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BONE COMPACTION FOLLOWING INSERTION AND CYCLIC LOADING OF DENTAL IMPLANTS

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Summary: Introduction
The bone-implant interface plays a key role in the primary stability of dental implants. A biomechanical investigation of a tapered dental implant comparing two distinct drilling protocols suggested a marginal difference in primary stability. In order to understand this finding into more details, biomechanical tests were repeated in the present study with radiolucent PEEK (Polyether ether ketone) implants of identical geometry to explore trabecular bone compaction after insertion and after cyclic loading.
Methods
Following a soft (Ø 2mm) or a dense (Ø 2.8/3.2mm) drilling protocol, implants in PEEK with the replicated geometry of a variable-thread tapered implant (Nobel Active, Nobel Biocare AB, Göteborg, Sweden) were inserted into 12 cylindrical human trabecular bone samples (BV/TV=11%) and subjected to off-axis cyclic loading. Micro-computed tomography scans (MicroCT) were taken with a resolution of 36 mm at four time points: 1) before drilling, 2) before implantation, 3) before mechanical testing, and 4) after mechanical testing. The images were registered, segmented and subtracted to evaluate compaction of trabecular bone around the implant between each step. Primary stability was assessed by extracting stiffness and ultimate force from the cyclic force-displacement curves.
Results
After drilling, most debris were located at the bottom of the hole for both protocols. Following insertion, the radius of trabecular bone compaction was higher for the soft (1 mm) than for the dense (0.5 mm) protocol. During compaction produced by cyclic loading the implants tilted around a point located approximately at 60% of the implant length from the top surface. However, no statistically significant differences in either stiffness or ultimate force were observed between soft and dense protocols.
Discussion
The use of PEEK implants and proper image registration techniques allow to visualize and analyse compaction of the surrounding bone at each step of the implantation procedure. This study showed that distinct drilling protocols influence the compaction of the bone around the implant, but not the primary stability.
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