Torsional Failure Characteristics of a NiTi file based on a Case Report

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File separation;
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Abstract: The use of nickel-titanium rotary files has been accepted worldwide. One of the major concerns about its use is the chance of file separation. Two types of failure have already been identified: cyclic fatigue and torsional failure. A scanning electron microscope analysis was performed on a recent case of file separation. The scan was used to show the main characteristics of torsional failure and to compare these characteristics with a known example of cyclic fatigue type failure. The clinical reasons that may lead to such failure are also discussed.

Palavras-Chave:
Limas mecanizadas níquel-titânio;
Fractura por torção;
Fractura de lima;
Microscópio electrónico de varrimento

Resumo: A instrumentação mecanizada com limas de níquel-titânio é usada mundialmente, sendo a separação e fractura destes instrumentos considerada uma grande preocupação. São documentados dois tipos de fracturas: por fadiga cíclica ou por fractura por torção. Uma análise de microscópio electrónico de varredura foi realizada num recente caso de fractura de uma lima. A análise é usada para documentar as características da fractura por torção e compará-la com a fadiga cíclica. As razoes clínicas que podem levar a este tipo de falha são também debatidas.

INTRODUCTION

The introduction of the Nickel-Titanium (NiTi) rotary files has revolutionized the instrumentation of root canals treatment by reducing practitioner fatigue and time required to complete the procedure[1]. There are fewer procedural errors, such as transportation and ledging that are associated mainly with less flexibile stainless steel files used typically with hand instrumentation [2]. Despite the higher flexibility, NiTi file separation may still occur[3,4,5].

The prognosis of an endodontic treatment procedure depends on the correct cleaning, shaping, and disinfection of the canal[6,7]. The separation of an instrument inside the canal may prevent these events from occurring. When it happens it is important to understand that the presence of a separated instrument in the canal in itself does not predispose the case to post treatment disease. Rather, it is the presence of any necrotic, infected pulp tissue that remains in the canal space that determines the prognosis [8]. When separation does happen it is important to rectify the treatment plan based on the correct diagnosis. Depending on the microbiological contamination of the root canal system the separated file may or may not result in a poorer prognosis. The treatment plan options in this situation include by-passing or removal of the instrument, apical surgery, or obturation to the point of the separated instrument depending on the pulp status. Knowing how and why these failures may happen is essential so at the very least, they can be avoided.

The purpose of this paper is to present a case report of a NiTi separation and to review the characteristics of NiTi files torsional failure characteristics and to understand why it may separate based on a case report involving the separation of such a file.

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CASE REPORT

A 38 year old female was referred to the New York University Post Graduate Endodontics clinic. The patient was sent, by a Prosthodontic clinic resident for re-treatment of tooth 47 (the mandibular lower right second molar) with the objective of improving the result of the previous root canal filling before proceeding with the oral rehabilitation that would include tooth 47 as a terminal abutment of a fixed multi unit bridge (Figure 1). There was no chief complaint and the medical history was non-contributory. The dental history included a previous root canal treatment completed more than ten years previous to the current visit. The patient has not complained of any symptoms. Periapical radiographic analysis showed short fillings on both the mesial and distal roots. No radiographic indication suggesting a periapical lesion was found.

The clinical situation was explained to the patient. The treatment options were given which included no treatment, re-treatment or extraction. The possible complications of the procedure were explained to the patient which included a risk of file separation, perforation, or a less than ideal clinical outcome due to the nature of the preoperative condition of the tooth. An informed consent to treatment was accepted by the patient.

An aseptic technique was used, the access opening was completed and the previous paste-like filling was removed. Three canals were identified and the canals were negotiated to the working length with a stainless steel hand file ISO size .08. This step was accomplished with the continuous intracanal use of a lubricant (RC Prep-Premier Dental, Plymouth PA) and a 5.25% solution of sodium hypochlorite.

Coronal enlargement was first performed with a ProTaper SX file (Tulsa Dental, Tulsa OK) and then a brand new ProTaper S1 (Tulsa Dental, Tulsa OK) rotary file was used to achieve the working length. The instruments were used with a Tulsa Dental Motor (Tulsa OK) at a medium torque setting and a speed of 300 RPM. An instrument separation occurred during this phase of cleaning and shaping (Figure 2). The by-pass option was attempted and was successful. The treatment was concluded in three appointments, with the use of calcium hydroxide as intracanal medication between the appointments. The objective requested by the oral rehabilitation team, the improvement of the quality of the original root therapy procedure, was achieved (Figure 3).

Figure 1 - A diagnostic radiograph. The Prosthodontic clinic requested an improvement of the root canal treatment for a better prognosis.

Figure 2 - Radiographic image of a separated ProTaper S1 file on the mesial bucal canal.

Figure 3 - The final radiograph. The separated file was by-passed and the request of Prostodontic department was achievied.

SEM ANALYSIS OF THE SEPARATED FILE

For research purposes the separated coronal file fragment was taken to the NYU Biomaterials Department laboratory for analysis with the Scanning Electron Microscope.

The longitudinal view showed that the tip of the file