

Introduction:

The aim of this in-vitro study was to examine the fracture performance of experimental two-part zirconia implants after simulation of oral service. Zirconia implants were investigated with screwed zirconia abutments and compared to commercially available titanium implant systems.

Materials and methods:

Material and Methods: Experimental zirconia (n=8 per group, Tosoh Y-TZP, J) implants (Z) with corresponding zirconia abutments were fabricated. Implants (diameter of 3.8, 4.1 and 4.8 mm) were arranged in resin (Palapress Vario, Heraeus-Kulzer, G) under 45° to the tooth axis. Zirconia abutments were screwed (25 Ncm) onto the implants and restored with standardized crowns (PMMA, d=10mm).

After 24hrs (baseline) and after TCML, maximum load to fracture was determined (v=1mm/min, 1446, Zwick, G). Thermal cycling and mechanical loading [TCML] was performed with 2,400,000 [ML] a 50N and 2x6000 [TC] (2min each water cycle- 5°C and 55°C), which are supposed to simulate ten years of oral service. During simulation all restorations were controlled (chipping, fracture). Type and size of crown failure was analyzed in detail by means of SEM (Quanta; FEI-Philips, NL). As a reference titanium implants (with abutments) (T) with diameters of 3.25, and 4.5 mm were investigated (Semandos S, Bego, G). Statistics: One-way ANOVA ($\alpha=0.05$).

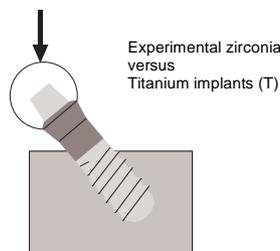


Fig.: Loading situation during TCML and fracture test



Fig.: Regensburg chewing simulator, Thermal cycling and mechanical loading [TCML]: 2,400,000 [ML] a 50N and 2x6000 [TC] (2min; 5°C and 55°C)



Fig.: Zwick 1446 testing device, v=1mm/min

Results:

None of the implants failed during TCML. Group comparison revealed a significant ($p<0.039$) reduction of fracture resistance after TCML for T3.25 and Z4.8.

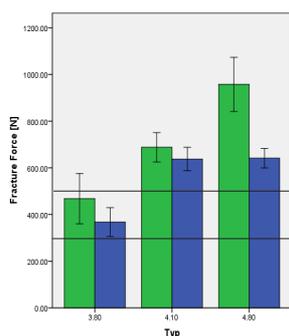


Fig.: Fracture Force Zirconia

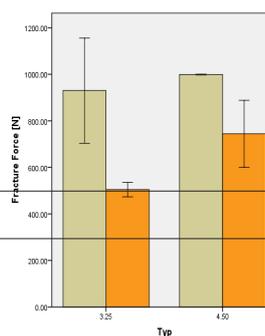


Fig.: Fracture Force Titanium

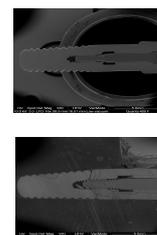


Fig.: Zirconia implant above: before fracture test below: after fracture test

Material	Zirconia Z			Titanium T	
Implant diameter [mm]	3.8	4.1	4.8	3.25	4.5
Fracture Force [N], baseline	468±108	688±63	957±116	930±226	999±14
Fracture Force [N], after TCML	368±61	638±50	642±42	505±31	744±144

Discussion:

Fracture resistance of zirconia implants in tendency was lower in comparison to the values of titanium implants, but zirconia implants showed promising fracture values after simulated 10-years oral service of >350N for anterior (d=3.8mm) and of >600N (d>4.1mm) for posterior applications.