5. Light and Electron Microscopic Research on the Cemento-genesis of Gompholic Artificial Dental Roots

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Light and electron microscopic (SEM) as well as microanalyzer, observation of the gompholic artificial dental roots were carried out experimentally as well as clinically and the results are presented here.
From the interdisceplinary standpoint of odontology and evolutionary study, biomechanics, biomaterials, molecular biology, molecular genetics, comparative anatomy, and developmental embryology, the authors carried out synthetic research to develop a gompholic artificial dental root. In odontology, mammalia have the characteristic gompholic tooth system with heterodontia. The gompholic system is the tooth with a periodontal supportive apparatus, namely a periodontal ligament with fibrous osseous cementum and the alveolar bone proper, i.e., the socket bone. As evidence of successful development of gompholic artificial dental root, successful observation of cemetogenesis by SEM as well as peri-root ligament and the alveolar bone proper in light microscopy were presented. As well analyses by microanalyzer of newly induced cementum were carried out and presented.

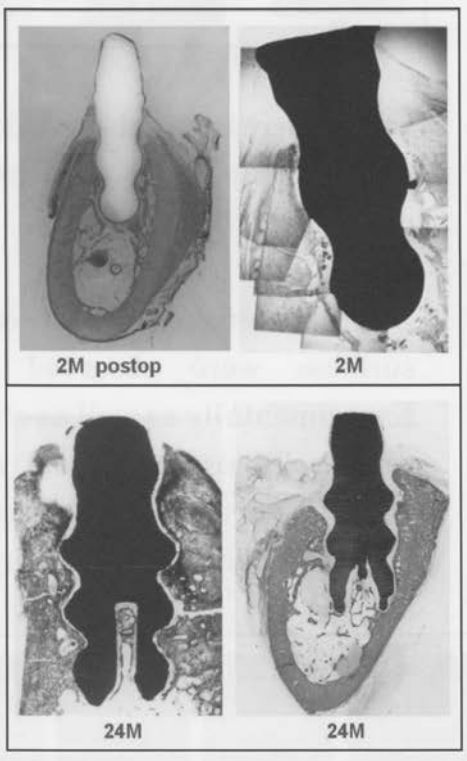
Introduction

The conventional concept of dental implants completely lacks odontology. Therefore, the dental implant system is quite different from the gompholic mammalian heterodontia tooth system. Heterodontia means that the root and crown shape of the tooth corresponds to the location of the jawbone as well as to species-specific characteristic foods belonging to the species feeding habits. The reptilian tooth system is the ankylotic and homodontia system. The screw-type dental implants have the same shape and ankylotic system as reptilian homodontia, which are teeth with the same-shaped crown and root regardless of the jaw site.
Developmental research on artificial dental roots of the mammalian gompholic system has been carried out by the authors successfully for the first time in the world from the interdisciplinal viewpoint. Characteristics of the mammalian tooth system are gompholic with tribosphenic tritubercular molars. The meaning of heterodontia in morphology, i.e., several variations in crown and root shapes in different sites of mammalian jawbones are optimal shapes according to the different tooth functions, i.e., sphenic

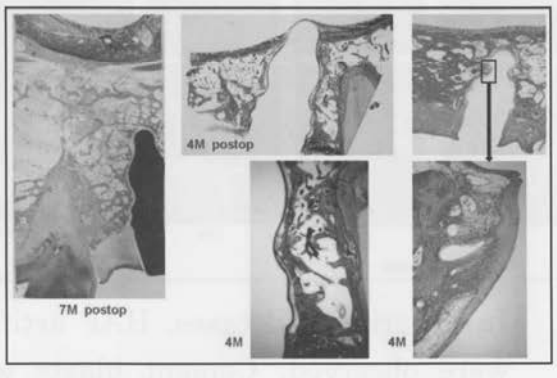
incisors and canines, and tribosphenic-tritubercu ar molars.
For the optimal shapes of teeth adapted to their functions, the gompholic joint system is inevitable, i.e., fibrous articulation with cementoblasts, ligaments with capillaries, and the alveolar bone proper. From this viewpoint, the author has developed artificial dental roots of the heterodontia gompholic system. Integrated research on animal experiments, biomechanical research as well as clinical research, have been carried out. It has been proved by light microscopy, microanalyses, and scanning electromicroscopy (SEM) that cementoblasts, the cementum, periodontal ligaments, and the alveolar bone proper, develop around artificial roots.

