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Design and testing of a 3d-printed porous root-analogue implant

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Purpose Immediate implantation can avoid multiple surgical traumas and shorten the treatment time. However, traditional implants can't get good initial stability in immediate planting because of a poor fit for multiple-root tooth socket. This study aims to design a porous multiple-root-analogue implant, and then analyzes the implants' structural characteristics and effect on osteogenic differentiation. Methods In this study, we have reconstructed patient's CT data to design a porous root-analogue implant of the molar area for immediate implantation. We export the model to Stereolithography (STL) format and fabricate this implant by using 3D-printing titanium. Beside of the root-analogue shape, we design a porous structure for the implant. Archimedes method and scanning electron microscope (SEM) analysis are employed to detect the implants' structural characteristics. Real-time PCR was applied to investigate the effect of implants on osteogenic differentiation. Results and discussion Archimedes method showed that the porosity of 3D printed implants was similar to the porosity of design model. There was no statistical difference (P=0.13>0.05). It was found that the edge length of the micropores is around 500μm via SEM observation. Titanium powders melted into round convex particles and formed a rough surface for the implants. The normal differentiation on the implant was present in the human osteoblast MG-63 in vitro experiment. The expression level of osteogenic differentiation-related genes (OCN, OPN, Col-1) increases along with the increase in cultured time.

Conclusions: Our research concludes that the 3D-printed porous root-analogue implants with rough surface have a positive effect on the attachment and differentiation of the MG-63 cell.

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