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A SCANNING ELECTRON MICROSCOPIC COMPARISON OF THREE NICKEL TITANIUM ROTARY SYSTEMS FOR CANAL CLEANING ABILITY WITH AND WITHOUT THE USE OF A DENTAL MICROSCOPE - AN IN VITRO STUDY.

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ABSTRACT

Aim: To compare the effectiveness of the canal cleaning ability by using three different NiTi rotary systems, with and without the use of dental microscope, using a scanning electron microscope.

Materials and method: Sixty extracted single rooted mandibular premolar teeth with similar dimensions were randomly divided into two groups of thirty samples each, further subdivided into three groups of ten samples each. GroupI- Specimens were prepared under a dental microscope, Group-II - Specimen were prepared without the use of a dental microscope. Sub group IA, IIA- ProTaper series of rotary instruments. Sub group IB, IIB- Mtwo series of rotary instruments. Sub group IC, IIC- Twisted Files series of rotary instruments. In all specimens 15% EDTA was used during preparation and was irrigated by 3% Sodium hypochlorite and saline. Samples were sectioned bucco-lingually and then observed for debris under a scanning electron microscope.

Results: All instruments showed no statistically significant difference with and without the use of a dental microscope. Mtwo files showed good results in debris score followed by Twisted files. ProTaper showed maximum amount of debris although it was not statistically significant. None of the instruments succeeded in achieving completely clean canals.

Conclusion: The use of magnification did not achieve total root canal debridement in any of the rotary instruments. Mtwo rotary instruments produced least amount of debris. ProTaper rotary instruments showed the maximum amount of debris followed by Twisted files rotary instruments.

Keywords: Mtwo, Twisted files, ProTaper, dental microscope, debris, scanning electron microscope.

INTRODUCTION

In recent years, nickel-titanium (NiTi) rotary root canal preparation systems have altered the techniques of root canal instrumentation. Preparations with NiTi rotary systems remain significantly more centered in the canal space, resulting in less transportation than hand instrumentation with stainless steel instruments.[1,2]

Thorough cleaning removes micro-organisms and permits better adaptation of filling materials and enhances the action of intracanal medicaments. Not only is the removal of pulpal remnants necessary, but removal of the smear layer from root canal walls is also equally important.[3]

Debris is defined as dentin chips, pulp remnants and particles loosely attached to the root canal walls. All endodontic instruments create dentin debris and smear layer as a consequence of cutting action on root canal walls. A key part of root canal treatment is canal instrumentation, including shaping root canals in a manner that allows rinsing with irrigating solutions, disinfection with medicaments, and ultimately obturation. Effective cleaning of root canals may also be influenced by the apical size of a preparation.[4] A 30 gauge needle used for irrigation is most effective in removing debris in the apical one third of canals [5], and thus it has been suggested that the minimal apical size of a prepared canal should be of international standard organization # 30 in order to allow proper chemo-mechanical cleansing of the canals with irrigants.

The art of dentistry is based on precision. The human naked eye is capable of distinguishing fine detail, but it is no match for what can be accomplished when an image is sharpened and enlarged. The microscope and other forms of magnification fill that need, especially for accomplishing endodontic procedures. Un-instrumented surfaces and debris can be visualized under magnification. Similarly locating all the canals precisely has been achieved.

Thus the purpose of this in vitro study is to compare and evaluate the efficacy of three different rotary instruments: ProTaper, Mtwo and Twisted Files in the removal of debris from the root canals with and without the use of a dental microscope using a scanning electron microscope.

MATERIALS AND METHODS

Sixty freshly extracted single rooted mandibular premolar teeth extracted on periodontal or orthodontic basis were collected. Teeth were stored in containers containing normal saline at room temperature. Single root canals having patent and almost straight canals without bi/ trifurcation were included and grossly decayed teeth, teeth with severely curved roots, teeth with obliterated canals, teeth with multiple canals were excluded from the study. Teeth were randomly distributed among the groups.

