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Evaluation of new rotary spreaders for lateral condensation obturation technique (*In vitro* study)

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Abstract

This study was done to evaluate new manufactured rotary spreaders one made from stainless steel material and second from nickel titanium and compared them with conventional finger spreader for their affect on the amount of gutta percha (in mg) that can be applied to fill the root canal and evaluation of apical extension of first, second, third and fourth auxiliary gutta percha cones for the standardized endodontic preparation in the endodontic acrylic training blocks (Endo Training Bloc-L, Dentsply-Maillefer, Ballaigues, Switzerland). In this study these endodontic acrylic blocks were prepared for endodontic filling by using K-files (Densply, Switzerland) starting from size 10 till size 30 in sequential order at working length of 15mm (conventional standardized endodontic preparation). The preparation was performed by using rotary hand piece (W&H; Austria) that can accept K-files with gear of 1:4, the hand piece and acrylic endodontic block were arrange in a surveyor in such a way that the files were at right angle to the surface of endodontic block. The preparation time for each size was 1 minute with 15 second irrigation with isopropyl alcohol perform before and after using each file, then the prepared canal was filled with size 30 master gutta perch then the spreaders of this study was applied for 30sec followed by insertion of auxiliary gutta perch (size 20) and the apical extension of the first, second, third and fourth auxiliary gutta percha were detected and filling procedure was continue till no more auxiliary can be applied to prepared canal at 3mm from its coronal end, the weight of the endodontic blocks were detected before and after endodontic filling by using electronic balance and the difference was calculated for each group of this study which represent amount of gutta percha used inside the canal of endodontic block in milligram. Results showed that there was high statistical significant differences in amount of gutta perch and apical extension of auxiliary gutta percha when using the new rotary spreaders as compared with conventional finger spreader at the $P<0.01$ and also the results showed that there was high statistical significant differences in amount of gutta perch and apical extension of auxiliary gutta percha when using the new rotary nickel titanium spreaders as compared with new stainless steel spreader at the $P<0.01$.

Keywords: Rotary, Spreader, Auxiliary, Gutta percha

Introduction

Endodontic obturation of the instrumented root canal is the final step of an endodontic treatment. Regardless of whether the treatment was undertaken to a vital pulp (pulpectomy), a necrotic and/or infected pulp (root canal therapy) or a previous root canal filling (retreatment), the prime objective of the root filling is to prevent microbial organisms from entering, growing and multiplying in the empty space that resulted from the instrumentation procedure. Endodontic filling also serves as a wound dressing against which healthy periapical tissue can be laid down (Gunnar *et al.,* 2010). There are many techniques for obturating the root canal system: cold lateral condensation, warm vertical condensation, warm lateral condensation, thermo compaction (mechanical and ultrasonic), injection of thermo plasticized gutta percha and chloropercha warm vertical condensation of the root canal space (Pitt Ford *et al.,* 2002).

Lateral condensation technique of endodontic obturation can be performed by using the gutta percha with sealer which had been used for many years and clinical surveys have indicated that it is the most popular method for endodontic obturation (Weine, 1996). It is relatively uncomplicated and simple technique requires a simple armamentarium, and seals and obturates as well as any other technique in conventional situations. A major advantage it has over most other techniques is working length control of

master gutta percha with an apical stop and with careful use of the spreader. Additional advantages include ease of retreatment, positive dimensional stability, adaptation to the canal walls, and the ability to prepare post space, There are no major disadvantages to lateral condensation other than difficulties in obturating an open apex, severely curved canals and canals with internal resorptions (Richard and Mahmoud, 2002). In lateral compaction techniques additional auxiliary gutta percha cones are inserted and compacted laterally around the master cone to reduce the thickness of the sealer layer as much as possible. In this technique, after application of the master cone in position with endodontic sealer, specially designed Spreaders which are long, tapered, pointed instruments are placed in the canal as far apically as possible and should reach to within 1-2mm from the apical end of the endodontic instrumented canal, the master cone is laterally compacted against the wall, then spreader is removed and the first auxiliary point forced fully into place. The canal is obturated in this way until it is not possible to place another auxiliary cone further than 2–3mm into the instrumented canal (Gunnar *et al.,* 2010; Weine, 1996; Richard and Mahmoud, 2002). In this study a new rotary endodontic spreaders with reciprocation motion by endodontic engine (preprogrammed X smart plus, Densply, Switzerland) was constructed from stainless steel and nickel titanium materials to be alternative to conventional endodontic spreader to decrease the application time, less effort in their application, more control apicat introduction inside prepared canal and tighter seal specially at apical one third (5-6mm from apical foramen).

