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Quality Assessment of the Deviated Molar Root Canals Tooling.

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ABSTRACT

This paper presents the results of a study of 155 root canals of the extracted maxillary and mandibular molars, used for making 620 thin sections for scanning electron microscopy. We conducted dental X-rays to measure bending angles of root canal by S. Schneider method, further divided the molar root canal into groups depending on their bending degree in both the bucco-lingual and the medio-distal direction. Results of the study showed that the increase in the molar root canal deviation by more than 25° in both the bucco-lingual and medio-distal directions reduces greatly their tooling quality. The tooling process requires special attention to the preparation of the middle and apical third of the buccal and lingual/palatal surfaces of molar root canals. Considering the individual features of root canals architectonic, diversifying the endodontic instruments, as well as improving their cutting efficiency will ensure a higher level of tooling quality.

Keywords: molars, root canal treatment, root canals, microscopic study

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INTRODUCTION

The problem of preventing the complications arising during endodontic treatment of maxillary and mandibular molars is of current concern [1,2,3]. One of the key to the problem is to develop a tooling method for deviated molar root canals in treating the pulp and periodontal diseases [4,5,6]. Even root canals of canines and incisors have signs of poorly conducted tooling [7,8,9]. Modern studies have shown that the walls of most root canals of single- and multi-rooted teeth are treated substandardly. Several authors have studied the causes of the above phenomenon; however, no definitive conclusions on preventive measures have been made yet [10,11,12]. There is just an accomplished fact that poor root canal tooling performance depends on their complex and variable architectonics [13,14,15]. One of its manifestation features in the molar root canals is their significant deviation, detectable by accurate visualization techniques [16,17].

Objective of Research

To assess the quality of both tooling and efficiency of root canal treatment considering the objective prediction of the molar root canals curvature.

MATERIALS AND RESEARCH METHODS

155 extracted human maxillary and mandibular molars have served as an object of the study. After fixing in 10% formalin solution, the extracted molars were fastened on silicon plates and subjected to X-ray examination in frontal and lateral projections. We conducted dental X-rays to measure bending angles of root canal by S. Schneider method. We further divided the molar root canal into groups depending on their bending degree in both the bucco-lingual and the medio-distal direction. Thereafter, we opened dental cavities with burr and subjected root canals to tooling with the flexible nickel-titanium instruments with non-active tip by StepBack method with files reciprocating within 90-100°.

Preparation of the root canals was completed after a thorough treatment of their walls when reaching manual smoothness of their surface. We further decalcified the teeth in Trilon-B for 10 days, then washed thoroughly, and additionally decalcified in 5% HNO₃ solution for 48 hours, and flushed with running water and dried. The prepared mandibular and maxillary molars were then used for making 620 thin sections. The samples were glued with conductive adhesive to an object table and studied with the use of a scanning electron microscope OLIMPUS (Japan) at an accelerating voltage of 5 to 80 mV. Scanning electron microscopy (SEM) was performed with the use of the JSM-6510 JEOL apparatus with a resolution of 3.0 nm (30 kV), 8.0 nm (3 kV), 15.0 nm (1 kV), with x8 to x300 000 magnification (at 11 kV and more), at image electric shift up to ± 50 μm, (WD = 10 mm), with saving the resulting images as .JPEG files. Objectivity of the selected criteria has been confirmed by the study of 10 root canal models of the untooled extracted molars. During the tooling quality analysis, we considered both the presence and the localization of defects depending on the nature of the surface studied (buccal, lingual, medial, distal) and the location along the root canal length.

We subjected all research materials to mathematical processing on the personal computer using the statistical software packages Exel 2007, Statistica for Windows 5.0. Results are presented as the arithmetic mean and its standard error ($M \pm m$). The significance of differences (p) between the values at different times in each group of patients was evaluated using a Wilcoxon test (for comparing the indicators measured under two different conditions on the same test sample). We used χ^2 - Pearson criterion to compare two, three or more empirical distributions of the same attribute. Comparing the values of the studied indicator in different groups in the same periods, we assessed the significance of differences with the use of Mann-Whitney U-test (for independent samples) and the method of Spearman rank correlation.

RESULTS

Our scanning electron microscopy allowed us to reveal the following pattern: an increase in the bending angle of molar root canals increases the number of unsatisfactory results of their tooling.

Results of the study have shown that all molar root canals with bending angle >25° had signs of poor tooling with endodontic instruments, while an especially low level of root canal tooling was in the bucco-lingual direction invisible by X-rays.

According to the obtained data, an increase in the bending angle of molar root canals in the bucco-lingual direction also increases the number of root canals with inadequately treated surface. Therefore, it is safe to say that the most favorable bending angle of the root canal for high-quality tooling in both the bucco-lingual and the medio-distal direction is one not exceeding 25° (see Figure 1-a). However, we should note that the registration rate of molar root canals with a slight bending angle (up to 10°) and poor quality of treatment with endodontic instruments, is very high in practice (49.45±7.24%). This is apparently due to the fact that the palatal and especially distal molar root canals often have a slit-like shape (Figure 1-b). Therefore, both buccal and lingual surfaces of these canals are insufficiently treated, even when using K-Reamer and K-Flexoreamer (the latter is highly flexible due to both the reduced helix pitch and a triangular cross-section of the tool rod, and is used primarily for passing through the deviated canals).

