Greater Bone Formation within Tantalum-based Porous Engineered Dental Implant

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1 Background

Tantalum (Ta)-based porous dental implants were designed for bone-to-implant contact as well as bone ingrowth into the porous structure in order to augment anchorage of the implant. The Ta-based porous implant uniquely differs from other implants due to the structural and mechanical features of its pores, such as a cancellous bone-like 3D structure, high coefficient of friction, high porosity up to 80%, average pore size of 430µm, and low modulus of elasticity of 3GPa.1 When Ta-based porous implants were placed in the healed extraction sites of canines, new bone formation within the pores and implant stability were confirmed during early healing.2 This study was aimed at further histological evaluations of bone tissue response to the porous mid-section of Ta-based porous implants placed in the fresh extraction sockets of canines.

2 Methods

Twenty-four Ta-based porous test implants (Trabecular Metal™ Dental Implants, Zimmer Dental Inc.) and 24 threaded control implants (Tapered Screw-Vent® implants, Zimmer Dental Inc.), 4.1mm in diameter and 13mm in length, were placed into 2 premolar (P3 and P4) and 2 molar (M1 and M2) mandibular fresh extraction sockets bilaterally in 6 canines. Implants were allowed to heal for 2, 4 or 12 weeks (two animals per time point). The mandibular jaws from all animals were removed and implants were retrieved en bloc. The specimens were immediately placed in 10% neutral buffered formalin for 48 hours. After fixation, the tissue blocks were trimmed and en bloc ground and polished to approximately 80µm in thickness. Each section was cut into two sections in the buccolingual direction along the central plane. The specimens were treated with 4% formalin for 48 hours. After fixation, the tissue blocks were trimmed and made two sections in the buccolingual direction along the central plane. The specimens were treated with 4% formalin for 48 hours. After fixation, the tissue blocks were trimmed and placed in 10% neutral buffered formalin for 2, 4, or 12 weeks (two animals per time point). The specimens were then dehydrated in ethylene glycol and critical point dried. The samples were then sputter coated with gold-palladium and examined under a scanning electron microscope. The specimens were then dehydrated in ethylene glycol and critical point dried. The samples were then sputter coated with gold-palladium and examined under a scanning electron microscope.

3 Results

As no implant failures occurred during or after the surgeries, none of implants were removed prior to the scheduled necropsy. Both groups showed a progression of new bone formation over the healing periods.

4 Discussion

The histologic and histomorphometric evaluations of the implant midsections revealed different types of bone tissue responses between the control and test groups. Test group demonstrated progressive osseointegration and bone growth into the Ta pores (osseoincorporation), while control group was limited to bone growth onto the Ti alloy surfaces (osseointegration).

5 Significance

In a canine fresh extraction socket model, histologic and histomorphometric evaluations revealed more new bone formation associated with the Ta pores than with the conventional threaded design during the early healing phase.

6 References


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