Designing Oral Implants to Dissipate Occlusal Load

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Almost 5 million dental implants are placed annually in the United States, and they are now considered the standard of care for the replacement of lost teeth. Despite their increased use for single-tooth prostheses and fixed complete prostheses, long-term success rate hovers around 60%. Teeth are subjected to vertical and horizontal forces during mastication, and the periodontal ligament that attaches the natural teeth to the bone cushions these forces. The collagen fibers of periodontal ligament act as shock absorbers to reduce build-up of excessive stress within the bone. Conventional implants are solid, single- or dual-piece implants that are fused to the bone and have no capability to effectively dissipate masticatory forces. Therefore, bone loss around implants is an invariable clinical finding. To better distribute compressive and shear forces levied on the implant and maintain the structural integrity of the peri-implant bone, a new dental implant design was investigated. An important feature of the design was the inclusion of internal shock-absorbing struts. Two 3-D-printed strut designs were evaluated against a vertical load, and results compared to a solid counterpart. Curved struts were more effective at cushioning and distributing the vertical load than straight-strut or solid implants. However, the curved struts were not efficient at withstanding heavier loads. Redesigned struts that were buttressed at critical locations greatly improved load bearing ability of the modified implant.