Materials and Methods

In this study 30 curved L-shaped simulated canals in plastic blocks (Endo Training Bloc-L, Dentsply-Maillefer, Ballaigues, Switzerland), the simulated canals were standardized as follows: they were 16.5mm canal long, the foramen diameter was 0.15mm and the initial taper was 0.02.

Endodontic instrumentation: All thirty endodontic acrylic blocks were prepare for endodontic filling by using K-file (Densply, Switzerland) starting from size 10 till size 30 in sequential order at working length of 15mm the (standardized endodontic preparation). The preparation was performed by using rotary hand piece (W&H; Austria) that can accept K -file with gear of 1:4, the hand piece with reaming action (rotation movement) and acrylic endodontic block was arrange in a surveyor in such a way that the files were at right angle to the surface of endodontic block (Figure 1). The preparation time for each size was 1min with 15sec irrigation with isopropyl alcohol perform before and after using each file.

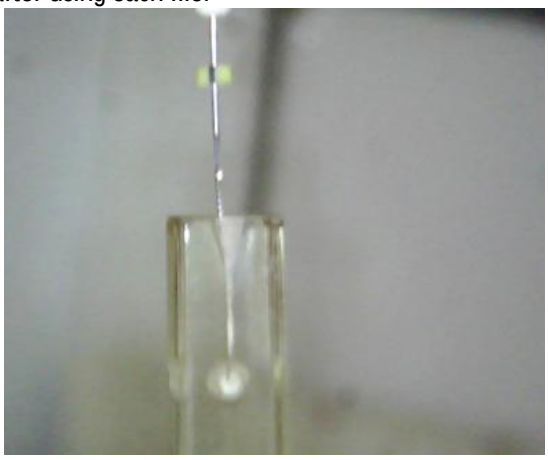

Figure (1): The k-file was applied at right angle to the surface of endo. block

Sample grouping: The thirty instrumented endodontic blocks were divided into three groups:

1-Group I: was filled with gutta percha by lateral condensation technique by using finger Spreader (corresponding to size 20 K-file) with hand use (Figure 2).

2- Group II: was filled with gutta percha by lateral condensation technique by using stainless steel rotary spreader(corresponding to size 20 K-file) hold by hand piece of programmed endodontic engine with reciprocation motion (X smart plus, Densply, Switzerland) (Figure 3).

3- Group III: was filled with gutta percha by lateral condensation technique by using nickel titanium rotary spreader (corresponding to size 20 K-file) hold by hand piece of programmed endodontic engine with reciprocation motion (X smart plus, Densply, Switzerland) (Figure 4).

In each group of this study the apical extension of the first (group I1, group II1 and group III1), second (group I2, group II2 and group III2), third (group I3, group II3 and group III3) and fourth (group I4, group II4 and group III4) auxiliary gutta percha of lateral condensation technique were measured from cervical end to the apical extension into prepared canal after using different types of endodontic spreaders, through the translucent endodontic blocks of this study.

Figure (2): The finger spreader which was used in this study

Figure (3): New stainless steel rotary spreader.

Figure (4): New nickel titanium rotary spreader.

Oburation technique: All the thirty endodontic blocks were obturated by lateral condensation technique with master gutta percha apical cone size 30 and auxiliary gutta percha size 20 by using different endodontic Spreaders of this study for standardization the endodontic sealer was excluded in this study. The time was used for lateral condensation by different types of endodontic spreaders of this study was 30sec, while the insertion time for the auxiliary gutta percha inside the prepared canal was within 30sec after application of different types of endodontic spreaders the application of auxiliary gutta percha was continue till no more auxiliary can be introduced to the 3mm of cervical end of prepared canal (Gunnar *et al.,* 2010; Weine, 1996).

