

Aho AJ, Rekola J, Matinlinna J, Gunn J, Tirri T, Viitaniemi P, Vallittu P: Natural composite of wood as replacement material for bone defects. J Biomed Mater Res Part B: Appl Biomater 2007; 22(83B): 64-71.

Natural Composite of Wood as Replacement Material for Osteochondral Bone Defects

Allan J. Aho^{1,2}, Jami Rekola², Jukka Matinlinna¹, Jarmo Gunn², Teemu Tirri¹, Pertti Viitaniemi³, Pekka Vallittu¹

¹Department of Prosthetic Dentistry and Biomaterials Science, University of Turku, Turku, Finland

²Department of Orthopaedics and Traumatology, Turku University Hospital, Turku, Finland

³Department of Forest Products Technology, Helsinki University of Technology, Espoo, Finland

Abstract: Deciduous wood, birch, pretreated by a technique combining heat and water vapor was applied for the reconstruction of bone defects in the knee joint of rabbits. It was observed that wood showed characteristic properties to be incorporated by the host bone during observation time of 4, 8, and 20 weeks. The natural channel structure of wood served as a porous scaffold, allowing host bone growth as small islets into the wood implants. The other properties of heat-treated wood, such as bioactivity, good handling properties, and sufficient biomechanical properties might be additional favorable factors for the application of wood as a natural composite material for bone and cartilage repair. At the interface of the surfaces of wood and living bone, bonding occurred.

The Chemical Interface Model (CIM) for bonding bone to wood consists of the reactive ions, such as hydroxyl groups -OH, and covalent bonding as well as hydrogen bonding, which originate from both wood and bone. The bone tissue trauma, with its reactive Ca^{2+} and PO_4^{3-} ions, proteins, and collagen, available for interaction at ionic and nanolevel, are associated with the complicated chemistry in the cellular response of the early bone healing process. It was concluded that heat-treated wood acted like a porous biomaterial scaffold, allowing on-growth and in-growth of bone and cartilage differentiation on its surface, and demonstrating osteoconductive contact, bonding at the interface.