Influence of design and material on the mechanical properties of implant abutments

Dental implants have been successfully used to restorei complete and partially edentulous arches (Adell et al., 1981; Zarb and Schmitt, 1990). Several clinical studies have shown high success rates over 5 to 10 years, ranging from 95% to 97% for single implant restorations (Torabinejad et al., 2007; Zitzmann et al., 2010).

Titanium abutments restored with porcelain fused to metal crowns have been known to be the standard treatment option in implant dentistry as a result of its well-documented biomechanical properties (Aboushelib and Salameh, 2009; Adell et al., 1981) and survival rates (Pjetursson et al., 2015; Sailer et al., 2015).

A variety of contemporary materials are currently available for implant restorations, those can be categorized into ceramics and high-performance polymers (HPPs, e.g., resin-based materials). The choice of the restorative materials (abutment and crowns) is a key factor for the success of the entire implant restorations from an esthetic as well as biomechanical perspective, as this is the only probability to creating a shock-absorbing effect within the implant-prosthesis complex (Magne et al., 2013; Rosentritt et al., 2018).

All-ceramic restorations made of zirconia and lithium disilicate showed very promising results when used as implant abutments (Alsahhaf et al., 2017; Atsü et al., 2019; Kaweewongprasert et al., 2019; Lemos et al., 2019). Despite of their long-term survival rates and biocompatibility, increasing evidence suggests that zirconia and glass-ceramics, when used as crowns restoring dental implants, transfer more stress to the peri-implant bone and do not allow distribution of load to adjacent teeth (Kao et al., 2008; Magne et al., 2011; Magne et al., 2013; Menini et al., 2013).

Materials with increased damping or shock absorbing effect can decrease load transmission and micro-movements between the abutment and the implant resulting in reduced stress and strains on the bone (Kao et al., 2008; Magne et al., 2013). Such a damping effect might also decrease the well-known technical complications, such as screw loosening, screw fracture, or fracture of ceramic components (Magne et al., 2013; Rosentritt et al., 2018).

STATMENT OF ISSUES

- Can abutments made of different ceramics and HPPs withstand loads higher than the recorded physiological masticatory forces?

- Are there differences between cement-retained or screw-retained abutment regarding strength and mechanical behavior?

- Which material-combination of cement-retained abutments and crowns could withstand the highest loading forces?

The presentation aims to give insights about using different materials in implant-prosthodontics, as an overview and summarization of several studies published by the author.