Biomechanical and histologic basis of osseodensification drilling for endosteal implant placement in low density bone. An experimental study in sheep.

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Abstract

A bone drilling concept, namely osseodensification, has been introduced for the placement of endosteal implants to increase primary stability through densification of the osteotomy walls. This study investigated the effect of osseodensification on the initial stability and early osseointegration of conical and parallel walled endosteal implants in low density bone. Five male sheep were used. Three implants were inserted in the ilium, bilaterally, totaling 30 implants (n=15 conical, and n=15 parallel). Each animal received 3 implants of each type, inserted into bone sites prepared as follows: (i) regular-drilling (R: 2mm pilot, 3.2mm, and 3.8mm twist drills), (ii) clockwise osseodensification (CW), and (iii) counterclockwise (CCW) osseodensification drilling with Densah Bur (Versah, Jackson, MI, USA): 2.0mm pilot, 2.8mm, and 3.8mm multi-fluted burs. Insertion torque as a function of implant type and drilling technique, revealed higher values for osseodensification relative to R-drilling, regardless of implant macrogeometry. A significantly higher bone-to-implant contact (BIC) for both osseodensification techniques ($p<0.05$) was observed compared to R-drilling. There was no statistical difference in BIC as a function of implant type ($p=0.58$), nor in bone-area-fraction occupancy (BAFO) as a function of drilling technique ($p=0.22$), but there were higher levels of BAFO for parallel than conic implants ($p=0.001$). Six weeks after surgery, new bone formation along with remodeling sites was observed for all groups. Bone chips in proximity with the implants were seldom observed in the R-drilling group, but commonly observed in the CW, and more frequently under the CCW osseodensification technique. In low-density bone, endosteal implants present higher insertion torque levels when placed in osseodensification drilling sites, with no osseointegration impairment compared to standard subtractive drilling methods.