

Original Article

Assessment of cleaning efficacy of Mtwo NiTi rotary files and Hand K-files: A comparative in-vitro study

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Abstract

Background: Rotary instruments enhance the quality of obturation by providing conical shape to the root canal. Nickel titanium (NiTi) alloy instruments inherent flexibility that allows the files to preserve the original anatomy of curved canals and reduce the chances of procedural errors. The present study was designed to comparatively evaluate the cleaning efficacy of Mtwo NiTi rotary files and hand K-files. **Material and methods:** After approval of the study protocol, we selected 30 extracted maxillary incisors. The teeth were randomly grouped into three groups, Group 1, Group 2 and Group 3 with 10 teeth in each group. The instrumentation of specimens of group 1 was done using stainless steel K-files, in group 2 was done using Mtwo NiTi rotary files and in group 3 only irrigation was done without any instrumentation (Control group). After completion of instrumentation, the specimens were decalcified and cleared. The cleared specimens were viewed under stereo microscope at 10X for checking the amount of residual india ink at coronal, middle and apical region of the canals and scored from 0 to 3. **Results:** On comparing the control group with K-files and Mtwo rotary files, we observed that both the techniques were able to remove the ink from the canals. Statistically significant difference was observed in the apical, middle and coronal thirds of root canals on comparing control group with Group 1 and 2. On comparison between Group 1 and 2, non-significant difference was observed in the cleaning efficiency of the canals at apical, middle and coronal region. **Conclusion:** Based on the findings of present study, we conclude that manual K-files were similar in cleaning effectiveness to Mtwo rotary systems in cleaning tooth root canals.

Keywords: K files, Mtwo files, Rotary instruments, Root canal.

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INTRODUCTION

The goals of root canal therapy are to remove infected and necrotic pulpal tissue remnants, shape the root canal system to facilitate irrigation and medication and adequate sealing using obturation materials.¹ Rotary instruments enhance the quality of obturation by providing conical shape to the root canal. Nickel titanium (NiTi) alloy instruments inherent flexibility that allows the files to preserve the original anatomy of curved canals and reduce the chances of procedural errors.² Mtwo system was developed and introduced in 2003. The standard Mtwo rotary set includes four instruments with variable tip sizes ranging from #10 to #25 and tapers ranging from 0.04 to 0.06–0.07. According to the manufacturer, the minimally invasive Mtwo

NiTi instruments should be used in single-length techniques without early coronal enlargement.³ Mtwo NiTi rotary instruments have an S-shaped cross-section, a nonworking tip, a positive inclination angle, 2 cutting edges, and different tapers. According to the manufacturer, this design prevents fracture and the transportation of debris toward the apex.⁴ So, the present study was designed to comparatively evaluate the cleaning efficacy of Mtwo NiTi rotary files and hand K-files.

MATERIAL AND METHODS

The study was conducted in the department of conservative dentistry and endodontics of dental institution. Before commencing the study, the study protocol was submitted to the ethical

committee of institute for approval. After approval of the study protocol, we selected 30 extracted maxillary incisors. The inclusion criteria for selection of teeth were:

- Non-carious
- No signs of root resorption
- Completely formed apex
- Absence of any structural abnormality

The teeth were kept in 5% Sodium hypochlorite solution for 2 days to remove organic debris on the teeth and for disinfection of teeth. After removing from NaOCl solution, teeth were thoroughly cleaned with distilled water and remnant calculus from the surface of teeth was removed with ultrasonic scalar. The teeth were kept in formalin solution until used. Access cavity preparation for all teeth was done using round diamond bur. After access preparation, the patency of the root canals was verified using no.15 K-file. Barbed broaches were used to take out pulp from the canal. After removal of pulp, the root canals were rinsed with 2mL normal saline. Then, using 30-guaze needle root canals were packed with India ink. To assure the penetration of ink, no. 15 K-file was introduced into canal and then kept for 72 hours in wet conditions at room temperature. The teeth were randomly grouped into three groups, Group 1, Group 2 and Group 3 with 10 teeth in each group. The instrumentation of specimens of group 1 was done using stainless steel K-files, in group 2 was done using Mtwo NiTi rotary files and in group 3 only irrigation was done without any instrumentation (Control group). The instrumentation of all the specimens was done by the same operator. The working length of the root canals was standardized at 20 mm for all the teeth. Specimens of Group 1 were cleaned using K-file # 35 as master apical file and step back up to K-file # 50. Specimens in Group 2 were cleaned with the Mtwo rotary system. The instrumentation sequence was 10/.04, 15/.05, 20/.06, and 25/.06. The instruments were discarded after using on 4 teeth. In group 3, no instrumentation of the canals was done. After completion of instrumentation, the canals were irrigated with 5 ml normal saline dried with paper points, pulp chamber sealed with temporary cement and stored in moistened gauze. Now, the teeth were completely decalcified by immersing the specimens first in hydrochloric acid for 2 days and dehydrated by immersing successively in alcohol solutions. Then, teeth were cleared in methyl salicylate. The cleared specimens were viewed under stereo microscope at 10X for