2.1 Specimen preparation:

Crowns of all teeth were cut off at the cemento-enamel junction with a separating disc. The roots were then randomly divided into two groups of thirty samples each. Then each group was sub divided into three more groups containing ten samples each. The working length of all teeth was established by the insertion of a K file (SybronEndo) of ISO size10 into the

canal until its tip is visible at the apical foramen and then by subtraction of 0.5 mm. 15% EDTA (Glyde, Dentsply Maillefer), 3% Sodium hypochlorite and saline were used as irrigants alternatively. The specimens in the first group were prepared under a dental microscope (Carl Zeiss Opmi pico). A sequential crown down technique was carried in all the groups.

Group-I Specimens in this group were instrumented with the use of a dental microscope.
Group-II Specimens in this group were instrumented without the use of a dental microscope.
Sub group IA, IIA- Specimens were instrumented with ProTaper (Dentsply Maillefer) series of rotary instruments in a high torque, low speed hand piece with speed range between 150-350 rpm. Coronal to apical instrumentation technique- S-l, S-X, S-l, S-2, F-l, F2 was used
Sub group IB, IIB- Specimens were instrumented with Mtwo (VDW, Munich, Germany) series of rotary instruments in a high torque, low speed hand piece with speed range between 200-300 rpm. Coronal to apical instrumentation technique 10/.04, 15/.05, 20/.06, 25/.06 was followed according to the manufacturer's instructions

Sub group IC, IIC- Specimens were instrumented with Twisted files (SybronEndo) series of rotary instruments in a high torque, low speed hand piece with speed range between 300-500 rpm. Coronal to apical instrumentation technique 10/.04, 15/.05, 20/.06, 25/.06 was followed according to the manufacturer's instructions.

2.2 Specimen evaluation:

To facilitate fracture into two halves for Scanning Electron Microscope examination, all roots were grooved longitudinally on the external surfaces with a diamond disk avoiding penetration of root canals. Teeth were carefully split with hammer & chisel and stored in small labeled bottles containing normal saline until Scanning Electron Microscope evaluation. The specimens were examined under a Scanning Electron Microscope for assessment of microscopic pattern of debris at X500 magnification. A standardized series of three photomicrographs were taken for each pulp space (one in the apical third, one in the middle third & one in the coronal third) for comparative purposes.

Blind Evaluation of photomicrographs by two evaluators was undertaken to score debris with a five score index for each using reference photographs. Photomicrographs at X500 (for debris score) were taken in the apical, middle and coronal thirds of the canal. Each field was graded from score 1 to score 5 according to the scoring system and the mean value was calculated for each region of each half of the root. The rating system used was as proposed by Hulsmann et al (1997)(Fig.2).

The data was analysed using Student 't' test and Kruskal Wallis test . Level of significance was set at p = 0.05.

RESULTS

The results were tabulated as shown in Table 1.The study showed that under magnification there was lesser amount of debris produced than without magnification but was not statistically significantly and Mtwo series of rotary instruments produced the least amount of debris followed by Twisted files series of rotary instruments. ProTaper rotary instruments generated the maximum amount of debris but were not statistically significant. Intercomparison of debris between subgroup Protaper, Mtwo and twisted files with and without using the microscope is shown in Table II and Table III.

DISCUSSION

Thorough biomechanical preparation of the root canal is unanimously considered to be one of the major requirements for successful endodontic treatment.[6] The prime objectives of this phase are to remove completely the organic substance that maybe infected, or may become so, and to shape the root canal in conformity with the principles of obturation.[7]

Cleansing efficiency has been one of the issues discussed with regard to preparation techniques. It has been studied extensively, mainly by means of observation of the root canal walls and contents after preparation. Residual pulpal tissue debris is the principal criteria which has been evaluated.[8]

Endodontic instruments may, in themselves vary in their debris removal efficacy and smear layer production due to their specific flute design.[2] Irrigation also plays a key role in successful debridement and disinfection.[9] In the present study, Sodium hypochlorite 3% was used as an irrigant since studies have shown that there is no difference in the bactericidal and tissue dissolving properties between 3% and 5.25% Sodium hypochlorite.

