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A Note on Gradated Enameled Microarchitecture in A Shark Tooth

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Description

Despite decreased angiogenesis, osteogenesis, and remodeling, bone healing is a major difficulty. The influence of akermanite bio ceramics ($Ca_2MgSi_2O_7$) extract on cell proliferation, osteogenic differentiation, and antigenic factor expression in BMSCs generated from ovariectomized rats (BMSCs-OVX) as well as the expression of osteoclast genic factors was investigated in this study . Akermanite was found to boost cell proliferation, ALP activity, Runx2 expression, BMP-2, BSP, OPN, OCN, OPG, and antigenic factors like VEGF and ANG-1. Akermanite on the other hand, has been shown to inhibit the expression of osteoclast genic factors such as RANKL and TNF-. Akermanite was also found to activate the ERK, P38, AKT, and STAT3 signaling pathways, with evidence of interaction between them. More notably the impact of akermanite extract on RANKL-induced inflammation was studied.

Introduction

Osteoporosis has become one of the most common and complex skeletal ailments, affecting over 200 million people worldwide. It affects postmenopausal women, the elderly, and individuals with other medical conditions or as a result of specific therapeutic procedures. Low bone mass, poor bone strength, and micro architectural degeneration of bone are all symptoms of osteoporosis, which is caused by excessive osteoplastic bone desorption and a diminished capacity of osteoblasts to replace the resorbed bone. Patients with osteoporosis are at an increased risk of fractures and bone defects as a result of fractures, metastatic bone tumor excision and arthroplasty revision of the knee and hip.

However, while much attention has been paid to fracture prevention and the development of therapeutic approaches for increasing bone density and mass in both research and clinical studies, less has been paid to the study of osteoporotic bone regeneration, particularly in the presence of grafted biomaterials.

Dental zirconia is the most modified (Y_2O_3) tetragonal zirconia poly crystalline is added for stabilization the crystal structure transformation during firing at an elevated temperature and improves the physical properties of zirconia. While heating, the monoclinic phase of zirconia starts transforming to the tetragonal phase at 1187°C, peaks at 1197°C, and finishes at 1206°C. During cooling, the transformation from the tetragonal to the monoclinic phase starts at 1052°C peaks at 1048°C,and finishes at 1020°C. The zirconia tetragonal-to-monoclinic phase transformation is known as a martensitic transformation. During the zirconia phase transformation, the unit cell of the monoclinic configuration occupies about 4% more volume than the tetragonal configuration, which is relatively large volume change. This can be result in the formation of ceramic cracks if no stabilizing oxides were used [1-5].

Ceria (CeO_2), yttria (Y_2O_3), alumina (Al_2O_3), magnesia (MgO) and calico (CaO) have been used as stabilizing oxides. So as the monoclinic phase does not form under normal cooling conditions, the cubic and tetragonal phases are retained and cracked formation due to the phase transformation is avoided. It is also very important to consider the stabilization of the tetragonal and cubic structures requires different amounts of dopants. The tetragonal phase is the stabilized at lower dopant concentration than the cubic phases. However, the way of stabilizing the tetragonal phase at the room temperature is to decrease the crystal size. This effect has been attributed to the surface energy differences. Consequently, zirconia-based upon ceramics used for the biomedical purposes typically exist as a metastable tetragonal partially stabilized zirconia (PSZ) at the room temperature. Metastable means that trapped the energy still exists within the material to drive it back to that monoclinic phase. It turned out that the highly localized stress ahead for a propagating crack is sufficient to trigger the zirconia grains to transform in the vicinity of the crack tip. In this case the 4% volume increases becomes beneficial, essentially squeezing the crack for closing and increasing toughness, known as transformation toughening [5]. Shark tooth "files" are continuously in motion as they develop, with individual teeth moving from the dental epithelium inside the mouth, up and over the edge of the jaw, before being discarded after use16. Therefore, each tooth file offers an immediate time series of developing tooth maturation, use, and wear, as seen, for instance, in our X-ray-CT of the Port Jackson shark's jaws and teeth. The position of the teeth in the jaw and any morphological changes make it possible to identify the teeth that are now in use (the functional teeth) Only teeth that are paired with the opposite jaw teeth (i.e., rows 4-8) are in a position to contribute to grasping actions as a result of the change in orientation and location of tooth cusps in a file. Younger and older teeth (i.e., rows 9–12 and 1-3, respectively) are outside of the functional zone. When compared to the sharp and pointed pre-functional teeth our -CT results demonstrate that functional and post-functional teeth exhibit evident abrasion and blunting, respectively.

Conflict of Interest

The authors declare that there is no conflict of interest associated with this manuscript.

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