

POSTER

Effect of occlusal-loading on microgap of implant abutment connection

Area: Preprosthetic Ortodontics

University/Department:

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Objective:

Failure of implant-abutment connections are relatively frequent clinical problems. During chewing and biting, the prosthetic restoration and the implant abutment connection is affected by various physiological forces, e.g on a single molar implant this might be about 120 N in the axial direction. Microgaps between implant and abutment can produce biological and mechanical problems such fatigue failures or adverse biologic responses. Penetration of oral microorganisms through gaps between these components may add to risk of soft tissue inflammation or be responsible for the failure of peri-implantitis treatment. The formation of a marginal gap between the implant and abutment might lead to increased loss of a marginal bone because of the penetration of bacteria into the implant-abutment interface. A literature review of Goodacre in 1999 of clinical complications of osseointegrated implants showed that screw loosening or screw fracture varied between 2% and 45% of the implant restorations, with the highest amount in single crown. A recently published meta-analysis of Pjetursson in 2004 on implant-related complications calculated a cumulative incidence of connection-related complications (screw loosening or fracture) of 7.3% after 5 years of clinical service. Purpose of the study in vitro is to evaluate the marginal adaptation of implant abutment Ankylos (Dentsply, Mannheim Germany) and Anyone (Megagen, Korea) after mechanical loading (Chewing simulator CS4, Mechatronik, Feldkirchen-Westerham Germany) for 1.200.000 cycles.

Materials:

Twelve implants (Anyone Megagen diameter 4.5 mm length 10 mm n=6) and six implant (Ankylos Dentsply diameter 3.5 mm length 11 mm n=6) were embedded perpendicularly in an acrylic resin (Palapress, Heraeus Kulzer, Armonk, NY, USA) with custom-made stainless teflon ring form. The implants were mounted in the resin to mimic oral conditions, where the bone may absorb some forces transmitted to the implant-abutment screw connection. All standard abutments (EZ Plus Megagen diameter 4.5X5.5 mm and Abutment Ankylos regular diameter 4.5X5.0 mm) and were restored with identical single molar crowns. A calibrated electronic implant torque controller (Intrasurg, KAVO, Biberach, Germany) was used to ensure proper seating torque for all abutments following the manufacturer's instruction (35 N/cm for Anyone; 25 N/cm for Ankylos). The crowns were casted in a metal alloy and luted to the abutments with a self-adhesive cement (RelyX Unicem, 3M ESPE, St Paul, MN, USA) to minimize the risk of losing crown retention as comparing to conventional cement. After the implant were embedded, the abutment-crown combination were assembled to the implant with an abutment screw according to the manufacturer's protocol. A calibrated electronic implant torque controller (Intrasurg, KAVO, Biberach, Germany) was used to ensure proper seating torque for all abutments. Occlusal loading and thermocycling of specimens were performed in a CS-4.4 equipment (SD Mechatronik GmbH, Germany) (fig. 1) using a stainless steel antagonist (6 mm diameter), 3.5 mm away from the crown's occlusal center on the tapered occlusal area, for 1.200.000 cycles at 50 N at a frequency of 1 HZ. This dynamic loading contained an additional horizontal sliding motion 2mm rectangular to the implant axis to induce bending moments at the implant-abutment interface. Because of various occurrences of unexpected abutment-screw loosening during the dynamic loading test, the implant-abutment connections were controlled for mechanical integrity at intervals 10.000 chewing cycles.

After dynamic loading the abutment-implant connections were analysed with SEM (Quanta 250; FEI, Hillsboro, OR, USA). For evaluation of the microgaps, the implant-abutment systems were embedded in a glycol methacrylate resin. After polymerization, each specimen was sectioned along its longitudinal axis with a low-speed diamond saw (Micromet; Remet, Italy) under water irrigation.

The non-parametric Krustal-Wallis test and the Bonferroni test were used.

Results:

A loss of retention between abutment-implant and fracture was assed as a failure.

All specimens no mechanical failure occurred during dynamic loading. The microgap of the implant-abutment connection after mechanical loading were found similar for two systematic implant under Scanning Electron Microscopy ($P>0.05$).

Conclusion:

The marginal quality of implant-abutment after mechanical cycling showed no significant differences between two conical implant abutment. Further clinical research is essential to evaluate if different conical implant-abutment connection designs exhibited significant differences in survival and microgaps under dynamic loading.