A thoroughly instrumented and cleaned root canal should not be expected to be free from smear layer, debris and pulpal tissue remnants. These factors should not be considered as dominant reasons for preferring one preparation technique over another. The present study recorded debris in all the specimens which is in agreement with reports in which residual debris was observed in canals after instrumentation and irrigation with Sodium hypochlorite.[10,11,12,13,14,15,16]

In this study, efficacy of ProTaper, Mtwo and Twisted files rotary instruments have been evaluated for the removal of debris and smear layer using a scanning electron microscope for evaluation. Several studies have confirmed the ability of rotary Ni-Ti instruments to maintain original root canal curvature and remove debris even in severely curved canals.[17,18,19,20,21,22,23]

In the present study, Mtwo instruments showed superior results in relation to cleaning ability in the coronal and middle third followed by Twisted files and ProTaper rotary instruments. The apical third cleanliness remained almost the same with all the three rotary systems. This could be due to instrument designed to cut more superiorly in the coronal and middle third which further enhanced the irrigant penetration in these areas.

The use of magnification in this study showed better results in the debris scoring in the coronal and middle thirds but the apical score remained the same even with magnification. Even though a difference was seen it was not statistically significant.

In the present study all the three file systems showed similar results with no statistical significance. However Mtwo files showed better results in debris score followed by Twisted files and ProTaper which is in accordance to a study done by Malagino et al. None of the techniques so far has shown debris and smear layer free surface at the apical third of the canal. Further in vitro and in vivo investigation is required to evaluate the efficacy of these instruments in removal of debris and smear layer.

CONCLUSION

i. The use of magnification did not achieve total root canal debridement in any of the rotary instruments

ii. Mtwo rotary instruments produced least amount of debris and smear layer.

iii. ProTaper rotary instruments showed the maximum amount of debris followed by Twisted files rotary instruments

	N	MEAN	S.D	t	P
CORONAL Group I	30	2.0667	1.55216		
Group II	30	2.2000	1.49482	.33900	0.736 ns
MIDDLE Group I	30	2.8000	1.18613		
Group II	30	3.0000	1.11417	.67300	0.504 ns
APICAL Group I	30	3.8000	.76112		
Group II	30	3.8000	.76112	.00000	1 ns

TABLE.1 INTERCOMPARISON OF DEBRIS BETWEEN GROUP I AND II CORONAL, MIDDLE, APICAL.STUDENT 'T' UNPAIRED TEST

	N	MEAN	S.D	H	P
CORONAL					
Subgroup IA	10	2.0000	1.63299	.151	0.927 ns
Subgroup IB	10	2.1000	1.59513		
Subgroup IC	10	2.1000	1.59513		

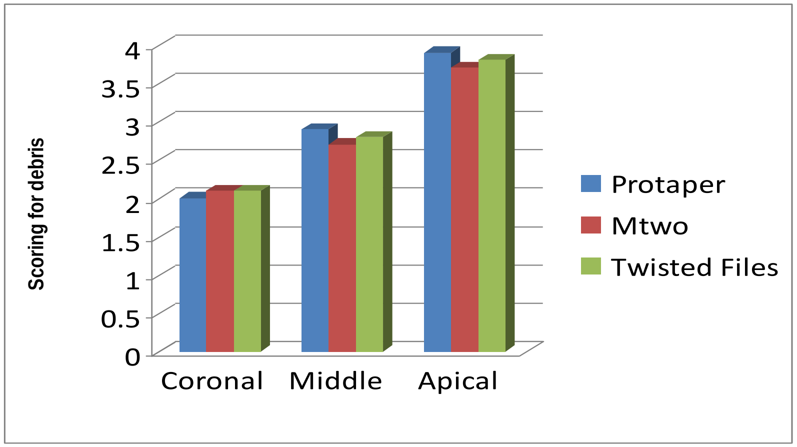
MIDDLE					
Subgroup IA	10	2.9000	1.19722	.483	0.785 ns
Subgroup IB	10	2.7000	1.25167		
Subgroup IC	10	2.8000	1.22927		
APICAL					
Subgroup IA	10	3.9000	.73786	.430	.807 ns
Subgroup IB	10	3.7000	.82327		
Subgroup IC	10	3.8000	.78881		

