Considerations on Dental Implants Fixation

Medic Cristian Dobreci**
*Politehnica” University of Bucharest, **University of Medicine and Pharmacy

ABSTRACT

Considerations on dental implants fixation
In the paper it is presented a testing bench and the tests done on the special fixing screws of the upperstructure of the metallic dental implants.
Are expressed also conclusions on measurements and those resulting for the users and producers.

INTRODUCTION

In the nowadays dental practice one of the frequently used prosthetic methods consists in the use of metallic dental implants, also known as root implants (after NIH 1988). These implants implies a threaded body (fig.1) which is inserted in the mandibular or maxilar bone.
On this artificially created „root”, after osseointegration is fixed, the upperstructure of the tooth manufactured in the dental laboratory in conformity with the anatomical structure of the dental element of the patient. The fixing element of the upperstructure is, in this case, also a special screw of M1.8 or M2 thread (depending of the manufacturing company.

Fig.1 Root implant
A – implant with surface treated with Titanium plasma; B – implant with surface treated with hydroxylapatite (TPS); C - implant with fine surface texture; D - implant with medium surface texture.
Root osseointegration needs 3 to 6 months, time during which its central threaded channel is loaded up with different substances. Taking into consideration other substances used in the dental practice such as metronidazole gel, special dental adhesive, clorehexidine, etc., during the processes of threading into and out of the screw has been reported accidents by tearing it off which is a very serious case as the restoring of the implants is in general compromised.

The objective of the paper has been to investigate the resistance of the fixing screw for different working hypothesis.
2. The testing bench and procedure

In order to check the different types of screws it has been manufactured a receiving part having 10 threaded seats (fig.2, position 5) from which five are M1.8 and five M2. The receiving part is mounted on the rotating plate 1 of the testing bench. Above the plate is positioned the moment transducer 2 which is connected to the computer 4. By the rotation of the plate the special screw is threaded into the receiving part 5. The seats were treated initially with blood, metronidazole gel, special dental adhesive, clorhexidrine and the first seat was dried. The maximum clamping moment used was of 350Nmm as in the manufacturer documentation.

The tested special screws were measured with a parameter SUHL –TGL 20250.

Table 1 Outer diameter deviation of the thread for the M2 screw

<table>
<thead>
<tr>
<th>Numărul probei</th>
<th>Dimensiune nominală filet [mm]</th>
<th>Abaterea de la dimensiunea nominală [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>M2</td>
<td>-0.022</td>
</tr>
<tr>
<td>2.</td>
<td>M2</td>
<td>-0.020</td>
</tr>
<tr>
<td>3.</td>
<td>M2</td>
<td>-0.095</td>
</tr>
<tr>
<td>4.</td>
<td>M2</td>
<td>-0.092</td>
</tr>
<tr>
<td>5.</td>
<td>M2</td>
<td>-0.021</td>
</tr>
</tbody>
</table>

Table 2 Outer diameter deviation of the thread of the M1.8 screw

<table>
<thead>
<tr>
<th>Numărul probei</th>
<th>Dimensiune nominală filet [mm]</th>
<th>Abaterea de la dimensiunea nominală [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>M1,8</td>
<td>-0.006</td>
</tr>
<tr>
<td>2.</td>
<td>M1,8</td>
<td>+0.004</td>
</tr>
<tr>
<td>3.</td>
<td>M1,8</td>
<td>+0.0015</td>
</tr>
<tr>
<td>4.</td>
<td>M1,8</td>
<td>-0.0092</td>
</tr>
<tr>
<td>5.</td>
<td>M1,8</td>
<td>+0.011</td>
</tr>
</tbody>
</table>

Fig. 4 Tightening screw M2, dry

Fig. 5 Tightening screw M2, with clorhexidrine
Fig. 6 Tightening screw M2, metronidazole gel

Fig. 7 Tightening screw M2, with adhesive

Fig. 8 Tightening screw M2, with blood

Fig. 9 Tightening screw M1,8, dry

Fig. 9 Tightening screw M1,8, cu clorhexidrine

Fig. 10 Tightening screw M1,8, with metronidazole
According to the known relationship of torque screw:

\[ M_t = Q \left[ \frac{d_2}{2} \times \tan (\alpha + \varphi') + \mu_1 \times D_m/2 \right] \]  

(1)

where:

\[ \mu_{\text{dry}} = 0.2, \quad \mu_{\text{wet}} = 0.15, \quad \varphi'_{\text{dry}} = \arctan 0.2 = 11.3099^\circ, \quad \varphi'_{\text{wet}} = \arctan 0.15 = 8.53^\circ, \quad \alpha = 30^\circ \]

it can be deduced the values of the tensile forces in the screw rods when they are maximum stressed:

\[ Q = 243,345 \text{ N for the M2 screw and } Q' = 483,50 \text{ N for the M1,8 screw} \]  

(2)

For the two screws the resulting effective tensile forces in the threaded rods are:

\[ \sigma_t = \frac{4Q}{\pi d_1^2} = 136,019 \text{ N/ mm}^2 \quad \text{și } \sigma'_t = 297,03 \text{ N/ mm}^2. \]  

(3)

3. CONCLUSIONS

In none of the tests was observed breaking any screw rod no matter of the material interposed between the screw and the receiving plate. Also have not noticed cracks in the structure of materials.
The conclusion here is clear that the tightening of these bolts wrench to the recommended value of 350 Nmm, there is no risk of breaking special screws. But producers are required to verify possible structural failure of the materials these being the only ones which could lead to accidental breakage of these screws.

Even if tightening the screws at a maximum, possibly manually created with the special designed instruments for tightening in the dental office, the tensile stress values do not exceed allowable values, which justifies once again the claim that in the absence of structural defects breaking their material is excluded. During interventions, while working with them it is indicated to use dynamometric keys in order to eliminate any unpleasant event.

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