Fabrication and histological evaluation of calcium carbonate- and carbonate apatite-coated titanium implants

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（炭酸カルシウムおよび炭酸アパタイトコーティングチタンインプラントの作製と組織学的評価）

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論 文 内 容 の 要 旨

Titanium (Ti) implants that realize rapid osseointegration are required for favorable outcome. Rough implant surfaces favor osseointegration, and the coating of implants with natural bone mineral, i.e., carbonate apatite (CO_3Ap), may be effective for osseointegration. To achieve rapid osseointegration, rough Ti substrates were coated with CO_3Ap (CO_3Ap-Ti), and the effects were evaluated in vitro and in vivo. For comparison, rough Ti without coating (rough-Ti) and calcium carbonate-coated rough Ti ($CaCO_3$-Ti) substrates were fabricated. The adhesive strengths of $CaCO_3$ and CO_3Ap to the substrates were ~56.6 and ~76.8 MPa, respectively, being significantly higher than the strength defined in ISO13779-2 (15 MPa). $CaCO_3$ and CO_3Ap coatings significantly promoted pre-osteoblastic MC3T3-E1 cell proliferation. Additionally, the CO_3Ap coating promoted higher osteogenic differentiation activity than $CaCO_3$ coating. CO_3Ap-Ti implantation into rabbit tibia defects prompted bone maturation, compared to $CaCO_3$-Ti or rough-Ti implantation. The bone-implant contact percentage with CO_3Ap-Ti and $CaCO_3$-Ti was higher than that with rough-Ti. Consequently, CO_3Ap -Ti acquired robust bond with the host bone at early stage (four weeks post-implantation), compared to $CaCO_3$-Ti and rough-Ti: the CO_3Ap-Ti–bone bonding strength was ~1.9- and ~5.5-fold higher than that of $CaCO_3$-Ti and rough-Ti, respectively. Thus, CO_3Ap coating of Ti implants was effective for achieving rapid osseointegration.