Assessment of surface debris on factory-delivered rotary endodontic files: SEM study

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فحصت الدراسة مائة وخمسة وثلاثون مبردا جديدا ٠,٠٤، ٠,٠٦، وأخرى بمقاسات أكبر، جرى فحصها بالمجهر الالكتروني الماسح مباشرة بعد نزعها من عبواتها الأصلية بهدف تحري فضلات السطح وذلك بتكبير ٥٠ مرة. أجري فحص للأدوات مرة ثانية بعد تنظيفها بالأمواج فوق الصوتية. أظهرت النتائج أن جميع الأدوات المفحوصة لم تكن خالية من البقايا المعدنية أو الجزيئات الأجنبية عند استلامها من المصنع. يبدو أن تنظيف الأدوات بالأمواج فوق الصوتية مع محاليل التنظيف له أثر فعال في التقليل من فضلات عملية التصنيع، استنتج من هذه الدراسة انه يجب تنظيف المبارد الجديدة الصنع قبل استعمالها في عملية تنظيف الأقنية الجذرية.

One hundred and thirty-five new profile files 0.04, 0.06 and Greater Taper (GT) were examined immediately upon removal from their original packages for surface debris using the SEM at a magnification of 50x. A second examination of the instruments was performed after they were cleansed in an ultrasonic bath. Results showed that in the first examination, none of the examined instruments was free of metallic spurs or foreign particles as received from the manufacturers. The use of ultrasonic bath together with a cleanser solution was very helpful in minimizing the surface impurities of the files from the manufacturing process. It was concluded that the newly manufactured files have to be cleaned before using them in root canal treatment.

Introduction

Cleaning and shaping procedures are some of the most important phases in root canal therapy.[1,2] Traditionally, K-files were used to prepare root canals in circumferential filing mode utilizing the step back technique.[3]

In the early 1990's, a new automated system for root canal instrumentation, the profile 0.04 tapers series 29 rotary instruments was introduced. These engine driven files are constructed from super flexible nickel titanium alloy and offer a standard 29% increase between the tip diameters of each size instrument. In the late 90's, the same manufacturer introduced a new file system, the greater taper GT Rotary Instrument System to be used in conjunction with the profile 0.04 taper system, with standardized diameter tips of 0.20 mm and four different tapers 0.06, 0.08, 0.10, and 0.12 taper. These four files were used first, and then the final apical preparation was achieved by the use of profile 0.04 taper system in a crown-down sequence. The result of using these rotary instruments was promising.[4-6]

Cleaning endodontic instruments after clinical usage is a mandatory practice. Numerous methods for cleaning have been used such as cotton rolls and gauze used dry or soaked with antiseptic substance, hand brush, rubber dam and sponges which have been used as a mechanical cleanser alone or combined with a detergent or antiseptic solution.[7-12] Disadvantages of these methods are that the brushes are time consuming and tends to produce metal spurs; while others leaves remnants on the files. A new method using ultrasonic cleaners has the advantage of being faster and easier in cleaning dental instruments. No recent study examined the surfaces of new rotary instruments for surface debris. No current information on the effectiveness of this method to cleanse the new profile rotary files (0.04 taper, 0.06 taper and GT files) prior to use is available. Therefore, purposes of this study were two fold: first, to evaluate the presence of debris on the surface of new unused profile files and second, to analyze the effectiveness of an ultrasonic bath and a cleanser solution to cleanse the instruments.

Material and Methods

A total of 135 new unused nickel titanium rotary profile files* size #20 were divided into 3 groups. Group I consisted of 45 files of size #3 profile 0.04 taper (yellow color) 29% series, group II consisted of 45 files of size #3 profile 0.06 taper (yellow color), and group III consisted of 45 files of size #2 profile Greater Taper (GT) files (yellow color) were used, all with tip diameter equal to 0.20 mm. The three file groups had the same cross section design, the same tip diameter (0.20 mm), but with taper difference of 0.02 each (0.04,0.06, and 0.08, respectively). All files were 25 mm in length.

Received 3 November 2003; Revised 11 April 2004
Accepted 30 June 2004
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After they were removed from their original packages, the files were handled by the sterilized metallic handle so that the instrument blades were not touched by the operator's hands.

To standardize the areas of observation and to avoid movement of the files during examination, they were mounted on sterilized aluminum stubs containing an especially devised holder jig. Three areas of each file from the cervical, middle and apical portions of the cutting blades were examined in a scanning electron microscope** at magnification of 50x. To know the amount of debris on the surfaces of each instrument in all three analyzed areas, the final results were obtained from a combination of these areas and subjectively rated on a scale from 0 to 3. A score of 3 represented an instrument that was severely coated with debris and foreign particles (Fig. 1).

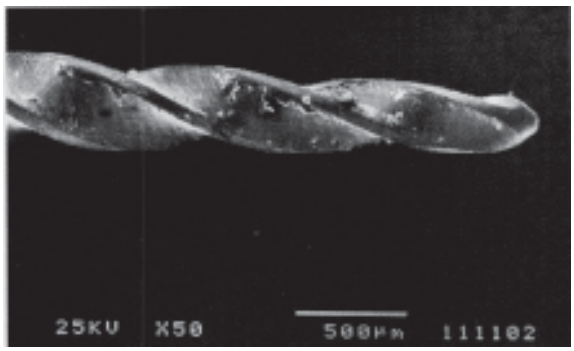

Fig. 1. SE photomicrograph of 0.06 profile file categorized as score 3 before sonication.

