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• 計畫英文名稱	Investigation of Boundary Conditions of Dental Implants Using Vibration Theory
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• 中文關鍵字	自然頻率；牙科植體；有限元素分析
• 英文關鍵字	Natural frequency；Dental implant；Finite element analysis
• 中文摘要	目前有關人工牙根植入後，與邊界骨間固持狀態大多是經由放射線 X-Ray 影像來偵測，但 X-Ray 卻有其侵入性傷害的缺點，因此發展並評估一套新的非侵入性診斷技術，以解決 X-Ray 影像的不便，是本研究的主要目的。本研究利用模態測試法配合有限元素分析，分別從體外實驗及數值運算的模擬中，分析人工牙根自然頻率與骨質流失程度的關係。在方法上首先建立一人工牙根與癒合連接體的三維有限元素模型，並經由一系列的體外模態測試實驗來驗證有限元素模型的可信度。接著，在計算運算收斂性的檢視之後，藉由同時改變人工牙根邊界骨質密度與剛性係數等材料性質參數，計算在不同的邊界骨質密度下，人工牙根自然頻率的變化。分析結果顯示，不論是經由體外模態實驗或是經由有限元素法的數值計算，人工牙根的自然頻率均會隨著邊界骨高度的下降而呈現線性遞減的現象。而當人工牙根的邊界骨質密度由 100%依序遞減至原來的 10%之後，人工牙根的自然頻率亦以線性方式降低(r=-0.996, P<0.01)，其值由 17921 Hz 下降至 641 Hz。本研究結果顯示，利用自然頻率爲參數作爲評估人工牙根邊界骨高度或邊界骨質密度，是可信且可行的。
• 英文摘要	For years, radiographic examination has been the main clinical method for the assessment of the dental implant in vivo condition. However, the use of such method is limited for many applications due to its low sensitivity. As a result, it is thus difficult to diagnose in the early stages of bone losses. Therefore, there is a strong clinical demand for a novel non-invasive technique to evaluate objectively the status of the dental implant under various bone qualities. Thus, the goal of current study is to provide a preliminary numerical analysis of the vibrating behavior of a dental implant at implant-bone interface. A 3D cylinder-type titanium implant FE model was established, with physical dimensions of 3.75 mm×10 mm. The implant was placed into a 10×10×15 mm/sup 3/ section of bone. The natural frequencies of the FE model were calculated under different boundary levels and bone densities. Our results indicated that the modeled

natural frequency decreased linearly ($r=-0.975$, $p<0.01$) from 17921 to 4966 Hz, with a decreased ratio of 72.3%, while boundary levels decreased 6.8 mm below the first thread of the screw. On the other hand, a linear relationship ($r=-0.996$, $p<0.01$) also found between the bone density and natural frequencies of the implant. Natural frequencies decreased linearly from 17921 Hz (without bone loss) to 641 Hz (90% bone loss) when the bone densities decreased. Our results supported that natural frequency analysis could be a useful clinical tool in the diagnosis during surgical process, and prognosis of implanted dental implant during the healing stages and subsequent routine follow-up care after the treatment.