Ultrasonically enhanced oxidative aqueous solution etching of grade 4 commercially pure titanium for dental implant use

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The surface topography of dental implants can be defined as having macro-, micro-, and nanoscopic features. In particular, nanoroughness improves the biointegration of implants by creating a specific nanotopography that can selectively influence and control cellular behavior. Recently, a simple surface modification treatment of titanium (Ti) for dental implant use was developed to produce nano- and microscale features on the surfaces via simple immersion in an oxidative aqueous solution. It was speculated that the novel oxidative solution represents a promising, eco-friendly alternative to concentrated solutions of strong acid for the surface modification of Ti implants. However, this treatment method of Ti surfaces requires a relatively long immersion time in the oxidative solution. In this study, ultrasonically enhanced chemical etching was employed to fabricate effectively etched Ti surfaces within a short immersion time. Polished grade 4 commercially pure dental Ti discs were immersed in the oxidative aqueous solution for 10, 20, 30, 40, or 50 min with ultrasonic agitation. The micro- and nanostructures of the Ti surfaces were characterized using a field emission-scanning electron microscope (JSM-6700F, Jeol, Japan). The etched surfaces were also studied in terms of surface roughness and wettability (surface energy). The application of ultrasonication during etching greatly accelerated the chemical etching effect of Ti and created both micro- and nanostructures on the surfaces much more effectively. In addition, all the etched Ti surfaces exhibited a superhydrophilic surface. The findings of this study suggest that the ultrasonically enhanced oxidative aqueous solution etching can be effectively used to create reproducible nano/microscale topographies on grade 4 commercially pure Ti for dental implant use.

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