Weight measurements: Each of the thirty endodontic blocks was undergo weight measurements before endodontic obturation and then was undergo weight measurements after endodontic obturation by using Digital electronic balance and the difference in weight measurements were calculated for all groups of this study which represent amount of gutta percha that was used for filling the prepared canals of endodontic blocks.

Statistical analysis: Descriptive (statistical Tables and statistical Figures) and inferential statistics (ANOVA test was used among the groups of this study and LSD test was used between the groups of this study) was used in this study.

Results and Discussion

1-Weight of the gutta percha after obturation by using different types of spreaders of this study: The results showed (Figure 5 and Table 1) that the group III has the highest gutta percha weight while the group I has the lowest gutta percha weight. One-way ANOVA test (Table 2) showed that there was highly statistically significant difference among all the groups at the P value less than 0.01. LSD test (Table 3) showed that the group III has highly statistical significant difference more gutta percha weight as compared with group I and group II and also the results showed that the group II has highly statistical significant difference more gutta percha weight as compared with group I.

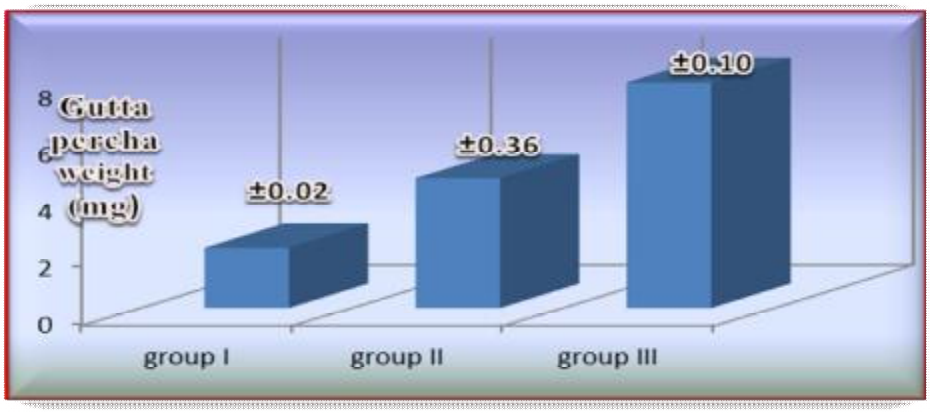

Figure (5): Gutta percha weight (mg) of all groups of this study.

2- Apical extension of the auxiliary gutta percha that was used in obturation by using different types of spreaders of this study:

A - Apical extension of the first auxiliary gutta percha that was used in obturation by using different types of Spreaders of this study: The results showed (Figure 6 and Table 1) that the group III1 has the highest apical extension of the first auxiliary gutta percha while the group I1 has the lowest apical extension of first the auxiliary gutta percha. ANOVA test for the groups of this study for first auxiliary gutta percha showed that there was highly statistical significant difference among these groups (Table 5). LSD test showed that the group III1has highly statistical significant difference more apical extension of the gutta percha as compared with group I1 and group II1, while the group II1 is highly statistical significant difference more apical extension of the gutta percha as compared with group I1(Table 6).

B - Apical extension of the second auxiliary Gutta percha that was used in obturation by using different types of Spreaders of this study: The results showed (Figure 6 and Table 1) that the group III2 has the highest apical extension of the second auxiliary gutta percha while the group I2 has the lowest apical extension of first the auxiliary gutta percha. ANOVA test for the groups of this study for Second auxiliary gutta percha showed that there was highly statistical significant difference among these groups (Table 7). LSD test showed that the group III2 has highly statistical significant difference more apical extension of the gutta percha as compared with group I2 and group II2, while the group II2 is highly statistical significant difference more apical extension of the gutta percha as compared with groupI2 (Table 8).