checking the amount of residual india ink at coronal, middle and apical region of the canals and scored from 0 to 3. Score 0 was awarded to wholly clean canal, 1 was awarded to hardly any ink residues, 2 was awarded to incomplete ink removal and 3 was awarded to no ink removal. The results were evaluated. The statistical analysis of the data was done using SPSS version 11.0 for windows. Chi-square and Student's t-test were used for checking the significance of the data. A p-value of 0.05 and lesser was defined to be statistical significant.

RESULTS

Table 1, 2 and 3 shows the cleaning efficacy scores of K-files, Mtwo rotary files and Control group. On comparing the control group with K-files and Mtwo rotary files, we observed that both the techniques were able to remove the ink from the canals. Statistically significant difference was observed in the apical, middle and coronal thirds of root canals on comparing control group with Group 1 and 2. On comparison between Group 1 and 2, non-significant difference was observed in the cleaning efficiency of the canals at apical, middle and coronal region.

Table 1: Frequency of cleaning efficacy scores of K-files

SCORES	Apical region	Middle region	Coronal region
0	3	3	4
1	4	5	5
2	3	2	1
3	0	0	0
Total	10	10	10

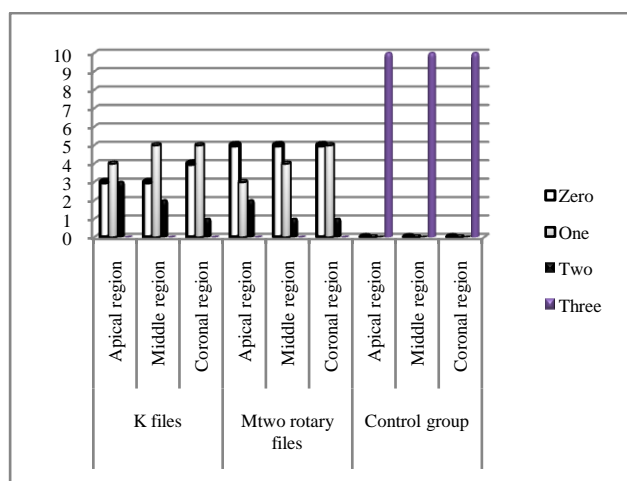
Table 2: Frequency of cleaning efficacy scores of M-two rotary files

SCORES	Apical region	Middle region	Coronal region
0	5	5	5
1	3	4	5
2	2	1	1
3	0	0	0
Total	10	10	10

Table 3: Control group

SCORES	Apical region	Middle region	Coronal region
0	0	0	0
1	0	0	0
2	0	0	0
3	10	10	10
Total	10	10	10

Graph 1: Frequency of cleaning efficacy of K- files, Mtwo rotary files and control group



DISCUSSION

Elimination of microorganisms from the root canal system (RCS) by appropriate cleaning and shaping is the most important factor ensuring the success of endodontic treatment. Thus, appropriate cleaning, shaping and sealing of the RCS are essential. Endodontic instruments and techniques have undergone numerous modifications to achieve the highest cleaning and shaping efficacy. At present, NiTi engine-driven files are highly popular because they are efficient and safe especially for preparation of fine curved canals due to their high flexibility and elasticity.^{5, 6} In the present study, we evaluated the cleaning efficacy of Mtwo rotary NiTi files and hand K-files. We observed that both the techniques were able to remove the ink from the canals. Statistically significant difference was

