

Influence of pre-existing surface defects on NiTi rotary instrument failure: A SEM study

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I. Objectives

The purpose of this study is to determine if propagation of pre-existing manufacturing defects results in brittle fracture of NiTi rotary files by examining the fracture surface of the instrument by SEM, and to compare the fracture time of NiTi rotary files with different flute designs under cyclic loading.

II. Materials and Methods

This study examined three groups of rotary NiTi instruments (K3, ProFile, Hero). Of each group, 04 taper, size 30 and 06 taper, size 25 were selected. : 120 in total. Surface defects were created by simulating the machining process of NiTi rotaries.

The instruments were inserted around the three stainless-steel pins that are used to restrain the instruments with 40 degree of curvature and rotated at 300rpm until they fractured. The time to fracture was measured and the fracture surfaces of each files were observed with scanning electron microscopy.

III. Results

Significant differences in cycles to failure were observed between experimental and control group. Especially K3 experimental group were failed significantly fewer cycles than control group. Different cross-sections demonstrated different stiffness and therefore different cycles to failure.

Several of fractured files demonstrated characteristic patterns of brittle fracture consistent with the propagation of pre-existing cracks associated with machining damage. And there was a transition from brittle fracture to ductile failure.

IV. Conclusions

This study indicate that manufacturing defect of NiTi rotary instruments significantly decrease fatigue life under experimental conditions. It may one possible factor for NiTi fracture in clinical practice.