

## Original Research

### Comparison of cleaning efficacy of two niti single file system-reciproc and trunatomy-An in vitro study

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#### ABSTRACT:

**Aim:** To evaluate cleaning efficacy of two NiTi single files reciprocating (Reciproc) and rotary files (Trunatomy) using stereomicroscope. **Methodology:** 60 single-rooted freshly extracted teeth were selected and divided into 3 groups. For each group, all root canals were shaped with 2 different NiTi instruments (Trunatomy and Reciproc) and irrigated with 5.25% NaOCl and 17% ethylenediaminetetraacetic acid (EDTA). Specimens were sectioned buccolingually and examined under stereomicroscope. The presence/absence of debris canal were evaluated using two 5-step scales for scores. **Results:** Root canal instrumentation done with Group A (Reciproc) resulted in significantly less debris on root canal walls as compared to Group B (Trunatomy) and Group C (instrumented). **Conclusion:** The innovative reciprocating system (Reciproc) showed better canal cleaning ability when compared to Trunatomy (rotary system).

**Keywords:** Trunatomy, Reciproc, stereomicroscope

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#### INTRODUCTION

The successful endodontic therapy depends on the complete elimination and debridement of microorganisms within the root canal system, thereby preventing reinfection of canals.<sup>1</sup> To achieve these objectives, pulpal remnants and debris must be thoroughly and completely removed from the root canal wall.<sup>2</sup>

Root canal preparation is performed with files, reamers, sonic instruments or mechanical apparatus and with nickel titanium (Ni-Ti) instruments. Since most hand techniques are time consuming and may lead to iatrogenic errors (i.e ledging, zipping, canal transportation and apical blockage), much attention has been directed towards root canal preparation with NiTi rotary instruments. The design and flexibility of nickel titanium alloy allow these files to preserve the original anatomy of root canal and reduce procedural errors.<sup>3</sup>

Various single file systems with different metallurgy and design characteristics have been promoted to prepare the root canals with one instrument using

either continuous rotation or reciprocation motion which is safe for canal preparation, even in severely curved root canals.<sup>4</sup>

In recent years, several novel thermomechanical processing and manufacturing technologies have been developed to optimize the microstructure of NiTi alloys, in order to improve their mechanical properties and root canal preparation quality.<sup>5</sup>

Recently Trunatomy NiTi rotary system was introduced Dentsply Sirona, Maillefer, Ballaigues, Switzerland in year 2020. This file system has been developed with novel type of heat treated NiTi instrument with special design.

This file system is manufactured from a 0.8mm NiTi wire instead of 1.2mm NiTi wire that is used to manufacture most generic files and exhibits off-centred parallelogram cross section.<sup>6</sup>

In many other systems, the NiTi rotary system appears to have some drawbacks

This led to the revolution of single-file NiTi reciprocating systems, which has been adopted by Dr. Yared. In 2010 Reciproc (RC, VDW, Munich,

Germany) was commercially introduced into the market.<sup>7</sup> It has S shaped cross-section with regressive taper (Fig. 2). It is made of M wire technology.<sup>1</sup> The single-file Ni Ti system consists of three files, including the R25 (ISO 25; 8%), R40 (ISO 40; 6%), and R50 (ISO 50; 5%).<sup>8</sup>

This has many advantages over the conventional rotary NiTi systems:

1. greater time efficiency because it requires only a single file to prepare all the canals.
2. single files are made from M-wire, that give them the greatest flexibility and cyclic fatigue resistance; and
3. reciprocating systems move in rotating reciprocation movements (balanced force).

One movement is counter-clock wise, which engages and cuts dentin, and the other is clock-wise, which disengages the file from the dentin to avoid taper lock and relieves stress on the file. This type of movement prevents file breakage and increases its resistance to both cyclic and torsional fatigue.<sup>9</sup>

Though various studies have been done on NiTi rotary systems for cyclic fatigue, error reduction during root canal preparation, and preservation of root canal shape, less literature is present on Trunatomy files.

Hence, this study intends to compare cleaning efficacy of two NiTi single rotary files i.e (Trunatomy) and reciprocating files (Reciproc blue) using stereomicroscope.

#### AIM

To evaluate cleaning efficacy of two NiTi single files reciprocating (Reciproc) and rotary files(Trunatomy) using stereomicroscope

#### MATERIALS AND METHOD

##### TOOTH SELECTION

A total of 60 extracted premolars with straight single roots were selected. Teeth with double canals, fractures, calcification and internal resorption were excluded from this study.

##### PREPARATION OF SPECIMEN

All the samples selected were cleaned using ultrasonic scaler, followed by placement of each sample in modelling wax for stable support. Coronal access was completed using access cavity bur (SS White), and working length was determined using 10/15 K files and working length was confirmed using RVG. All teeth were randomly assigned in three equal groups of 20 samples each according to the instrumentation system used.