C - Apical extension of the third auxiliary gutta percha that was used in obturation by using different types of spreaders of this study: The results showed (Figure 6 and Table 1) that the group III3 has the highest apical extension of the third auxiliary gutta percha while the group I3 has the lowest apical extension of third the auxiliary gutta percha. ANOVA test for the groups of this study for third auxiliary gutta percha showed that there was highly statistical significant difference among these groups (Table 9). LSD test showed that the group III3 has highly statistical significant difference more apical extension of the gutta percha as compared with group I3 and group II3, while the group II3 is highly statistical significant difference more apical extension of the gutta percha as compared with groupI3 (Table10).

D - Apical extension of the fourth auxiliary Gutta percha that was used in obturation by using different types of Spreaders of this study: The results showed (Figure 6 and Table 1) that the group III4 has the highest apical extension of the fourth auxiliary gutta percha while the group I4 has the lowest apical extension of first the auxiliary gutta percha. ANOVA test for the groups of this study for forth auxiliary gutta percha showed that there was highly statistical significant difference among these groups (Table 11). LSD test showed that the group III4 has highly statistical significant difference more apical extension of the gutta percha as compared with group I4 and group II4, while the group II4 is highly statistical significant difference more apical extension of the gutta percha as compared with groupI4 (Table12).

Table (1): Mean, standard deviation, maximum and minimum of gutta percha weight (mg) of all groups of this study.

GROUPS	N	Mean	±SD	Maximum	Minimum
Group I	10	2.0980	.01989	2.12	2.05
Group II	10	4.5410	.36115	4.76	3.53
Group III	10	7.8947	.10276	8.09	7.75

Table (2): ANOVA test for gutta percha weight (mg) of all groups of this study.

	Sum of square	df	Mean square	F	P(value)
Between groups	169.391	2	84.695	1797.106	0.000
Within groups	1.272	27	047.		
Total	169.391	29			

d.f.=degree of freedom P-value=probability

Table (3): LSD test to compare gutta percha weight (mg) of all groups of this study.

Comparison: (I)Group X (J)Group	Mean differences(I-J)	Significance
Group III X Group I	5.796	0.000*
Group III X Group II	3.353	0.000*
Group II X Group I	2.443	0.000*

* significant at (P<0.01)

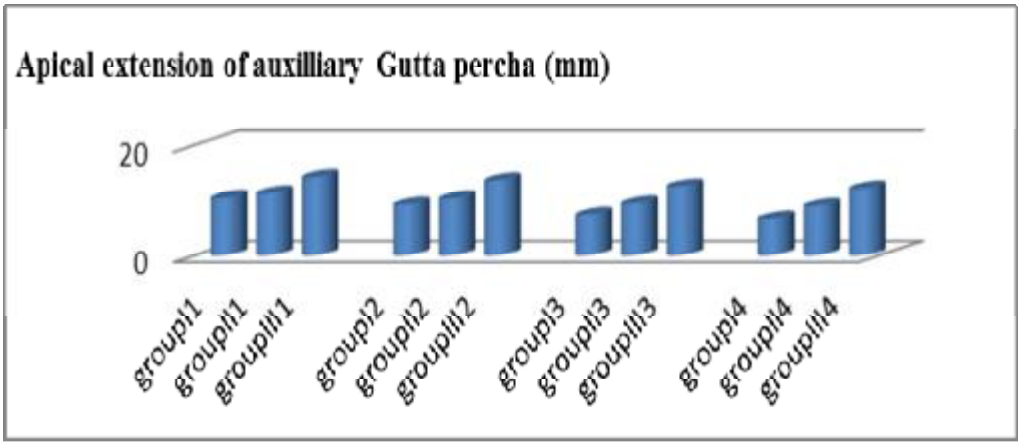

Figure (6): Apical extension of auxiliary gutta percha (mm) f all groups of this study.

Table (4): Apical extension of first, second, third and fourth auxiliary gutta percha (mm) of all groups of this study.

Groups	N.	Mean	±SD
Group I1	10	10.5000	707110.
Group I2	10	9.3000	674950.
Group I3	10	7.4000	516400.
Group I4	10	6.7000	674950.
Group II1	10	11.3000	483050.
Group II2	10	10.4000	516400.
Group II3	10	9.5000	527050.
Group II4	10	9.0500	761940.
Group III1	10	14.3000	483050.
Group III2	10	13.7000	632460.
Group III3	10	12.6000	658280.
Group III4	10	12.2000	78881.0.