TABLE.2 INTERCOMPARISON OF DEBRIS BETWEEN SUBGROUP IA, IB, IC (CORONAL, MIDDLE, APICAL) KRUSKAL WALLIS TEST

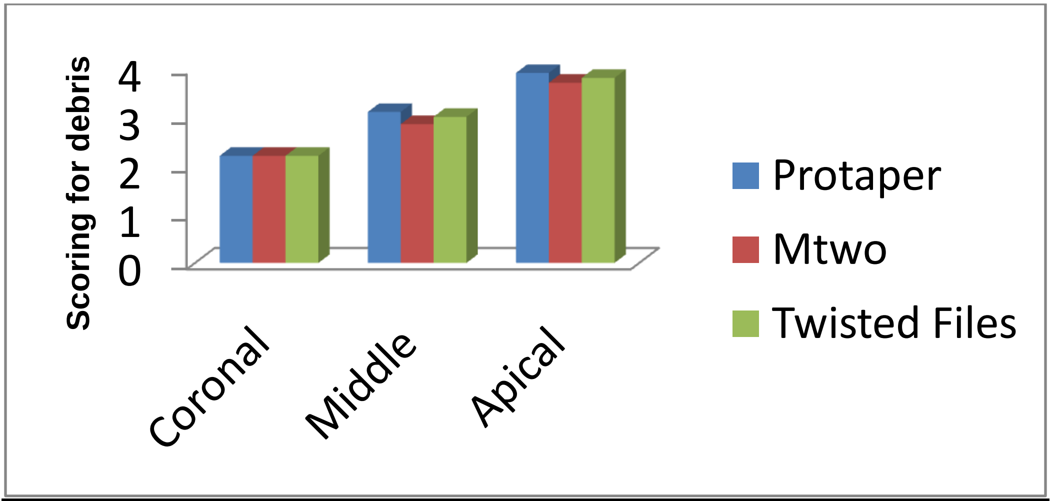
	N	MEAN	S.D	H	P
CORONAL					
Subgroup IIA	10	2.2000	1.54919	.000	1.000

Subgroup IIB	10	2.2000	1.54919		ns
Subgroup IIC	10	2.2000	1.54919		
MIDDLE					
Subgroup IIA	10	3.1000	1.10050	.430	.807 ns
Subgroup IIB	10	2.9000	1.19722		
Subgroup IIC	10	3.0000	1.15470		
APICAL					
Subgroup IIA	10	3.9000	.73786	.430	.807 ns
Subgroup IIB	10	3.7000	.82327		
Subgroup IIC	10	3.8000	.78881		

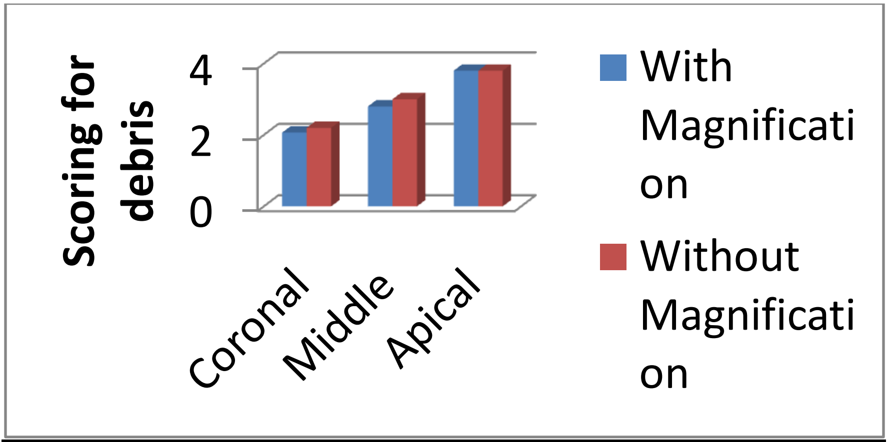
TABLE.3 INTERCOMPARISON OF DEBRIS BETWEEN SUBGROUP IIA, IIB, IIC (CORONAL, MIDDLE, APICAL) KRUSKAL WALLIS TEST



GRAPH.1 BAR DIAGRAM SHOWING THE COMPARISON BETWEEN PROTAPER, Mtwo AND TWISTED FILES WITH MAGNIFICATION.