A score of 2 represented an instrument that was moderately coated, 1 represented an instrument in which some scattered particles were observed on the metallic surface, and a score 0 represented an instrument completely free of debris. After representative areas of each instrument were analyzed and photographed, they were subjected to the ultrasonic bath vibration for 5 minutes using a Biosonic machine*** and a cleanser solution.† All cleansing procedures were carried out by the same operator. Subsequently, the instruments were re-mounted on the holder jig and the same three areas were microscopically re-examined using the same technique mentioned previously. Two-way (ANOVA) of repeated measure design was used for groups both before and after SEM examination.

**JSM-T330A, JOEL, Tokyo, Japan

Results

Results are shown in Figures 2 and 3. None of the 135 new instruments was free of metal spurs or foreign particles before cleaning procedure. All groups scored 0 after sonication. Statistical analysis using two-way (ANOVA) repeated measure design test showed that there was a significant difference prior to and following cleaning with the ultrasonic cleanser ($P<0.001$). However, significant differences ($P=0.964$) were not found within each of the three groups ($P=0.708$). Furthermore, interaction effects of before /after SEM examination and groups was highly insignificant ($P=0.964$). Therefore, there was no need for further analysis.

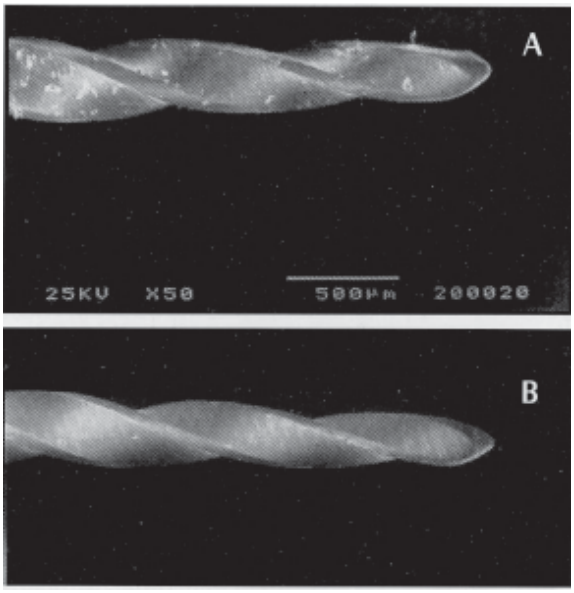

Fig. 2. SE photomicrograph of 0.06 profile file categorized as score 3 before sonication (A) and score 0 after sonication (B).

Discussion

The use of profile files (0.04, 0.06, and GT) is another alternative method to the use of conventional hand filling technique in the preparation of root canals.[4,6] In this investigation, the surface impurities and debris of the investigated files as received from the manufacturers and after cleansing with sonication bath before their use in root canals was

** Transonic 660/H, Elma

† BIB Forte, Alpro Dental Products

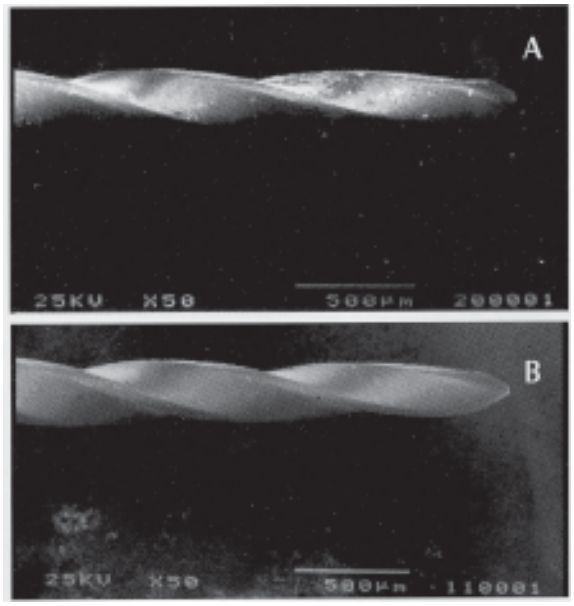

Fig. 3. SE photomicrograph of 0.04 profile file categorized as score 2 before sonication (A) and score 0 after sonication (B).

qualitatively analyzed. Constant irrigation is necessary during instrumentation procedures to minimize extrusion of canal contents into the apical area. Numerous *in vitro* studies have shown this extrusion.[12-15] Holland *et al.*[16] were able to demonstrate that debris carried to the apical area impair healing. Surface debris and metallic spurs on the surface of different endodontic instruments are one source of the debris as reported by Segall *et al.*[17] They added that different endodontic instruments as received from the manufacturers have debris, metallic spurs and foreign particles on their surfaces. Moreover, Goldberg[18] suggested that these debris and metallic spurs could be transferred via instruments to the root canal during canal preparation. The use of an ultrasonic bath in conjunction with a cleanser solution is considered one of the most effective methods for cleansing endodontic instruments after use.[7]

None of the instruments examined upon the removal from their manufacturer packaging was free from surface debris and impurities. These findings were in total agreement with those of Segall *et al.*[17] and Goldberg[18] who recommended that new files should not be used in patients without being first subjected to cleaning and sterilization to minimize manufacturing debris contamination.

Better quality control over instrument fabrication and handling to prevent contamination and debris deposition cannot be overemphasized and would eliminate or diminish this problem.

Conclusion

The degree of debris coating and metal spurs on the surfaces of the files after they were removed from their original packaging was significant. The results of this study demonstrated the need to cleanse these instruments prior to their clinical use on patients. Cleansing by ultrasonic bath is an effective method to remove the debris before instrumentation of root canals.

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