Table (5): ANOVA test for apical extension of the gutta perch for group I1, group II1 and group III1.

	Sum of square	df	Mean square	F	P(value)
Between groups	80.267	2	40.133	124.552	000.
Within groups	8.700	27	322.		
Total	88.967	29			

d.f.=degree of freedom P-value=probability

Table (6): LSD test to compare apical extension of the gutta perch for group I1 , group II1 and group III1.

Comparison: (I)Group X (J)Group	Mean differences(I-J)	Significance
Group III1 X Group I1	3.8*	0.000
Group III1 X Group II1	3.0*	0.000
Group II1 X Group I1	0.8*	0.004

* significant at (P<0.01)

Table (7): ANOVA test for apical extension of the gutta perch for group I2, group II2 and group III2.

	Sum of square	df	Mean square	F	P(value)
Between groups	104.867	2	52.433	140.168	000.
Within groups	10.100	27	374.		
Total	114.967	29			

d.f.=degree of freedom P-value=probability

Table (8): LSD test to compare apical extension of the gutta perch for group I2, group II2 and group III2.

Comparison: (I)Group X (J)Group	Mean differences(I-J)	Significance
Group III2 X Group I2	4.4*	0.00
Group III2 X Group II2	3.3*	0.00
Group II2 X Group I2	1.1*	0.00

* significant at (P<0.01)

Table (9): ANOVA test for apical extension of the gutta perch for group I3, group II3 and group III3.

	Sum of square	df	Mean square	F	P(value)
Between groups	136.867	2	68.433	209.966	000.
Within groups	8.800	27	326.		
Total	145.667	29			

d.f.=degree of freedom P-value=probability

Table (10): LSD test to compare apical extension of the gutta perch for group I3 , group II3 and group III3.

Comparison: (I)Group X (J)Group	Mean differences(I-J)	Significance
Group III3 X Group I3	5.2*	0.00
Group III3 X Group II3	3.1*	0.00
Group II3 X Group I3	2.1*	0.00

* significant at (P<0.01)

Table (11): ANOVA test for apical extension of the gutta perch for group I4, group II4 and group III4.

	Sum of square	df	Mean square	F	P(value)
Between groups	152.317	2	76.158	137.774	000.
Within groups	14.925	27	553.		
Total	167.242	29			

d.f.=degree of freedom, P-value=probability

Table (12): LSD test to compare apical extension of the gutta perch for group I4 , group II4 and group III4.

Comparison (I)Group X (J)Group	Mean differences(I-J)	Significance
Group III4 X Group I4	5.5*	0.00
Group III4 X Group II4	3.15*	0.00
Group II4 X Group I4	2.3*	0.00

* significant at (P<0.01)

Allison *et al.* (1979) were the first scientist who draw attention towards correlation between Spreader depth of penetration, canal preparation and quality of apical obturation, they showed that the microleakage extended close to the point where the tip of spreader had penetrated. Also, Allison *et al.* (1981) had noticed that the fitting master cone with tag back not critical to establish a fluid tight seal since master cone fitted to within 1mm of the working length with slight friction fit (Allison *et al.*, 1979; Allison *et al.*, 1981). Walton *et al.* (1996) said that the finger Spreader made from stainless steel is more flexible than handled Spreader they showed that the handled Spreaders wouldn't negotiate

