# 以表面處理對迷你骨釘作爲矯正錨定時機械性質及顯微結構對其周圍骨整合之機制研究

# The study of mechanical and microstructure variations of mini-implants for orthodontic anchorage with surface treatments


## 中文摘要

由於鈦金屬表面會生成一氧化層，使鈦金屬及其合金具極佳的生物相容性，研究指出植體表面氧化層厚度與孔徑大小對於細胞初始的攀附行爲、增殖及分化有密切的關係。但因鈦金屬植體表面之機械性質與原生骨組織仍有差異，導致植體植入後可能發生因應力遮蔽效應所產生的骨質吸收問題。若能於植體表面氧化層製作奈米網狀多孔性結構，除將有助於細胞攀附、增殖及分化外，亦可有效降低鈦植體表面之楊氏係數，避免應力遮蔽效應發生，達到更趨完善的骨整合效應。本研究以電化學陰極處理方式使鈦基金屬表層形成一層氫化鈦薄膜，再以電化學陽極處理，使表面形成一層三維網狀奈米多孔性二氧化鈦結構，佐以物理及化學性的分析儀器測試表面之成分、元素、膜厚、孔洞大小及結構，探討奈米網狀多孔性二氧化鈦之形成於鈦金屬表面楊氏係數及應力遮蔽效應的影響。研究結果顯示網狀奈米多孔性二氧化鈦結構可將鈦金屬表面楊氏係數降低至與骨組織相近；臨床研究結果顯示，經過表面處理之植入物，成功率明顯較未經過處理高，顯示本研究所提出之表面處理程序可有效增進鈦金屬之生物力學相容性，進一步改善骨組織癒合能力。

## 英文摘要

Metals are becoming increasingly popular as orthopedic and dental fields by many researches. However, there is particular difference in the Young’s modulus between artificial implants and human bones. The difference of Young’s modulus will result in stress shielding effect, leading to early bone loss. In this research, we proposed the electrochemical process as surface treatment of titanium-based mini-implant. Titanium hydrides were formed on implant surface following cathodic treatment. Nanoporous titanium oxide structure was formed by anodic surface treatment. Physical properties, chemical properties as well as biocompatibility of titanium implant with and without electrochemical treatments were analyzed clearly. Furthermore, effect of mechanical properties and stress shielding on nanoporous implant surface and bone were also investigated and discussed. This research also explores the effects of nano-(??-TiH, g-TiH2, and a-TiH1.971) phases on the formation of multi-nano-titania film by anodization with cathodic pretreatment. A

multi-nanoporous titania film was formed on the titanium after anodization. Anodization with cathodic pretreatment not only yields a titanium surface with a multi-nanostructure, but also transforms the titanium surface into a nanostructured titania surface. Formation of nano-hydrides by cathodization and oxidation by anodization are believed to enhance biocompatibility and improve bone to interface contact (BIC), thereby accelerate the initial osseointegration and re-osseointegration. From our clinical survey, the lower failure rate of mini-implants with surface treatment could be also found.