PO-CI-003

CLINICAL INNOVATIONS

Evaluation of heat generated by a new site preparation using low-speed tools without irrigation

Agnieszka Meljon* [1], Markus Geisendorf[1], Simon Kamber[1], Florian Fuchs[1], Ainara Irastorza-Landa[1]
[1]Nobel Biocare Services AG, Kloten, Switzerland

Background and Aim

Bone health at osteotomy site is one of the key determinants of successful osseointegration of the dental implant. As such, it is of paramount importance to limit the thermal and mechanical damage to bone during osteotomy formation as well as implant insertion [1].

The new biologically-friendly Nobel Biocare N1 system introduces a novel site preparation protocol as well as a novel tapered implant with trioval coronal macroshape that are designed to preserve the viable bone and bone chips [2, 3]. The site is prepared using OsseoShapers (OS), which create osteotomies at low rotational speed (<50rpm) without irrigation while the implant allows for favorable bone strain distribution due to its trioval design [3].

AIM

To evaluate the maximum cumulative temperature increase during osteotomy preparation and implantation of the novel N1 implant system and compare it to a conventional drill protocol

References

[1] Möhlhenrich SC, Modabber A, Steiner T, Mitchell DA, Hölzle F. Heat generation and drill wear during dental implant site preparation: systematic review. British Journal of Oral and Maxillofacial Surgery 2015;53(8):679
[2] Chen CH, Coyac BR, Arioka M, Leahy B, Tulu US, Aghvami M, Holst S, Hoffmann W, Quarry A, Bahat O, Salmon B, Brunski JB, Helms JA. A Novel Osteotomy Preparation Technique to Preserve Implant Site Viability and Enhance Osteogenesis. Journal of Clinical Medicine 2019;8(2):170
[3] Yin X, Li J, Hoffmann W, Gasser A, Brunski JB, Helms JA. Mechanical and Biological Advantages of a Tri-Oval Implant Design. Journal of Clinical Medicine 2019;8(4):427

Methods and Materials

The two groups compared in this study included the novel N1 system (group N1) and the conventional protocol of variable-thread tapered implants NobelActive, (group NA), both Nobel Biocare AG, Göteborg, Sweden. The osteotomies and implantations of RP 13 mm implants (n=8 for each group) were performed following the manufacturer's recommendations (Figure 1).

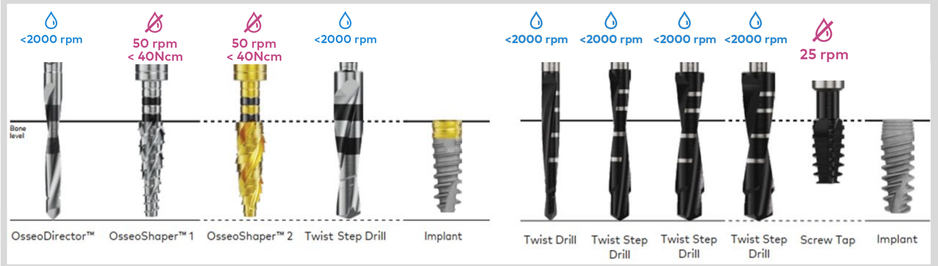
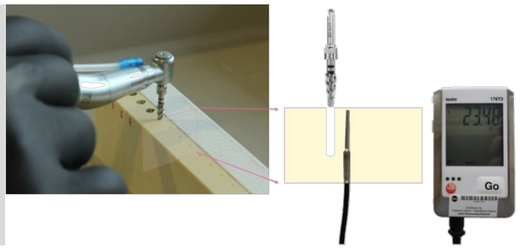


Figure 1. Site preparation protocols for N1 (left panel) and conventional variable-thread tapered implant (group NA; right panel)

The heat generated during site preparation and implant insertion was evaluated in bone surrogate (Sawbones, Pacific Research Laboratories, USA) with density of 40pcf, which corresponds to very thick cortical bone, i.e., dense bone type I according to the Lekholm and Zarb classification. The temperature change (ΔT) during each protocol step from the starting temperature was monitored using a PT-100 thermocouple (Testo Industrial Services AG, Switzerland) placed in bone surrogate material at a 3.5 mm controlled distance in relation to the outer surface of each implant (Figure 2). Data was statistically compared using two sided 2t-test (Minitab 2017).

Figure 2. Test setup used for the for the evaluation of the maximum cumulative temperature increase with a PT-100 thermocouple connected to the temperature display



Results

- Both protocols led to temperature increase (Figure 3):
  - In the N1 group, the maximum ΔT was 1.83 ± 0.23°C after implantation.
  - In the NA group, the maximum ΔT was significantly higher ($p<0.05$) with the highest value of 2.64 ± 0.53°C. The third twist drill was responsible for the highest temperature increase.
- The temperature profile for N1 site preparation is characterized by a more regular, stepwise temperature increase and lower heat produced by the single procedure steps (Figure 3).

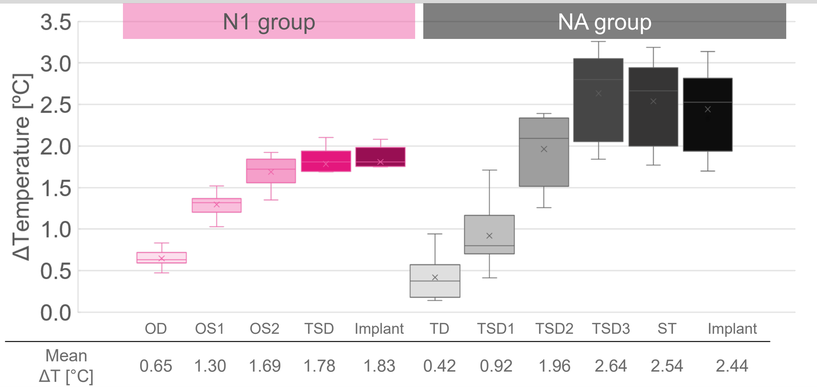


Figure 3. Temperature increase during individual osteotomy preparation steps in the N1 (left panel) and conventional NA (right panel) protocols.

Conclusion

Under the tested in vitro conditions, the N1 system site preparation at low speed and without irrigation followed by implant insertion generates significantly less heat in comparison to the conventional protocol. Further studies should investigate whether this biologically friendly concept that limits thermal damage during osteotomy formation and implant insertion has influence on the osseointegration process.

Presented at EAO Digital Days 2021