Materials and methods

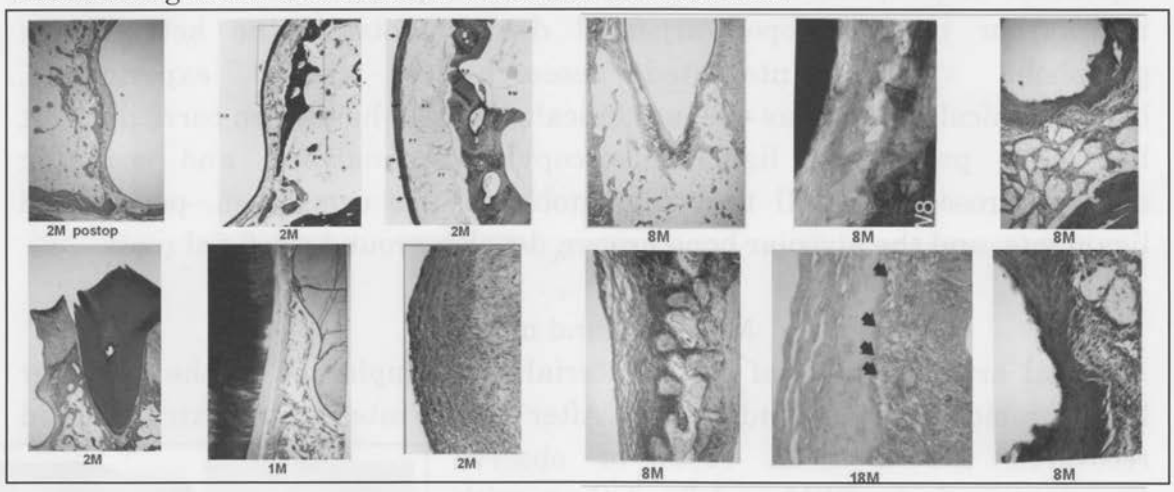
Several artificial roots of each material were implanted in the upper or lower premolar region of adult dogs. After a fixed interval, we extracted and recovered the artificial roots to observe cementogenesis by SEM and fixed them with osmium oxide and vaporized with palladium platinum. After that the surface of the roots was observed by SEM as well as analyzed by micro-analyzer. For light microscopic as well as micro-analyzer observation several artificial roots was extirpated with surrounding periodontal tissue together with the alveolar bone. Specimens were made and observed light microscopically as well as analyzed by micro-analyzer. These observations were compared SEM findings, which had already obtained with microanalyzer analyses. The substances of the clinically-used artificial root surface was also fixed with osmium oxide and specimens for SEM were made and observed.



Experimentally, Ti and HAP artificial roots of the resembling type were implanted in the upper and lower jawbones of canines for light microscopic obsrvation.
Light microscopic findings of gompholic Ti and sintered hydroxyapatite artificial root, low magnification are presentated here. Undecalcified specimens.

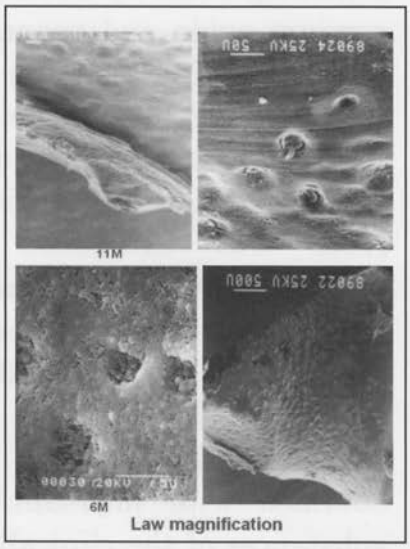


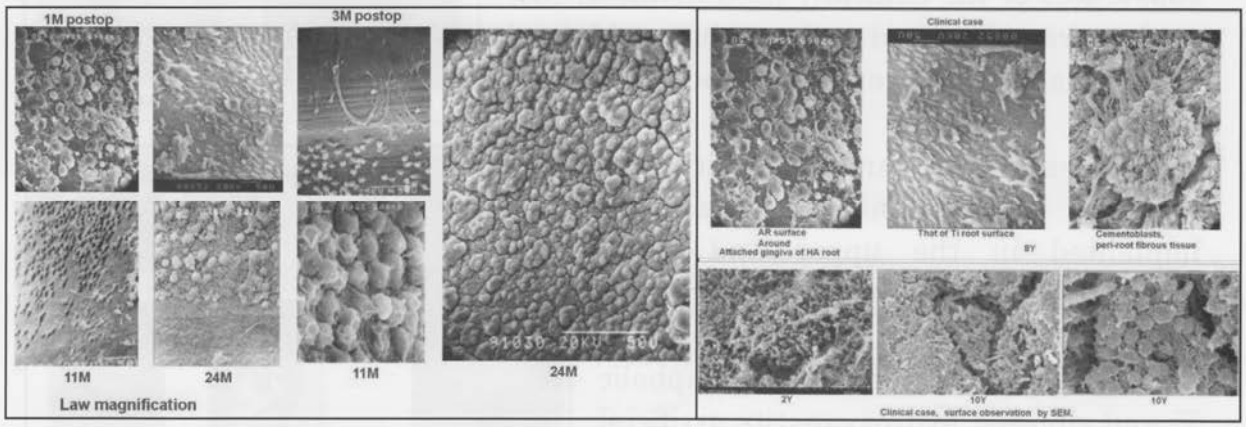
After several months postop, the artificial roots were recovered, specimens were made, and observed microscopically. Artificial root with peri-root fibrous tissue as well as the alveolar bone proper (socket bone) quite resembling those of a natural tooth can be observed.



