

Biofunctionalization of dental surfaces: Towards obtaining antimicrobial yet biocompatible orthodontic archwires

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Fixed orthodontic archwires affect oral hygiene leading to microbial infections, resulting in specific changes in the oral environment, including a reduction in pH and an elevation of cariogenic flora levels in saliva and biofilm, entailing a risk of gingival and cariogenic lesions. These effects can be maximized or minimized using archwires made of different metallic alloys. In recent years, considerable interest has grown considering the surface engineering of dental alloys and the usage of ions or nanoparticles (NPs) to increase their antimicrobial efficacy [1-4]. Hereby, we studied the possibilities of improving the surface characteristics and biofunctionality of the orthodontic materials used in clinical dental practice. Seven commonly used commercial archwires, belonging compositionally to four alloys: stainless-steel, β -titanium alloy, nickel-titanium alloy, and titanium-niobium alloy were surface-treated, through hydrothermal etching using an aqueous phosphate solution, before being coated with silver [5]. All samples were analysed structurally and microbiologically. The structural assessment was performed pre- and post-etching and post-silver deposition using scanning electron microscopy (SEM) and high-resolution and scanning transmission electron microscopy (HRTEM and STEM), all combined with energy dispersive X-ray spectroscopy (EDX). This assessment confirmed the successful etching process and the growth of two types of titanium phosphate (TiP) phases on most of the titanium-containing alloys. These phases of titanium phosphate (nanolayered α - and nanofibrous π -TiP) were previously reported to as biocompatible as other calcium phosphate phases and capable of being used for incorporating biofunctional NPs [6-9]. Furthermore, microscopic inspection revealed that the obtained silver coating on all alloys is in the form of silver nanoparticles (AgNPs). Microbiologically, the bacterial and fungal affinity of the blank and treated archwires were assessed, besides their cytotoxicity. Overall, the surface treatment of most of the alloys succeeded in improving their antimicrobial effectiveness, without much compromise to their cytocompatibility for at least half of the treated archwires.

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