# 利用共振頻率非破壞性檢測不同製造方式的鎳鈦合金根管銼

# Nondestructive Tests of Ni-Ti Instruments with Different Manufacturing methods：A Resonance Frequency Analysis


## 中文摘要

鎳鈦合金根管銼已經廣泛的使用在牙髓病的治療上，但其無預警的斷裂也是令牙醫師關心的問題，之前並無一科學性的方法來評估鎳鈦合金根管銼的壽命，而本研究室利用自然頻率的分析方式對鎳鈦合金根管銼(ProFile)做非破壞性的疲勞檢測，確定此方式可行且在臨床上有應用的價值。

近來市面上出現一種新的製造方式，其所製造出來的鎳鈦合金根管銼更具有撓曲性及抵抗性，利用旋轉鎳鈦合金金屬合併熱處理的過程來增加其超彈性及抵抗疲勞破壞。因此本研究繼續探討不同製造過程的鎳鈦合金根管銼，在發生疲勞破壞的情況下，其自然頻率的變化與其使用壽命之間的相關性，主要是評估由旋轉方式所製造的 TF 器械以及傳統機器切削所製造的 ProFile 器械。

在本實驗中，利用人工牙根穩固度檢測儀(Implomate)對 TF 器械和 ProFile 器械在經由模擬臨床之動態操作過程中作分析記錄。結果顯示，全新之 ProFile 器械其自然頻率值出現在 5050+0 Hz 到 5563+25 Hz 之間，經由體外動態操作的過程後，ProFile 器械的自然頻率值呈現逐步下降和出現少數器械扭曲變形的現象，其中沒有出現器械扭曲變形的 ProFile 器械，其 K 值平均降到 0.95+0.01。其餘出現器械扭曲變形的 ProFile 器械，K 值則降到平均 0.90+0.01。另一組的 TF 器械，其全新的自然頻率值在 5150+0 Hz 與 5250+0 Hz 之間，同樣經過體外動態操作後，其 K 值則下降到 0.93+0.02。

自然頻率分析法的結果顯示，不同製造方式的鎳鈦合金根管銼，在經過使用後會有不同幅度的下降以及長度的增加量，因此可以將這種檢測方式應用在臨床上。

## 英文摘要

Nickel-Titanium (Ni-Ti) instruments have become widely used in the endodontic treatment. However, their unexpected separation was a serious concern in endodontics. To date, no scientific methods have been developed to evaluate the functional lifespan of Ni-Ti instruments. In this study, we used resonance frequency (RF) analysis to nondestructively detect the fatigue life of Ni-Ti instruments to determine the feasibility of this technique for use in the clinic.

Recently, a new manufacturing method to produce more flexible and resistant Ni-Ti instruments (Twisted File, TF) has been developed. It uses twisting of a ground blank in combination with heat treatment to reportedly enhance superelasticity and increase cyclic fatigue resistance. With this regard, this research aim to investigate the

influence of Ni-Ti instruments with different manufacturing methods on the cyclic fatigue. In addition, the relationship between the fatigue life and RF value was evaluated by comparing the lifespan of Ni-Ti instruments and their measured RF values.

To simulated clinical operation, we used a commercialized RF analysis device (Implomate). Our result shows that the average RF value of new ProFile instruments focus between 5050+0 Hz and 5563+25 Hz. After the in vitro simulated operation, the RF values of the ProFile instruments decreased gradually. For ProFile instruments, without unwinding defects, normalized RF value (K value) before fracture is 0.95+0.01. However, when unwinding defects were detected in the ProFile instruments, the normalized RF value (K value) before fracture decreased to 0.90+0.01. On the other hand, the RF value of the new Twisted File (TF) instruments was measured from 5150+0 Hz to 5250+0 Hz. After clinical operated procedure was simulated, all the instruments showed fracture with unwinding defects. The K value before fracture of the TF instruments was 0.93+0.02.

These results demonstrate that the RF analysis tests have potential as a tool for structural detection in Ni-Ti instruments and that the method presented is feasible for clinical application.