A Novel Osseous Densification Approach in Implant Osteotomy Preparation to Increase Biomechanical Primary Stability, Bone Mineral Density, and Bone-to-Implant Contact.

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Abstract

PURPOSE: It is essential to have sufficient bone bulk and density at the implant site in order to achieve good bone-to-implant contact and primary stability, which are crucial for osseointegration. A new osteotomy preparation technique was recently introduced that uses a bone preservation method that creates a layer of compacted bone along the surface of the osteotomy. The hypothesis of this study was that this novel technique would increase primary implant stability, bone mineral density, and the percentage of bone at the implant surface compared with drilling technique.

MATERIALS AND METHODS: A total of 72 osteotomies were created in porcine tibial plateau bone samples using three preparation techniques: standard drilling; osseous extraction drilling with a new tapered, multi-fluted bur design; and osseous densification with the same multi-fluted bur rotating in a reversed direction that preserved and created a compacted layer of bone. The surgical process (temperature increase, drilling force, and torque), mechanical stability during the insertion and removal of 4.1-mm and 6.0- mm diameter implants (implant torque and stability quotient), and bone imaging (scanning electron microscopy, microcomputed tomography measurement of bone mineral density, and histomorphology) were compared among the three preparation techniques.

RESULTS: Osseous densification significantly increased insertion and removal torques compared to standard drilling or extraction drilling. No significant differences in implant stability quotient readings or temperature increases were demonstrated among the three groups. Although the same bur was used for extraction drilling and osseous densification techniques, the osseous densification osteotomy diameters were smaller than both the extraction drilling and standard drilling osteotomies due to the spring-back effect of bone elastic strain created. Imaging methods documented a layer of increased bone mineral density around the periphery of osseous densification osteotomies. The percentage of bone at the implant surface was increased by

approximately three times for implants prepared with osseous densification compared with standard drilling.

CONCLUSION: This study confirmed the hypothesis that the osseous densification technique would increase primary stability, bone mineral density, and the percentage of bone at the implant surface compared with drilling. By preserving bulk bone, it is hypothesized that the healing process will be accelerated due to the bone matrix, cells, and biochemicals that are maintained in situ and autografted along the surface of the osteotomy site. The healing response requires further study in vivo.