

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



# **Mechanical and Histological Evaluation of Commercially Pure Titanium Dental Implants Coated with a Mixture of Nano Titanium Oxide and Nano Hydroxyapatite**

A thesis

Submitted to the Council of the College of Dentistry University  
of Baghdad, in Partial Fulfillment of the Requirements for the  
Degree of Master of Science in Prosthodontics

By  
**Muna Naseir Hussein**  
B.D.S.

Supervised by:  
**Assist. Prof. Dr. Hanan Abdul Rahman Khalaf**  
B.D.S., M.Sc.

2015 A.D.

1437 A.H

# Abstract

**Background:** The dental implant surface type is one of many factors that determine the long-term clinical success of implant restoration. The implant surface consists of bio-inert titanium oxide, but recently coatings with bioactive calcium phosphate ceramics have often been used on Ti implant surfaces. Bio-active surfaces are known to significantly improve the healing time of the human bone around the inserted dental implant.

**Aims of the study:** To assess the effect of mixture of nano titanium oxide with nano hydroxyapatite coating of screw shaped commercially pure titanium dental implant on bond strength at bone implant interface by torque removal test and histological analysis in comparison to nano hydroxyapatite coating.

**Materials and methods** Dip coating technique was used to obtain a uniform coating layer on commercially pure titanium screws. In order to examine the coating surface structure; X-ray diffraction (XRD) analysis, coating thickness measurement and microscopical examination were carried out on the coating surfaces of the commercially pure titanium.

The tibia of 12 white New Zealand rabbits were selected for implantation of the nano coated screws. Two screws were implanted inside each tibia of each experimental rabbit, one was coated with a mixture of nano titanium oxide and nano hydroxyapatite and the other screw was coated with nano hydroxyapatite only , a total of 48 screws were implanted. Torque removal test was performed to measure bond strength between implant and bone, after 2 and 6 weeks healing periods. For each period of time 20 screws were evaluated for the torque needed to get the implant out from the living bone and 4 screws were kept for histological examination.

**Results:** The results revealed that the mean removal torque recordings for the mixture of nano titanium oxide and nano hydroxyapatite coated implants was significantly higher than the nano hydroxyapatite coated screws over the two healing periods (2 and 6 weeks ). There was an increase in the bond strength value (torque

value) of living bone-implant contact with increased time. Besides, the histological evaluation exhibited increased new bone formation associated with the mixture of nano titanium oxide and nano hydroxyapatite coated screws, characterized by early proliferation of osteoblast cells and a maturation of bone in two weeks post implantation compared to the nano hydroxyapatite coated implants, also the bone formation was increased with the time of healing after implantation.

**Conclusion:** Commercially pure titanium implant coated with a mixture of nano titanium oxide and nano hydroxyapatite exhibited an increasing bond strength at bone implant interface than nano hydroxyapatite, which was demonstrated by higher torque removal force for (mixture of nano titanium oxide and nano hydroxyapatite after 2 and 6 weeks ( $20.13 \pm 4.4$ ,  $26.47 \pm 4.1$  N.cm respectively) than for (nano HA coating after 2 and 6 weeks ( $15.16 \pm 2.5$ ,  $20.12 \pm 2.3$  N.cm respectively) with the need of shorter time for bone formation as indicated by histological test.