Osseointegration of zirconia dental implants with a new rough surface. A biomechanical and histological study in mini pig.

M.Gahlert[1], S.Röhling[2], C.M.Sprecher[2], S.Eichhorn[3], E.Steinhäuser[3], M.Wieland[4], H.Kniha[1], S.Milz[2]

[1] Private Dental Clinic, Munich, Germany. [2] AO Research Institute, Davos, Switzerland. [3] Klinik für Orthopädie und Sportorthopädie der TUM, Munich, Germany. [4] Institut Straumann AG, Basel, Switzerland

INTRODUCTION: Mechanical properties and tooth like colour let zirconia ceramics appear as an interesting alternative for dental implants. The purpose of the present study was to investigate the osseointegration of zirconia implants with a new rough surface topography in comparison to the clinically[1] and experimentally[2] well documented titanium implants with a sandblasted and acid-etched surface (SLA).

METHODS: Cylindrical zirconia implants 4.1 mm in diameter and 10.0 mm in length were produced by using a new low pressure injection molding technique. After that the implants were acid etched. Ti-SLA implants of the exact shape served as controls.

The incisors 2 and 3 were extracted from both sides of the maxilla. After a healing period of at least 6 months, 16 adult miniature pigs received a total of 96 implants in their maxillae. The animals were euthanized after 4, 8 and 12 weeks. 59 implants were subjected to removal torque testing (RTQ) directly after the euthanasia. 28 implants were removed with the surrounding bone and histologically investigated. 9 implants were lost due to wound healing problems. The origin of these problems was the use of PEEK healing caps.

RESULTS: Both materials showed similar RTQ results. The average mean value for zirconia was 60.4 Ncm (42.4 - 69.6 Ncm) and 63.4 Ncm for Ti-SLA (42.1 - 75 Ncm).
Histological evaluation showed direct osseous integration for both materials (Fig. 1, 2). Zirconia implants revealed mean peri-implant bone density values of 42.3% at 4 weeks, 52.6% at 8 weeks, and 54.6% at 12 weeks after implantation, whereas Ti-SLA implants demonstrated mean values of 29%, 44.1% and 51.6% at corresponding time intervals. Concerning bone interface contact ratio the mean values for zirconia ranged between 27.1% and 51.1% and for Ti-SLA between 23.5% and 58.5%.
RTQ and histological evaluation revealed no significant differences between both materials at any given time point.

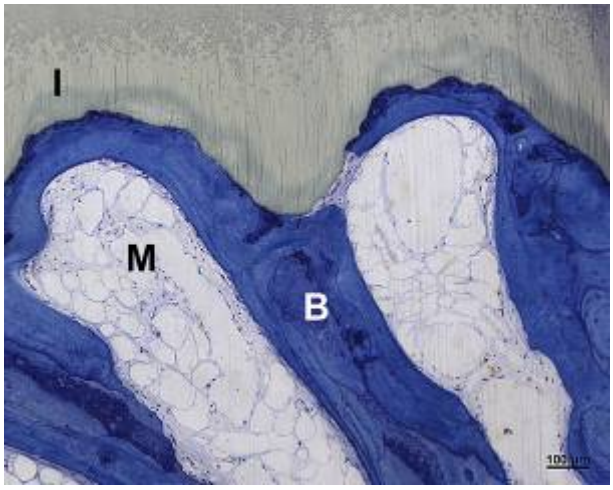

Fig. 1: Direct osseous integration of a zirconia implant (I); B: bone; M: bone marrow. Note that there is basically no difference in appearance when compared to Fig. 2.

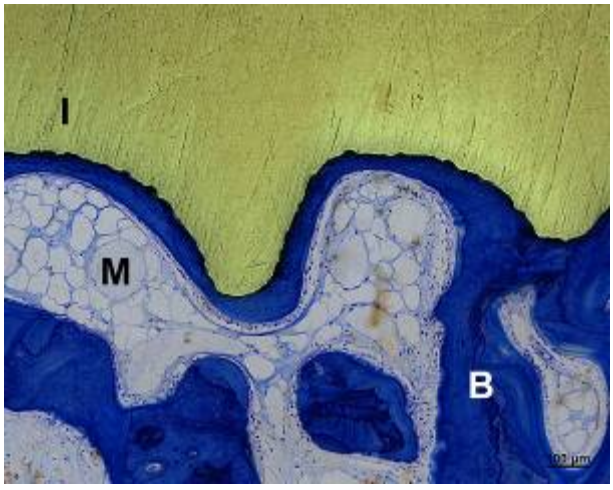

Fig. 2: Direct integration of a Ti-SLA implant (I); B: bone; M: bone marrow.

DISCUSSION & CONCLUSIONS: The biomechanical and histological results clearly indicate that zirconia implants have a comparable capacity for osseous integration as the titanium implants from the control group.

REFERENCES: [1]M. Bornstein et al. (2005) Clin. Oral Impl. Res. 16, 631-638. [2]D. Buser et al. (1999) *J Biomed Mater Res, 45, 75-83.*