Light microscopic observation of peri-root fibrous tissues, implanted into canine mandible and maxilla.

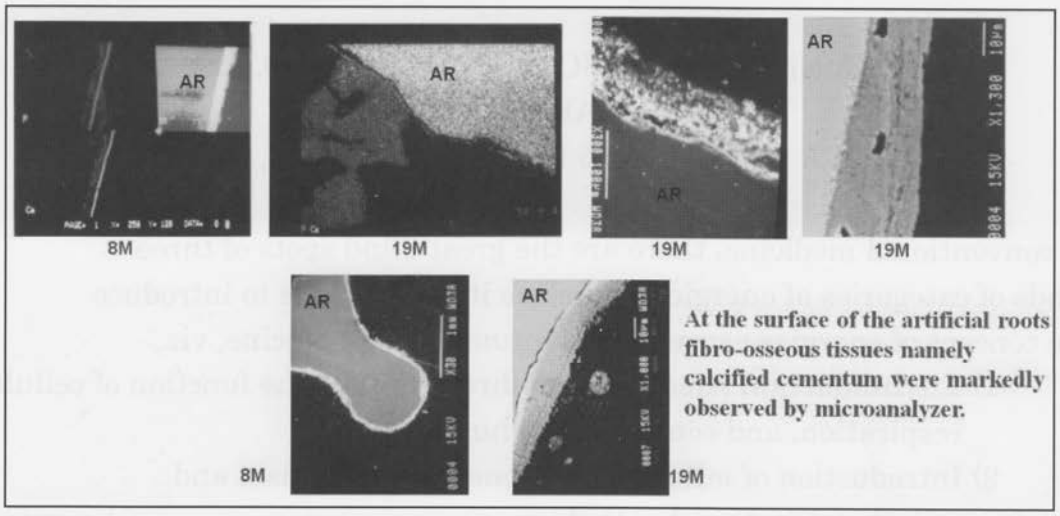
Electron microscopic observation of the root surfaces were observed by SEM as well. Experimentally as well as clinically, when HAP as well as Ti artificial roots were recovered, their surfaces were observed. Cementoblasts as well as fibrous tissue formation were also observed.





In experimental cases, HAP artificial roots were recovered, their surfaces were observed. Cement blasts with calcification and epithelial calls in

attached gingival regions were observed.



Observation of cementogenesis by mcroanalyzer.

Discussion and Conclusion

In odontology, the mammalian tooth system has Butler's field theory and Simpson's tribosphenic-tritubercular molar theory. Both theories are based on the optimizing system of the tooth morphology according to functional adaptation in biomechanical stimuli. For the optimization of the tooth shape, i.e., crown and root morphology, the articulating gompholic system is inevitable. The root shape is the most important feature to induce peri-root supportive tissue, namely cementoblasts, peri-root fibrous tissue with capillary, and the alveolar bone proper, for the masticatory function of artificial dental roots. At the surface of the root, cementoblasts develop by surface streaming potential. By the stress of mastication periodontal ligaments are pressed, then blood in capillaries in ligament blood into bone marrow of the jawbone through the pores of the socket bone of the alveolar bone proper. By these blood flow dynamics hemopoiesis in bone marrow occurs in the articulating system.

This supportive periodontal system is the most important characteristic hemopoietic articulation system for mammals, and is induced by the rhythmical occlusal function of masticatory striated muscles, which are derived from gill respiratory visceral smooth muscles. As evidence of the successful development of gompholic artificial dental root, successful observation of cemetogenesis by SEM as well as peri-root ligament and the alveolar bone proper in light microscopy were presented.