学位論文内容の要約

学位論文題目

Single-walled carbon nanotube membrane accelerates active osteogenesis in the bone defect. - the possibility for guided bone regeneration membrane-

（単層カーボンナノチューブを用いた骨誘導再生膜の開発と骨再生能の評価）

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Carbon nanotubes (CNTs) are investigated as biomaterials because of their chemical, physical, and biological properties. We have been studying the application of CNTs as biomaterials and reported that CNTs have high compatibility with bone tissue.

The guided bone regeneration (GBR) technique is commonly applied to reconstruct alveolar bone and treat peri-implant bone defects. For the GBR technique, a barrier membrane is used to cover the bone defects, preventing the entry of non-osteogenic cells like epithelial cells and fibroblasts in bone defects. Furthermore, the membrane is desired to maintain a space for new bone formation. However, previous materials sometimes delayed bone regeneration in clinical practice because of their mechanical and biological properties.

In this study, we developed a CNT-based GBR membrane with the possibility to accelerate bone regeneration because of the high strength to make space and cellular shielding to induce osteogenesis. The CNT membrane was made by dispersion single-walled CNT (SWCNT) in hyaluronic acid solution and filtration. The CNT membrane has a nanostructure surface due to the bundle of SWCNT and showed high strength and hydrophilicity after oxidation. In addition, the proliferation of osteoblasts was promoted, whereas non-osteogenic cells were not. The CNT membrane covered the bone defect made in rat calvaria. At 8 weeks after the surgery, more extensive bone formation was observed compared to the defect without membrane. The diffusion of CNT was scarcely observed around the membrane. These results indicate that the CNT membrane has adequate strength, stability, surface characteristics for osteoblast, and shielding properties to promote bone formation as a GBR membrane. Therefore, evidence of the safety and osteogenic potential of CNTs in the further animal experiment for the clinical situation will be sufficient for their clinical application in the GBR technique.