Second International Symposium on Apatite

July 3-7,1995

Investigation on Inducement of Tissues Around the Porous Hydroxyapatite Ceramics in Different Environmental Factors: Bone, Cartilage, and Muscle

Hisakazu Seno, . Akira Yanai, *Department of Plastic Surgery, School of Medicine Juntendo University*

Katunari Nishihara, *Department of Oral Surgery, Faculity of Medicine University of Tokyo*

Porous hydroxyapatite ceramics(HA) is known to have an osteoinductive ability. HA now is used not only in the area of plastic surgery, but also in orthopedic surgery and dentistry, and other fields as a replacement for autogenous free bone grafts.

The authors investigated inducement of tissue around the HA and pore of HA in different environments. HA (Apaceram, porosity: 40%, 2x2x5mm) was implanted into ribs, costal cartilage of ribs and intercostal muscles of dogs.

Histopathological examination was performed four to eleven weeks after implantation of HA. Active bone formation was observed in the cases of HA implanted in ribs. Cartilage formation was observed in HA implanted in costal cartilage, made of cartilage formation was different by way of implantation of HA. Inside the HA pores, hematogenesis was found in all cases.

The results suggest that HA has an affinity for cartilage, and reveal that conduction ability of HA is influenced not only by environmental factors but also by loading condition.

Second International Symposium on Apatite

July 3-7,1995

Comparative Studies on Apatite Artificial Root of Ankylotic and Gomphotic Type

Katsunari NISHIHARA

Department of Oral Surgery, Faculty of Medicine,

Conventionally, bioceramics or biometals and bone tissue are bonded directly in clinical use as osseointegration or ankylosis. However, direct bonding of bioceramics to living osseous tissue can not stand up in the bonding site under severe repeated loading because of differences in elastic moduli from each other. Therefore, mechanical supportive organs such as bone and teeth have to have a juncture system according to their functions. In mammals, four major juncture systems are known among different skeletons. They are constructed with different elastic moduli or have different mobility between each other. Major function of the juncture is understood as a conversion system of the principal stress trajectory. Bioceramic skeletons and bone tissue with a direct bonding system can be formed easily without loading, and stand up for a long term if very weak loading is applied. Therefore, without severe repeated loading, osseointegration or ankylosis can be attained easily between different substances with different material constants. Then why is osseointegration or ankylosis disrupted or destroyed under severe repeated loading? To solve this problem, numerical experiments by means of finite element analysis (FEA) were carried out using artificial root models implanted in the mandible in a plane strain state.

For investigation of the histological difference between gomphotic and ankylotic teeth, animal experiments of functional and nonfunctional groups were carried out. Thereafter, the results were compared with numerical experiments. Fibrous tissue around roots with alveolar bone proper was observed in specimens of the functional group and ankylosis of the artificial roots to the surrounding bone was observed in specimens without occlusal loading. Severe bone destruction was observed in cortical bone around ankylotic dental implants and the patterns of bone destruction under the usual function in the experiments showed a close correlation with results obtained from finite element analysis (FEA).

Second International Symposium on Apatite

July 3-7,1995

ℰ Xperimental Evolutionary Study by Means of Sintered Hydroxyapatite

Katsunari NISHIHARA, Tsuyoshi TANGE*, Kazushi HIROTA**
Kazuko, FUJII**, and Junzo Tanaka**

Department of Oral Surgery, Faculty of Medicine,
University of Tokyo
Department of Pathology, Faculty of Medicine,
University of Tokyo *
National Institute for Research in Inorganic Materials**

Trilateral Research combining phylogeny-ontogeny, biomechanics, and molecular genetics is proposed in this paper. Through this new research method correlation between inheritance and immune system was studied. After that a new concept for immunology as cytological digestion system was also proposed. Combining biomechanical stimuli with biomaterials in animal experimental evolutionary study was carried out. Hybrid type artificial organ could be successfully developed using hydroxyapatite chamber in animal muscle inducing hemopoietic bone marrow tissue. In order to develop effective artificial organ understanding of mechanisms in evolutional change is essential. Morphological evolution can be comprehended with correlation between phylogenic-ontogenic morphogenesis and biomechanics. Biomechanical factors are essential for evolution. Establishment of basic construction of the vertebrates was carried out during neoteny (larval form evolution) of the hemicordata, which integrated the respiration, nutrition, and excretion system into only one tube of the gut. These evolutional phenomena can be seen as revolutionary transformation of morphology in biomechanical responses to not only external but internal factorial changes. Through these evolutional transitions, various kinds of concerns have developed between morphology and the function of organs in the human body from the standpoint of basement construction of the vertebrates. Therefore, for effective development and use of artificial organ research on "Biogenetic Law" and correlation between organs is required.

Experimenatl evolutionary study was carried out by means of artificial dental roots and bone marrow chambers made of hydroxyapatite, using dogs, Japanese mankeys and sharks. Biomechanical stimuli, which were thought effected during evolutional change, were loaded upon these artificial organs after implantation. After that highly differentiated cells with functions were induced from mesenchyaml tissues attaching to hydrosyapatite artificial organs.