Group A (n=20): Reciproc

Group B (n=20): Trunatomy

Group C (n=20): Uninstrumented

##### ROOT CANAL INSTRUMENTATION

Root canal preparation was done using Ai Motopexendomoto in both test groups with speed and torque adjusted according to manufacturer's

instruction. All samples were prepared by the same operator, and each instrument was used for four samples after which it was discarded.

##### GROUP A (N=20): RECIPROC

The samples in this group were instrumented with primary file R25(0.08 taper) Reciproc (RC, VDW, Munich Germany) using endodontic motor at speed 300 rpm, and motion was kept at counterclockwise (CCW) = 150° and clockwise (CW) = 30°. After each instrumentation irrigation was done using 3ml of 3 % sodium hypochlorite, followed by 17 % EDTA for 1 min using 5 ml syringe. After complete cleaning and shaping final irrigation was done using sodium hypochlorite.

##### GROUP B (N=20): TRUNATOMY

Samples in this group were instrumented with Trunatomy Prime (Dentstply): same irrigation protocol i.e 3ml of 3 % sodium hypochlorite, followed by 17 % EDTA for 1 min using 5 ml syringe followed by complete cleaning and shaping final irrigation was done using Sodium hypochlorite.

##### GROUP C (N=20): NO INSTRUMENTATION

Samples in this group were left uninstrumented.

At the end of instrumentation, all the teeth were dried with paper points Later the samples were decoronated and sectioned buccolingually using double faced diamond disk for evaluation under stereomicroscope.

##### DEBRIS SCORE

Hulsmann scores were used for evaluation of canal cleanliness.<sup>10</sup>

The Stereomicroscope images were analyzed using the following 5 score index

Score 1-clean root canal wall only a few debris present

Score 2 –few agglomerations of debris covering

Score 3- many agglomerations of debris covering<50%of root canal wall

Score 4 - >50%of root canal wall covered by debris

Score 5- complete or nearly complete root canal wall covered by debris

##### STATISTICAL ANALYSIS

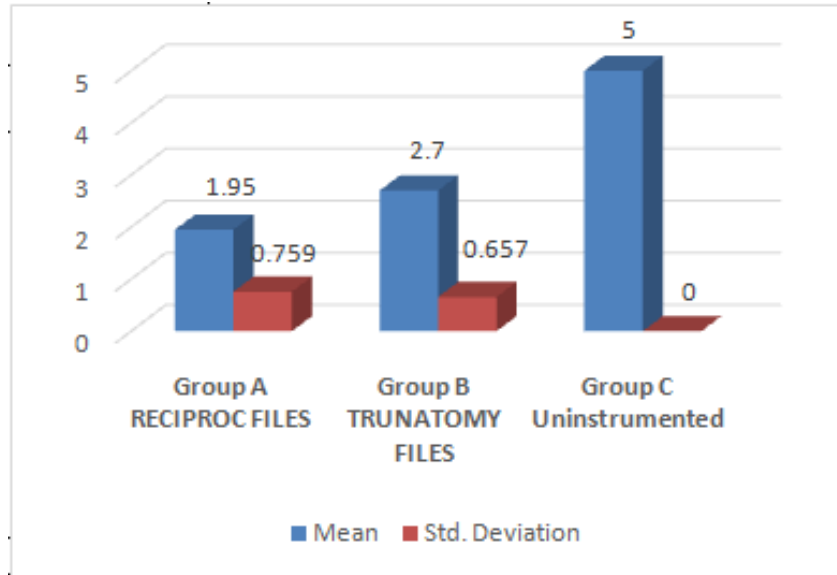
The data obtained was compiled in Microsoft excel sheet. To compare the mean debris score between the 3 groups ANOVA (Analysis of Variance) with Post Hoc Bonferroni Test was applied. To assess the difference in proportion of variable debris scores between the groups Kruskal-Wallis Test was applied.

##### RESULTS

The mean debris score in Group A(Reciproc) was **1.95 ± .759**, in Group B(TruNatomy) was **2.70 ± .656** and in Group C (Uninstrumented) was **5**. Root canal instrumentation done with Group A (Reciproc) resulted in significantly less debris on root canal walls

as compared to Group B (Trunatomy) and Group C (instrumented).