GRAPH.2 BAR DIAGRAM SHOWING THE COMPARISON BETWEEN PROTAPER Mtwo AND TWISTED FILES WITHOUT MAGNIFICATIO



GRAPH.3 BAR DIAGRAM SHOWING THE COMPARISON BETWEEN MAGNIFICATION AND WITHOUT MAGNIFICATIO

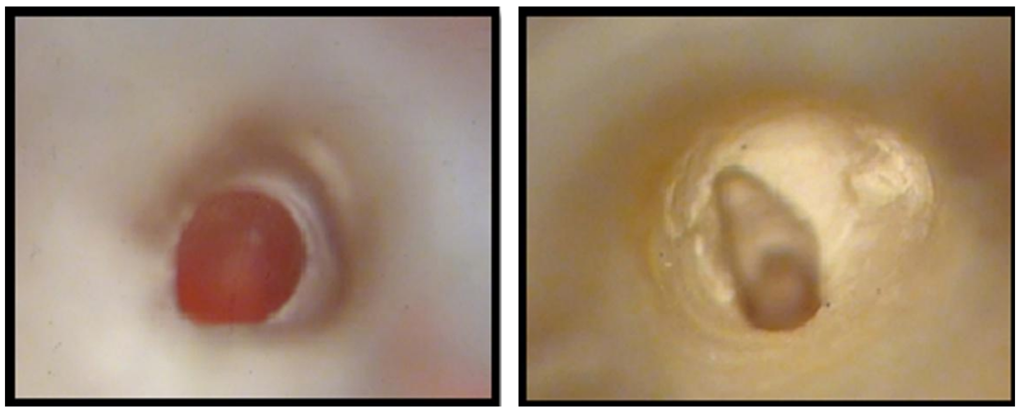


Fig 1: Microscopic pictures

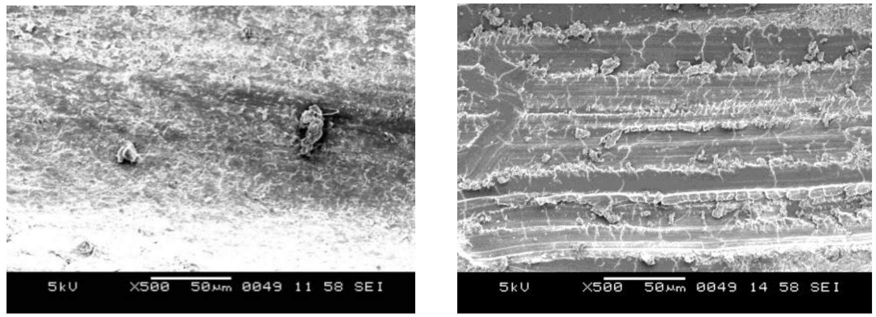
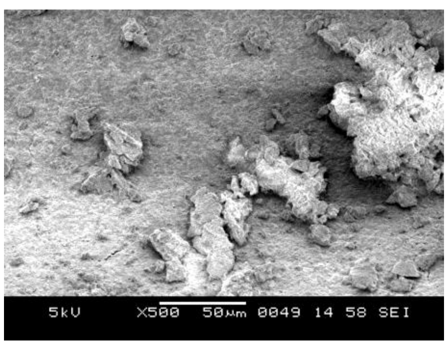


Fig 2: Scanning electron microscopic pictures. (scoring criteria)

1



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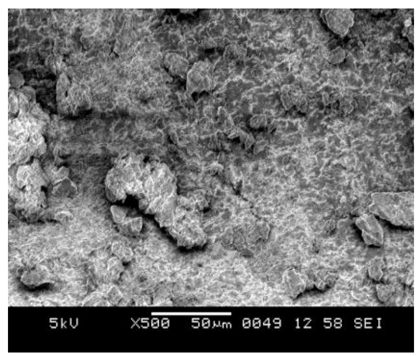

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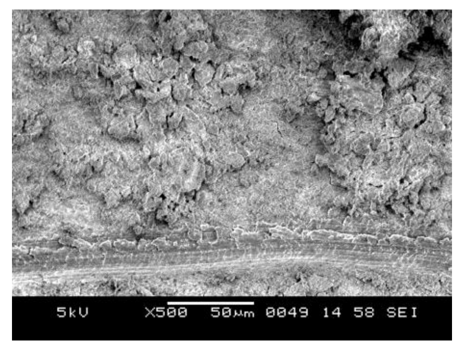

