Effect of high insertion torque on the coronal surface roughness of implants with different macro-geometries. An in- vitro study

Ofer Moses, Yariv Shimon, Talia Gurevich, Rachel Sarig, Zeev Ormianer
School of Dental Medicine, Tel Aviv University, **ISRAEL**.

Abstract

Methods and Materials

Results

Fig. 1

100 coronally shaped micro-threads (ROI-A) (**NEO** 3.75 mm, Alpha-Bio®) and 100 coronally shaped micro-ring implants (ROI-B) (**SPI** 3.75 mm, Alpha-Bio®) were examined (**Fig. 1**). Each group was divided into four sub-groups of 25 implants. Sub-groups 1, 2 and 3 were inserted into **bone analogs** (Bone-sim®, its density characterization as was performed in a CT scan appears in Hounsfield units, **Fig. 2**: (cortex 1137 HU, “spongy” part 597 HU) with prepared decreasing osteotomies diameters of 3.65, 3.2 and 2.8 mm respectively. The insertion torque and temperature during the installation of the implant into the different diameters were monitored. Group 4, composed of implants taken from the original packages and subjected to surface roughness measurements served as control and a reference value for the inserted implants. Temperature was measured by a dynamic thermal camera. Surface topography of the coronal surfaces of each implant of test groups was scanned using Nanofocus µ-surf explorer (Nanofocus®), and values were compared to the control group roughness. (**Fig. 4, Fig. 4a**).

The highest insertion torque and temperature values were measured for both groups, during implants insertion into 2.8 mm osteotomies for **NEO**: (243.26±36.77Ncm, 44.82°±14.34°) and **SPI**: (239.10±29.50 [Ncm], 38.86°±7.52°), (p< 0.0001). The lowest torque and temperature were measured during implants insertion into 3.65 mm osteotomies (**NEO**: 60.54±12.59Ncm, 25.70°±2.55°; **SPI**: 28.06±2.58°, 95.47±20.07Ncm), (p< 0.0001). The average surface roughness (Sa) of NEO and SPI control groups were (2.24±0.31µm) and (1.8±0.19µm) respectively. In comparison to the control, implant insertion in 2.8 mm osteotomy diameter resulted in significant roughness decrease of both the coronal micro-threads (1.25±0.35 µm) and the coronal micro rings (1.28±0.38 µm) implants. On the other hand, the 3.65 mm osteotomy diameter group resulted in a milder decrease in roughness, which was slighter, compared to the 2.8 groups (**NEO**: 2.08±0.79 µm, **SPI**: 1.52±0.64 µm). (**Fig. 3, 3a, 3b**)

Fig. 2

Fig. 3

Fig. 4

Fig. 3b

Background and Aim

Numerous studies are dealing with implants placement using different torque degrees. Most of them studied the effect of the torque values on the both bone and soft tissue housing the implants in short and long terms. Little is described in the literature-regarding the effect of the friction created between the implant's insertion torque and the bone, on the roughness of the implant surface.

AIM. This study aimed to evaluate the effect of different osteotomy diameters on the coronal surface roughness of two different standard implants. Each implant with different macro-geometry, which is thought to be an important factor among others, for successful osseointegration.

Implant surface nano-scan before insertion

Implant surface nano-scan after insertion 100N/cm

Fig. 4a

Conclusion

Within the limitation of this study, original coronal surface roughness of an implant is influenced by the degree of friction during implant installation in-vitro. In high torque values a **decrease in roughness** will occur accompanied by a rise in the temperature. **Clinical relevance:** clinician have to look for the minimal torque that ensure good primary stability avoiding the change of the original classical implant surface roughness.

References

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