observed in the apical, middle and coronal thirds of root canals on comparing control group with Group 1 and 2. On comparison between Group 1 and 2, non-significant difference was observed in the cleaning efficiency of the canals at apical, middle and coronal region. Ramezanalif et al compared the cleaning efficacy and instrumentation time of hand K-files and Mtwo rotary system for preparation of human primary molars. This experimental study was conducted on 100 extracted primary maxillary and mandibular intact molars with no resorption. Access cavities were prepared and India ink was injected into the root canal on a vibrator using an insulin syringe. Canals were then divided into 5 groups (n=20): in group I, canals were instrumented using K-files up to #25 for mesial and buccal canals and #30 for palatal and distal canals. In group II, canals were prepared using Mtwo rotary files (15/0.05, 20/0.06 and 25/0.06 for mesial and buccal canals and 15/0.05, 20/0.06, 25/0.06 and finally 30/0.05 for distal and palatal canals). In group III, root canals were only irrigated with saline. Groups IV and V were the positive and negative control groups, respectively. The time required for cleaning and preparation of the canals for each of the specimens in groups I, II and III was recorded. The mean score of cleanliness of Mtwo was not significantly different from K-file group. However the mean instrumentation time in Mtwo group was significantly shorter. The authors concluded that there were no differences regarding the cleaning efficacy of either system, Mtwo rotary files were far more time efficient.⁷ Honardar K et al compared the capability of K-files with Mtwo rotary file in terms of negotiation as well as depth of penetration in second mesiobuccal (MB2) canal of maxillary first molar. A total of 32 MB2 canal of maxillary first molars having different root curvatures (not more than 30 degree) and root lengths were selected and then detected by K-file #10, #8 and #6. Based upon file penetration the samples were assigned into four groups. Group A: K-file #10 penetrate >2mm into coronal third, group B: K-file #10 could penetrate <2mm into coronal third, continue proceeding with #8 which had >2mm penetration, group C: K-files #10 and 8 could penetrate <2mm, continue proceeding with #6 for deeper penetration, and group D: Mtwo file #10/.04 was applied into all three above groups until resistance was felt. Finally, accurate working lengths at each group after K-file #10 insertions into the canal were determined radiographically. The mean depths of root canal penetration were analyzed statistically using Duncan test by SAS

software (version 9.1) in GLM procedure. The mean of initial penetration for #10 Mtwo files was 19.16 mm, whilst it was 7.72mm for K-File #6, 10.72 mm for K-File #8, and 12 mm for K-File #10. The difference between Mtwo rotary files and hand K-Files was statistically significant. It was concluded that Mtwo rotary files could be an efficient substitute for hand files to negotiate MB2 canal both more easily and rapidly.⁸ Pathak S conducted a study to compare instrumentation time and cleaning efficacy of manual instrumentation and two rotary systems in the preparation of primary molar root canals. The teeth were randomly divided into three experimental groups, Group 1 K-file (n = 30), Group 2 Mtwo (n = 30), Group 3 WaveOne (n = 30), and one control group (n = 30). The root canals were prepared using one of the three file systems followed by clearing the teeth with different demineralizing solutions. The instrumentation time in each root canal was measured by a chronometer. The results were statistically evaluated using Kruskal–Wallis tests. Results: In the coronal third, WaveOne showed more ink removal and the difference found was highly significant. In the middle third of the root canal, WaveOne performed better than Mtwo and K-file. At the apical level, there was no statistical difference between the three systems. WaveOne was found to take significantly less time than Mtwo and K-file. WaveOne took less time and showed better cleaning efficacy when compared to other instrumentation techniques, especially in coronal and middle one-third. Ghoneim WM et al compared the cleaning efficacy of root canal walls after using two Nickel–Titanium (Ni–Ti) rotary files (Flexmaster and Mtwo) and one hand Ni–Ti file (Ni–Ti flex-K) when associated with different final irrigation regimens. Ninety extracted human premolars with similar range of canal curvature (21–39°) were selected. After crown removal and working length determination, roots were divided into three equal groups according to root canal instrumentation: Group I and Group II were prepared using Flexmaster, Mtwo Ni–Ti rotary systems respectively where Group III was prepared using hand NiTi flex-K files. Each group was further subdivided into three equal subgroups according to root canal final irrigation; subgroup A: SmearClear, subgroup B: 17% EDTA and subgroup C: NaOCl. Roots were then splitted longitudinally and processed for scanning electron microscopic (SEM) examination to evaluate and score the root canal cleanliness. Final root canal irrigation using either SmearClear or 17% EDTA

had significantly better cleaning efficiency than that of NaOCl in all tested groups. Ni–Ti hand files had significantly less cleaning efficacy than that of rotary systems except in subgroup C using NaOCl.^{9,10}

CONCLUSION

Based on the findings of present study, we conclude that manual K-files were similar in cleaning effectiveness to Mtwo rotary systems in cleaning tooth root canals.

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