia. On the other hand, the roughness of the rough part of the titanium zirconium and titanium implant is similar and on the zirconia implant are lower.

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REFERENCES