REFERENCES

1. Short JA, Morgan LA, Baumgartner JC. Comparison of canal centering ability of four instrumentation techniques. J Endod 1997;23:503-7
2. Peters OA, Laib A, Gohring TA, Barbakow F. Changes in root canal geometry after preparation assessed by high resolution computed tomography. J Endod 2001;27:1-6
3. Mirriam F. Zaccaro Scelza, Joao Humberto Antoniazzi and Pantaleo Scelza Efficacy of final irrigation - A SEM evaluation. J Endod 2000;26(6):355-8
4. Card SJ, Sigurdsson S, Orstavik D, Trope M. The effectiveness of increased apical enlargement in reducing intracanal bacteria. J Endod 2002;28:779-83.
5. Abou-Rass M, Piccinino M. The effectiveness of four clinical irrigation methods on the removal of root canal debris. Oral Surg 1982;54:323-8.
6. Schilder H. Cleaning and shaping the root canal. Dent Clin North Am 1974;18:269
7. Walton RE. Histologic evaluation of different methods of enlarging the pulp canal space. J Endod 1976:2:304-11.
8. Lim T.S, Wee T.Y, Choi M.Y Koh & Sae Lim.V Light and scanning electron microscopic evaluation of glyde file prep in smear layer removal Int Endod J 2003;36:336-343
9. Nadir Babay. Non diseased dentinal root surface following citric acid or tetracycline hydrochloride conditioning: A scanning electron microscopic study on the effects of ultrasonic irrigation before and after root conditioning. Quintessence Int 1997;28(2):93-7
10. Reynolds MC, Madison S, Walton RE, Krell KV, Rittman BR J. An vitro histological comparison of the step-back, sonic and ultrasonic instrumentation technique in small curved root canals. J Endod 1987;13:307-14

11. Tauber R, Morse OR, Sinai IA, Furst ML. A magnifying lens comparative evaluation of conventional and ultrasonically energized filing. J Endod 1983;9:269-74.
12. Langeland K, Liao K, Pascon EA. Work saving devices in endodontics. efficacy of sonic and ultrasonic techniques. J Endod 1985;11:499-510.
13. Ahmad M, Pitt Ford TR, Crum LA. Ultrasonic debridement of |canals: acoustic streaming and its possible role. J Endod 1987;13:490-9
14. Ahmad M, Pitt Ford TR, Crum LA. Ultrasonic debridement of roo canals: an insight into the mechanisms involved. J Endod 1987;13:93-101
15. Goldman LB, Goldman M, Kronman JH, SunLin P. The efficacy several irrigating solutions for endodontics: a scanning electron microscopic study. Oral Surg 1981;52:197-204.
16. M. Ahlquist, O. Henningsson, K Hultenby Ohlin.The effectiveness of manual and rotary technique in the cleaning of root canals; a scanning electron microscopy study. Int Endod J 2001; 34:533-537.
17. P.V.Abbott, P.Heijkoop,s. C Cardaci, W.R Hume & G.S. Heithersay an SEM study of the effects of different irrigation sequences and ultrasonics. Int Endod J 1991;24: 308-316
18. Craig Baumgartner J and Carson L and Madder a SEM evaluation of four root canal irrigation regimens J Endod 1987; 13(4): 147-157
19. Kochis KA, Walton Re, Lilly JP, Rick L, Rivera EM A histologic comparison of hand and Ni-Ti rotary instrumentation techniques J Endod 1998;24:286 (AAE-abstract or 60)
20. Thompson SA, Dummer PMH Shaping ability of light speed rotary instruments in simulated root canals Part I J Endod 1997; 23:698-702
21. Thompson SA, Dummer PMH Shaping ability of Quantec series 2000 rotary Ni-Ti rotary instruments in simulated root canals Int Endod J 1998;38:259-67
22. Thompson S A, Dummer PMH Shaping ability of HERO 642 rotary Ni-Ti rotary instruments in simulated root canals Part II Int Endod J 2000;33:248-54
23. Kosa D.A, Marshall JG, Baumgartner JC Analysis of canal centering various mechanical instrumentation technique. J Endod1998; 24:274.