

Article

Enhanced Osteoblast Adhesion and Proliferation on Vacuum Plasma-Treated Implant Surface

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Abstract: In this study, we propose a vacuum plasma device for surface treatment of dental implants. This plasma device was designed to allow direct installation of sealed implant packaging containing the dental implant. In this manner, the dental implant could be treated with plasma under a moderate vacuum environment while remaining in a sterile condition. To assess the osseointegration efficiency, in vitro experiments using sandblasted, large grit, acid etching (SLA), calcium coated-SLA (CaSLA), and calcium coated-SLA with plasma treatment (PCaSLA) were performed. The implant surface was observed with scanning electron microscope (SEM) before and after plasma treatment. Thereafter, protein adsorption, cell adhesion, proliferation, and differentiation efficiency were investigated on the surface of each implant type using saos-2, an osteoblast. Plasma treatment significantly improved protein adsorption, cell adhesion, and cell proliferation efficiency compared to both CaSLA and SLA without damaging the calcium coating. According to the findings, the proposed vacuum plasma device has shown the potential to improve osseointegration efficiency. We believe that this plasma technology can be an innovative chairside solution that can be easily handled in the clinical field with superb usability.

Keywords: vacuum plasma-treated implant; plasma treatment; osseointegration; osteoblast adhesion; osteoblast proliferation; protein adsorption

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1. Introduction

Dental implants made of titanium have become the most common technique for repairing extensive damage and loss of teeth. The clinical success of implants is dependent on a number of factors, including implant material, surface property, implant design, and bone quality of the patient [1]. Among these factors, implant material and surface property are the most critical determinants of in vivo reactivity, given that the implant is in direct contact with bone and induces osseointegration [1,2]. Commercially pure titanium (cpTi) is one of the most popular materials that are utilized in dental implants. cpTi has high corrosion resistance and releases a low level of metallic ions in bio-fluids; therefore, it is highly biocompatible [3–5]. In addition, given that titanium has high material strength, it is one of the best materials that can replace teeth which are usually exposed to compressive stress due to chewing activity. However, titanium is metal and not a bioactive substance by nature; therefore, a considerable period of time is required to achieve full integration between the titanium implant and the surrounding tissues [1,3,6].

To overcome this, various surface treatment methods have been developed, including the sandblasted, large grit, acid etching (SLA) technology [7–9]. The efficacy has been clinically validated and is now widely used worldwide. SLA is a technology that increases