

Development of mandibular reconstruction device made of titanium fiber scaffold.

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Statement of Purpose: Mandibular reconstruction after tumor ablative surgery is essential for returning QOL of oral cancer survivors. But bone reconstruction surgery puts a severe strain on the patient. To date, the author reported that titanium fiber scaffold had favor biocompatibility and high bone formation ability that was enhanced by hydroxyapatite coating with molecular precursor method. In the present study, the author shows the development of new mandibular reconstruction device with the titanium fiber scaffold.

Methods: This study was approved by Yokohama City University Ethic committee (Approved No. 11-127).

Titanium fiber scaffold were made of sintered titanium fiber mesh (Hi-Lex Co., Japan) was processed into a scaffold structure. The size and mean weight was 10 x 10 x 5 mm and 0.482 g. The diameter of the titanium fiber was 20 μm and the internal pore size and porosity was 100 – 200 μm and 87%.

For the hydroxyapatite (HA) coating, the titanium fiber scaffold was soaked into the mixture solution of Ca-EDTA/amine and dibutylammonium diphosphate salt in ethanol (Ca/P ratio; 1.67). After immersion, the titanium fiber scaffold was heated at 600 for 2 hours. For animal experiment, adult female Japanese white rabbits (Age; 14 – 17 weeks, weight; 2.9 – 3.9 kg) were used in the present study. Under general anesthesia mandibular bone was resected and a part of the bone was completely removed. The 10-mm length mandibular defect was reconstructed by the titanium fiber scaffold with or without hydroxyapatite coating. The materials was fixed with titanium plate (Synthes, Switzerland). 21 weeks after surgery, the 9 coating and 9 non-coating animals were sacrificed, and newly formed bone in/outside of the titanium fiber scaffold at the defect area was evaluated with computed tomographic (CT) and histological analysis.

Results: Bone discontinuity was restored by newly formed bone along the titanium fiber scaffold, especially in HA-coating group (Figure 1). CT analysis revealed that the amount of new bone outside of the HA-coating titanium fiber scaffold was significantly higher than that of the non-coating titanium fiber scaffold ($P < 0.05$, Mann-Whitney U-test)(Figure 2). Histological analysis revealed that the amount of new bone inside of the HA-coating titanium fiber scaffold was significantly higher than that of the non-coating titanium fiber scaffold ($P < 0.05$, Mann-Whitney U-test). (Figure 3, 4).

Conclusions: In hydroxyapatite coating titanium fiber scaffold, newly formed bone were seen in and out of the materials, and the defect was completely restored with newly formed bone, suggesting that titanium fiber scaffold was powerful materials for mandibular reconstruction device by hydroxyapatite coating



Figure 1

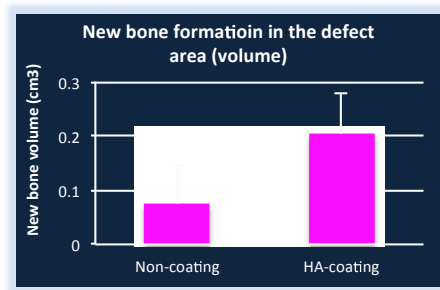


Figure 2

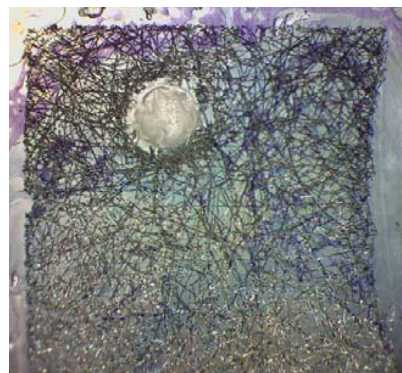


Figure 3

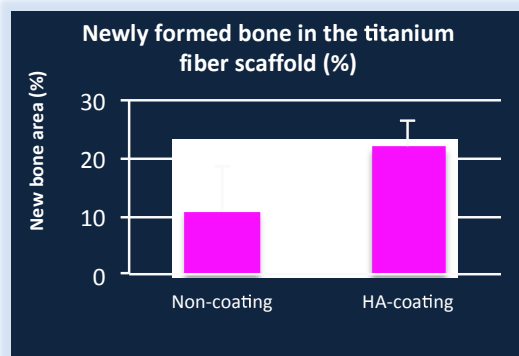


Figure 4