curved canal and the finger spreaders are better suitable for obturation of the curved canal rather than handled spreaders. Gound *et al.* (2001) conducted a study using nickel titanium finger spreader of size fine-medium or fine during obturation of curved canal in acrylic blocks, they found that when size 25 accessory cone is used, it penetrates deeper than conventional accessory cones of equal size of spreaders. In this study the nickel titanium spreader was used which made from M wire and offers greater flexibility and resistance to cyclic fatigue than traditional nickel titanium and stainless steel material, thus the results of this study showed that the rotary the new nickel titanium spreader used to obturation endodontic blocks gave more amount of the gutta perch inside the prepared canal and more apical extension of the first, second, third and fourth auxiliary gutta perch than new stainless steel rotary spreader of this study. Both spreader has been used with reciprocation motion. In the reciprocation motion repetitive back and forth motion or clockwise (CW) and counter clockwise (CCW) rotation which reduce the torsional stress by periodically reversing the rotation of the intracanal instruments (Johnson *et al.,* 2008; Kim *et al.,* 2012) and reduces various risks associated with continuous rotation intracanal instrument through curved canals and increase the lifespan of the intracanal instrument (Ruddle, 2012; Pedulla *et al.,* 2013). The results of this study showed also that both new nickel titanium spreader and new stainless steel rotary spreader gave more amount of the gutta perch inside the prepared canal and more apical extension of the first, second, third and fourth auxiliary gutta perch conventional Spreader with hand use, this results agree with results of Ground *et al.* (2000) described a modification of lateral condensation of gutta percha called mechanical lateral condensation placed alongside the master cone in a reciprocation action hand piece which was used to laterally displace cold gutta percha creating space for fine-fine accessory cones. Rotation of Spreader, in a reciprocating action, with apical pressure used to penetrate to within 1mm from the working length and deform the mater cone, and the resulting a heavier fill.

Conclusions

When conventional lateral condensation of gutta percha compared with rotary reciprocation lateral condensation, the new technique produces heavier fill and greater depth of penetration of auxiliary gutta percha cones than the conventional lateral condensation, thus possibility of tight apical seal and success rate of endodotic obturation will be higher. More evaluation studies is required for detection the efficiency of these new intracanal spreaders.

References

Allison, D.A.; Weber, C.T. and Walton, R.E. 1979. The influence of the method of canal preparation on the quality of apical and coronal obturation. J. Endod., 5: 298-304.

Allison, D.A.; Michlich, R. and Walton, R.E. 1981. The influence of master cone adaptation on the quality of the apical seal. J. Endod., 7(2): 61-65.

Ground, T.G. , Riehn, R.J. , Makkawy, H.A. Odgaard, E.C. 2000. A description of an alternative method of lateral condensation and a comparison of the ability to obturate canals using mechanical or traditional lateral condensation. J. Endod., 26(12): 756-759.

Ground, T.G.; Riehm, R.J.; Odgaard, E.C. and Makkawy, H. 2001. Effect of Spreader and accessory cones size on density of obturation using conventional or mechanical lateral condensation. J. Endod., 27(5): 358-361.

Gunnar B.; Preben, H.B. and Claes, R. 2010. Textbook of Endodontology, 2nd ed., Oxford, UK: Blackwell Munksgaard.

Johnson, E.; Lloyd, A.; Kuttler, S. and Namerow, K. 2008. Comparison between a noval nickel-titanium alloy and 508 nitinol on the cyclic fatigue life of ProFile 25/04 rotary instruments. J. Endo., 34(11): 1406-1409.

Kim, H.C.; Kwak S.W.; Cheung, G.S.; Ko, D.H.; Chung, S.M. and Lee, W. 2012. Cyclic fatigue and torsional resistance of two new nickel titanium instruments used in reciprocation motion: Reciproc. Versus Waveone. J. Endo., 38(4): 541-544.

Pedulla, E.; Grande, N.M.; Plotino, G.; Gambarini, G. and Rapisarda, F. Influence of continuous or reciprocating motion on cyclic fatigue resistance of 4 different nickel-titanium rotary instruments. J. Endod., 39: 258-261.

Pitt Ford, T.R.; Rhodes, J.S. and Pitt Ford, H.E. 2002. Endodontics: Problem-solving in clinical practice.

Richard, E. and Mahmoud, T. 2002. Principles and Practice of Endodontics, 3rd ed., ISBN-10 / ASIN: 0721691609.

Ruddle, C.J. 2012. Endodontic canal preparation, Wave one single-file technique. Dentistry Today, 1: 1-7.

Walton, R.E. 1996. Principles and Practice of Endodontics. 2th ed., Philadelphia, WB Saunders Co.

Weine, F.S. 1996. Endodontic therapy, 5th ed., St. Louis CV Mosby Co., Chp.7, 306-340pp.