Poster Number

BASIC RESEARCH

Different Apical Implant Designs and the Impact on Initial Stability

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Abstract

Initial stability following implant placement is often emphasized and might be influenced by implant design. Two implant designs, a commercially available implant (control) and an implant with more pronounced apical threads (test), see Figure 1, were investigated in a simplified extraction socket model. Apart from the apical part, the control and test implants were identical. The implants were installed in an under-prepared osteotomy with a depth of 4 mm. After reaching the bottom of the osteotomy, as the installation continued, the torque increased rapidly until the force stripped the threads of the synthetic bone material. The maximum torque recorded during installation showed an up to 20% increase for the test implants before stripping the threads, compared to the control implants. Further, the pronounced apical thread designs' effect on axial load required for the implant to engage and begin installing in the osteotomy was shown to be significantly less for the test implant.

Figure 1. Apical part of the control implant (left) and test implant (right).

Background and Aim

Initial stability following implant placement might be influenced by implant design[1]. More pronounced threads may allow higher engagement in the bone leading to higher initial stability, especially in extraction sockets. The aim of this study was to evaluate the insertion torque and axial load required to install dental implants with two different apical designs in a simplified, under-prepared, extraction socket model.

Methods and Materials

A simplified extraction socket model was constructed, with a depth of the osteotomy of 4 mm, using a synthetic bone material (Sawbones), corresponding to bone quality 2-3. Implants with two different apical designs were installed; test implants (with more pronounced apical threads; Astra Tech Implant EV) and control implants (with less pronounced threads), 20 samples of each design. Maximum insertion torque was recorded. The axial load required for the implants to engage into the under-prepared osteotomy, determined by applying loads in a systematic, stepwise order, in either a homogenous or a laminar synthetic bone material, was recorded.

Results

All results are shown as difference between test and control implants. The test implants required a higher torque compared to control implants before the threads in the osteotomy were stripped, for all diameters. The maximum installation torque recorded showed an up to 20% higher torque for test implants before stripping the threads, compared to control implants. The differences between test and control implants were significant according to Student's T-test (p=0.05), see Table 1.

	Ø 3.0	Ø 3.6	Ø 4.2	Ø 4.8	Ø 5.4
Torque increase	**+19.2% (7.3)**	**+20.3% (5.2)**	**+21.3% (5.0)**	**+7.6% (5.6)**	**+7.0% (6.3)**

Table 1. Percentile torque increase (test vs. control) for different implant diameters (Ø in mm*). Standard deviation shown in parenthesis.*

The required axial load for engagement for test implants was lower than for control implants during installation; up to 40% reduced load in homogenous synthetic bone and up to 60% reduced load for the denser laminar synthetic bone (Table 2).

	Ø 3.0	Ø 3.6	Ø 4.2	Ø 4.8	Ø 5.4
Homogenous PCF 30	**-31.7%**	**-31.7%**	**-31.7%**	**-31.7%**	**-42.2%**
Laminar PCF 50 - 25	**-59.4%**	**-52.8%**	**-55.4%**	**-50.9%**	**-58.9**

Table 2. Percentile load difference (test vs. control) in two different synthetic bone densities, for different implant diameters (Ø in mm*).*

Conclusion

The more pronounced apical thread design could withstand a higher maximum torque before thread stripping, compared to the control implant. A higher initial stability may thus be reached, while at the same time a higher resistance against over-torqueing of the implant is obtained.

Further, the test implant design, with more pronounced apical threads, enhanced the implant's ability to enter the osteotomy, reducing the need for axial load during the installation.

References

[1]Sierra-Rebolledo A, Allais-Leon M, Maurette-O'Brien P, Gay-Escoda C. Primary Apical Stability of Tapered Implants Through Reduction of Final Drilling Dimensions in Different Bone Density Models: A Biomechanical Study. Implant Dent 2016;25(6):775-82.

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