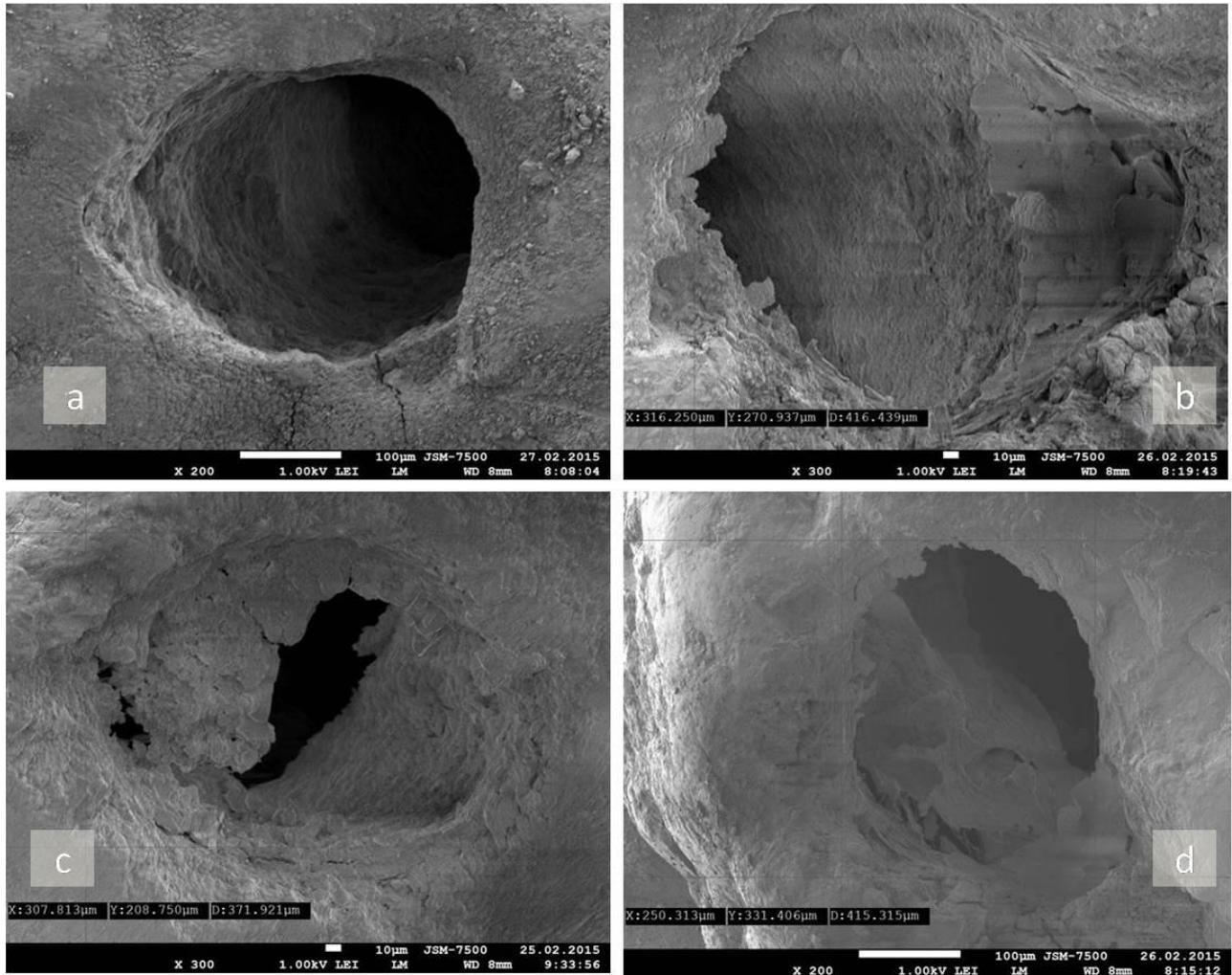


Figure 1: Microslides. Scanning electron microscopy. Inner surfaces of the molar root canal with medio-distal bend of 15° (a), the distal root canal of the slit-shaped molar with bucco-lingual bend of 10° (b), and the apical region of molar root canals bent by 45° (c) and 60° (d).

SUMMARY

The study of models of molar root canals, having a bending angle less than 25° prior to their tooling, revealed that poorly treated areas came up most frequently (44.82 ± 5.54%) on the lingual surfaces of these canals. As for the localization of these areas along the root canal length, they usually were at the middle third level. Treatment of medial and distal surface of the molar root canals deviated in the range of 25-50° with endodontic instruments showed a higher quality than that of either buccal or lingual surface. Middle and apical thirds of these canals were a conventional place for arrangement of roughness, sags, and ledges, indicating the lack of contact between the tool and the wall of the root canal during treatment (Fig. 1- c, d).

CONCLUSION

Analysis of the obtained data showed that the increase in the molar root canal deviation by more than 25° in both the bucco-lingual and medio-distal directions reduces greatly their tooling quality. The tooling process requires special attention to the preparation of the middle and apical third of the buccal and lingual/palatal surfaces of molar root canals. Considering the individual features of root canals architectonic, diversifying the endodontic instruments, as well as improving their cutting efficiency will ensure a higher level of tooling quality.

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