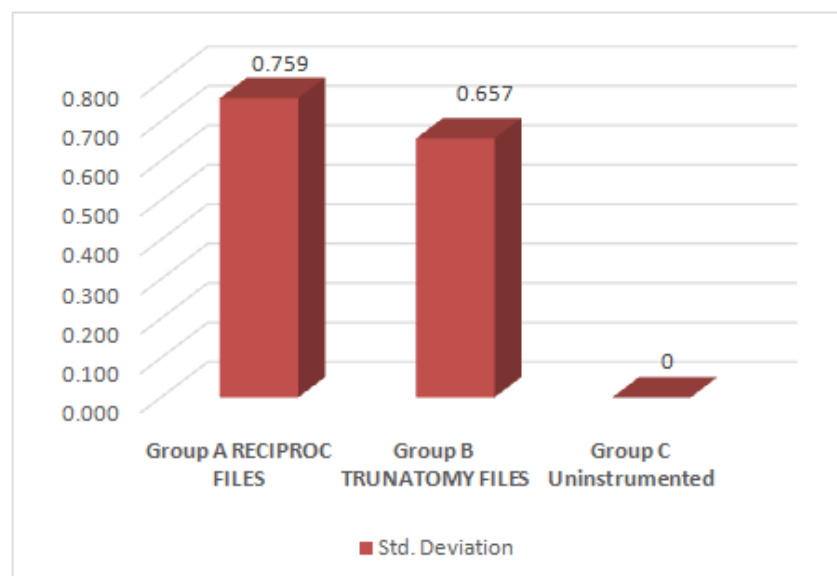
Group	Mean	Median	Std. Deviation
Group A RECIPROC FILES	1.9500	2.0000	.75915
Group B TRUNATOMY FILES	2.7000	3.0000	.65695
Group C Uninstrumented	5.0000	5.0000	.00000



When the mean debris score was compared between the 3 groups, it was found that there was significant difference between the groups.

In pair wise comparison the mean difference in debris score between Group A & Group B was -.750 which was statistically significant ( $p < 0.05$ ) and in between Group A & Group C was -3.050 which was statistically significant ( $p < 0.05$ ) and between Group B & Group C was -2.300 which was also statistically significant ( $p < 0.05$ ).

Multiple Comparisons			
Dependent Variable: Debris Score			
Bonferroni			
(I) Group	(J) Group	Mean Difference (I-J)	P value
Group A RECIPROC FILES	Group B TRUNATOMY FILES	-.75000*	.000
	Group C Uninstrumented	-3.05000*	.000
Group B TRUNATOMY FILES	Group C Uninstrumented	-2.30000*	.000



## DISCUSSION

In the present study, 60 premolars with straight roots were used and tooth with calcification, double canals and internal resorption were excluded to limit the bias. Performing the study on real canals of human teeth allowed us to experience clinical situation as far as possible because of the similarity in canal cross section, the dentin hardness and its surface texture. Since preparations were performed using different file design, care was exercised to ensure that nearly identical preparation was used in the study groups. One practitioner carried out the procedure for the purpose of standardization.

All the instruments were used 4 times after which they were discarded.<sup>11</sup> **Tripi et al.**<sup>75</sup> have also reported, by means of scanning electron microscopy, that instruments of the Reciproc and WaveOne systems may be used in approximately 5 canals without significant alterations occurring on their surface, suggesting the possibility of reusing the instruments. Probably this was the primary reason for no evidence of file deformation or fracture in the present study.

Debris comprises dentin chips, residual vital or necrotic pulp tissue attached to root canal walls, which is considered infected, and could cause reinfection of the root canal.<sup>15</sup> Hence debris was used as criteria to assess cleaning efficacy of different instruments in this study. In the present study, cleaning efficacy was examined on the basis of numerical evaluation scheme for debris by (**Haikel & Allemann in 1988, Hulsmann et al 1997**)<sup>15</sup> under stereomicroscope.

All NiTi instruments have been shown to produce moderate to heavy smear layers that need to be removed with the use of irrigation solutions.<sup>12</sup> An irrigation regimen similar to methodology proposed by **Foschi et al.**<sup>13</sup> was used for this study, with alternation of Ethylenediamine tetraacetic acid (EDTA) and sodium hypochlorite (NaOCL) at each change of instruments. Thus, it should be accentuated that the cleaning efficacy of the instruments evaluated in the present investigation might be enhanced using combination of NaOCL and EDTA as chelating agent. The association of NaOCL and EDTA is the gold standard in chemo mechanical preparation of root canals.<sup>12</sup> EDTA acts upon the inorganic components of the smear layer, decalcifies the peritubular and intertubular dentin and leaves collagen exposed. Subsequently use of NaOCL dissolves collagen, leaving the entrance of dentinal tubules more open and exposed.<sup>14</sup>

Both the file systems used in this study showed partially un-instrumented areas with debris remaining in all canal samples. This is in agreement with studies by **Bolanos & Jensen**<sup>15</sup>, **Hu'smann et al.**<sup>10</sup>, **Prati et al.**<sup>16</sup>, **Fornari et al**<sup>17</sup>, **Haapasalo et al.**<sup>18</sup>, **Paque' et al.**<sup>19</sup>, **Bu'rklein et al.**<sup>11</sup>, **Zmener et al.**<sup>20</sup> who also concluded presence of debris in canal space even after instrumentation.

