Osseointegration between Oxide Layer of Titanium and Bone by Different Heat Treatments

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Ⅰ. INTRODUCTION

Currently, various implants with different materials, designs, and surface structures are used and it was reported that the success rates are also highly variable. Although strenuous efforts have been made to identify contributing factors for implant success or not, the mechanism is not fully understood yet.

Various factors must be considered for successful osseointegration. Among the factors, it is significantly important that the physical and chemical properties of the implant surface. Especially, the oxide layer is known to have a direct effect on implant success by helping the attachment of cells and matrixes to the bone-implat interface[4-6].

The effect of the oxide layer has been clearly demonstrated by Larsson et al[7,8] who showed that rougher implant surface and thicker oxide layer showed more favorable osseointegration. Hazan et al[9] and Ha et al[10] also reported that thicker oxide layer revealed higher removal torque. According to Hazan et al[9], there was higher shear strength in implants with heat treatment compared to those without heat treatment, and maximal enhancement of bone growth was achieved at 280℃.

Our observations differ somewhat from the results by Hazan et al[9] which reported that the thickness of oxide layer doubled at 280℃ and there was even more increase in oxide layer at 550℃, on the other hand, bone growth reached the highest point at 280℃ and rather decreased at 550℃. But direct comparison is difficult due to the fact that our study was conducted for 10minutes while Hazan et al[9]'s study was conducted for 3hours.

Olin et al[11] and Ask et al[12] reported that heat treatment or electrochemical oxidation resulted in increased thickness of oxide layer in pure titanium. Radegran et al[13] showed that the temperature strongly influences the thickness of the oxide layer.

Many researches have been demonstrated the relationship between the temperature of heat treatment and the quality of the oxide layer formed[5,9-19]. However, the ideal temperature and the proper oxide layer thickness to achieve maximum biocompatibility and osseointegration are not well understood.

In this study, it was performed that the effect of the heat treatment temperature in implants on the thickness of the oxide layer and the osseointegration.

Ⅱ. MATERIAL AND METHODS

1. Implant fabrication