Republic of Iraq
Ministry of Higher Education and Scientific Research
University of Baghdad
College of Dentistry

MANUFACTURING, CHARACTERIZATION AND BIOCOMPATIBILITY OF Ti_2AlC IMPLANTS MATERIALS

A Thesis Submitted to Council College of Dentistry, Department of Prosthodontics, University of Baghdad in partial fulfilment of the requirements for the Degree of Doctor of Philosophy in Prosthodontics

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ABSTRACT

Introduction: A major factor influencing the success of the dental implant is the osseointegration. The optimum circumstance of the osseointegration is an intimate contact between bones and implant material without intervening space. Titanium and its alloys are suitable for dental implant and medical applications. Biocompatibility of the materials is a major factor in determine the success of the implant and have a great impact on their rate of osseointegration.

This study aims to fabricate and characterize the Max phase (Ti_2AlC) alloy in a cylindrical form for future application as an implant material, and to evaluate the biocompatibility, cytotoxicity and immune reaction of Ti_2AlC in comparison to CpTi & Ti_6Al_7Nb in rabbits

Material and method: max phase alloy materials (Ti_2AlC) were used for fabrication implant specimens, by using powder metallurgy method for comparison with commercially pure titanium (CpTi) and Ti_6Al_7Nb cylindrical specimen. A pilot study was conducted for selection of a proper compaction pressure which was later on sintered at a suitable tested temperature and holding time. Then the specimens were characterized by using energy dispersive X-ray spectroscopy, scanning electron microscope and atomic force microscopic examination. In addition to the porosity percentage and compressive strength test was calculated. Cylindrical implants were prepared from the study materials (CpTi, Ti_6Al_7Nb and Ti_2AlC) with (8mm) height and (3mm) diameter implanted in rabbits. Histological study was performed at 2 & 6 weeks post- surgical implant insertion. For evaluation of the tissue response, preparation of disc with (6 mm) diameter and (2 mm) thickness was done. Histological evaluation was done after 24 and 72 hours. Cytotoxicity assessment was performed by MTT test.

Results: The result of x-ray diffraction analysis showed different peeks of Ti, Al and C clearly. The compression strength recorded the highest mean values for Max phase alloy (Ti_2AlC). Histological findings show that Ti_2AlC enhanced proliferation of osteo-progenitor cells and report mature bone formation at 2 and 6 weeks. Moreover, Ti_2AlC records a higher percentage for viable cells by MTT test in comparison to CpTi and Ti_6Al_7Nb.

Immuno-reaction features for the tissue reaction towards the implantation of Ti_2AlC disc in subcutaneous site showed infiltration of lymphocyte and macrophage after 24 hour of implantation process, while the picture after 72 hours showed the presence of damaged lymphocyte as smudged cell, macrophage with detection of congested blood vessels.

Conclusion: Powder metallurgy method can be use in fabrication and characterization of max phase alloy in a cylindrical form with adequate properties when compared with Ti_6Al_7Nb and CpTi as implant material, histopathological findings showed that the Ti_2AlC enhanced proliferation of osteo-progenitor cell and report mature bone formation at 6 weeks. Moreover, Ti_2AlC records a higher percentage for viable cells by MTT test in comparison to CpTi and Ti_6Al_7Nb.

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تصنيع وتوصيف و التوافق البايولوجي لزرعة Ti_2AlC

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