Microtomographic assessment of argon plasma effect on HA / β TCP used for maxillary sinus lifting in rabbits.

Balan VF, Silva ER, Costa MM, Godoy EP, Medeiros LK, Xavier SP

University of Sao Paulo, Ribeirao Preto School of Dentistry, Department of Oral and Maxillofacial Surgery, Brazil.

Abstract

The aim of this study was to evaluate the effect of argon plasma on sinus lifting procedures using HA/ β TCP. Ten New Zealand rabbits (3.5-4 kg) were used in this split mouth randomized study. After mucosae sinus floor elevation, identical quantities (50 mg) of the HA / β TCP graft (60% / 40%, 450-1000 μ , GUIDOR calc-i-oss CRYSTAL+®, Sunstar, Etoy, Switzerland) were introduced into the elevated spaces. On the test side, the particles of the graft were submitted to argon plasma treatment before insertion (10 W, 1 bar, 12 min, Plasma R, Sweden and Martina, Pádua, Italy). Both sides were covered with a collagen membrane (Bio-Gide®, Geistlich, Wolhusen, Switzerland). Five animals were euthanized after 2 and 10 weeks. Specimens underwent microtomographic scanning (SkyScan 1172, Bruker, Kontich, Belgium). The cross-sectional images obtained were repositioned using the software DataViewer® (Bruker, Kontich, Belgium). The software CTAn® (Bruker, Kontich, Belgium) was used for microtomographic analysis. Total bone volume (TBV = residual graft + new bone) and the trabecular configuration (Tb.N = number; Tb.Th = thickness; Tb.Sp = spaces) were assessed. The statistical analysis was performed with IBM SPSS Statistics® software (IBM Inc., Chicago, IL, USA) using a Student *t* test. TBV was $121.2 \pm 8.3 \text{ mm}^3$ (control) vs $123.13 \pm 5.8 \text{ mm}^3$ (plasma) in 2 weeks and $140.5 \pm 19.5 \text{ mm}^3$ (control) vs $135.1 \pm 2.6 \text{ mm}^3$ (plasma) in 10 weeks. The intra and intergroup analyzes did not show any statistical difference. A similar trabecular pattern was observed for both plasma and control group. These results suggest that argon plasma did not affect new bone formation. Nevertheless, additional studies are required to support these preliminar findings.

Methods and Materials

Figure 1: Study design. To investigate the effect of argon plasma on sinus lifting procedures using HA/ β TCP. Ten New Zealand rabbits (3.5 – 4kg) were used in this split mouth randomized study.

Figure 2. Surgical Procedure; A: Transoperative view of antrostomies immediately after sinus filling with HA / β TCP (60% / 40%, 450-1000 μ , GUIDOR calc-i-oss CRYSTAL+®, Sunstar, Etoy, Switzerland). Before insertion, at the test site, graft material underwent argon plasma treatment (10 W, 1 bar, 12 min, Plasma R, Sweden and Martina, Pádua, Italy) B: Collagenous membrane (Bio-Gide®, Geistlich, Wolhusen, Switzerland) was used for covering the antrostomies before suture.

Figure 3: MicroCT analisys. Specimens were submitted to microtomographic evaluation (SkyScan 1172, Bruker, Kontich, Belgium). Total Bone Volume (mm^3 , TBV = residual graft + new bone) and the trabecular configuration (number, thickness and separation) were mensured for both control and plasma groups using CTAn software (Bruker, Kontich, Belgium).

Results

TBV was $121.2 \pm 8.3 \text{ mm}^3$ (control) vs $123.13 \pm 5.8 \text{ mm}^3$ (plasma) in 2 weeks and $140.5 \pm 19.5 \text{ mm}^3$ (control) vs $135.1 \pm 2.6 \text{ mm}^3$ (plasma) in 10 weeks. The intra and intergroup analyzes did not show any statistical difference. A similar trabecular pattern was observed for both plasma and control group.

Graph 1: Total Bone Volume (TBV: new bone vs residual graft)

Background and Aim

Background: Several bone substitutes have been used to fill the elevated area in sinus lifting procedures, including HA / β TCP. It has been shown that argon plasma increases cell adhesion to implant surface improving osseointegration. However, there is little information about the effect of argon plasma on the volumetric behavior of HA / β TCP used for sinus lifting procedures.

Aim: The aim of this study was to evaluate the effect of argon plasma on sinus lifting procedures using HA/ β TCP.

Conclusion

These results suggest that argon plasma did not affect new bone formation. Nevertheless, additional studies are required to support these preliminar findings.

References

- Canullo L, Genova T, Naenni N, Nakajima Y, Masuda K, Mussano F. Plasma of argon enhances the adhesion of murine osteoblasts on different graft materials. *Ann Anat.* 2018 Apr 26;218:265-270.
- Canullo L, Genova T, Wang HL, Carossa S, Mussano F. Plasma of Argon Increases Cell Attachment and Bacterial Decontamination on Different Implant Surfaces. *Int J Oral Maxillofac Implants.* 2017 Nov/Dec;32(6):1315-1323.