Further this finding is consistent with the investigations of **Peters et al.**<sup>21</sup>, **Tasdemir et al.**<sup>22</sup>,

**Gekelman et al.**<sup>23</sup>, **Paque' et al.**<sup>19</sup> using microcomputer tomography assessment of canal shapes. **Hu'smann et al. in 2003**<sup>24</sup>, **Paque' et al. in 2005**<sup>25</sup> therefore concluded that sufficient disinfection and copious irrigation are essential to improve root canal cleanliness.

Previous studies done by **Surakanti et al. in 2020**<sup>1</sup> is in agreement with our finding that cleaning ability of Reciproc was better when compared to WaveOne gold file system which can be attributed to the differences in the cross-sectional design of the files. Both files used were single file system and work in reciprocating motion.

Another study done by **Ramazani N et al in 2016**<sup>26</sup> showed similar results. Based on the results of their study they concluded Reciproc (reciprocating motion) had good cleaning efficacy when compared to MTwo (rotary motion) and K files.

The results of this study is also similar to the study by **Burklien et al 2012**<sup>11</sup> which compared Reciproc and WaveOne (reciprocating instruments) versus Protaper and MTwo (continuous rotating instruments) using SEM and concluded that Reciprocating instruments resulted in better cleanliness. It is important to note that EDTA was not used in their study. Irrigation was done using NaOCL only avoiding influence of other irrigation solutions. This certainly may have affected overall results. Few more studies done by **Berrutti et al.**<sup>27</sup>, **You YS and Cho YB**<sup>28</sup>, **Bandekar et a**<sup>29</sup>, **Katge et al**<sup>30</sup> are in agreement with present study results.

However, previous study by **Carvalho et al**<sup>31</sup> which compared Reciproc and Protaper for cleaning effectiveness concluded that reciprocating single file system and full sequence rotary instrumentation system promoted similar effectiveness, one of the reasons for which can be the use of distilled water for irrigation. This is in disagreement with the present study where Reciproc showed better debris removal than TruNatomy files where EDTA and NaOCl were used for irrigation.

Another study done by **P Claudio et al 2014**<sup>12</sup> compared M two and Reciproc and concluded that MTwo presented significantly lower smear layer than that of Reciproc group using SEM.

In the present study both file systems have demonstrated relatively cleaner root canals. However, use of Group A Reciproc resulted in significantly less debris with that in Group B i.e TruNatomy files which may be because of the differences in cross-sectional design of files, Reciproc which has 'S' shaped cross section while TruNatomy has off centered parallelogram.

However, another clinical aspect of this study when using single file system is, irrigation time and chemical debridement is reduced. To overcome this minimal irrigation time especially with Reciproc system additional activation of irrigation is advised which may improve chemical dissolution of residual debris ensuring complete disinfection.

Since the present study is in vitro, due to its great difference from clinical circumstances is one limitation of the study and should be taken in account in future studies. It is of great importance to emphasize that the results derived from our study cannot be generalized to other instrumentation files with different characteristic designs.

However more in vitro studies are required for further use of this file systems and its efficacy in cleaning of the root canals. By far no studies have compared cleaning efficacy of these two file system i.e Reciproc and Trunatomy.

Therefore, this study was undertaken to enhance cleaning and shaping of root canals in the field of endodontics.

However, there are certain limitations of the present study:

1. It is an vitro study, which does not mimic patients actual oral environment. Further in vivo studies are required for better and more precise conditions to develop consistent comparison in between tested groups.
2. Samples used in this study were single rooted premolars with straight canals, but further investigation is required for teeth with complex anatomy like curved roots, isthmus areas and multiple rooted teeth.

## CONCLUSION

Within the limitations of present study, the following conclusions are drawn:

- Both reciprocating system (Reciproc) and rotary system (Trunatomy) are efficient in cleaning root canals and showed significant difference in cleaning efficiency when compared to control group.
- The innovative reciprocating system (Reciproc) showed better canal cleaning ability when compared to Trunatomy (rotary system).
- Both instruments Reciproc and Trunatomy instrument can be used to complete the preparation of root canals.

## REFERENCES

1. Surakanti JR, Punna R, Vanapatla A, Vemisetty H, Sajja NP, Nidumukkala TP. Comparative evaluation of cleaning ability of reciproc and waveonegold reciprocating file systems – A scanning electron microscopic study. *Indian J Dent Sci.* 2018;10:98-101
2. Hülsmann M, Schade M, Schäfers F. A comparative study of root canal preparation with Hero 642 and Quantec SC rotary Ni-Ti instruments. *Int EndodJ.* 2001;34:538–546.
3. Walton R.E., Torabinejad M. 3rd ed. Saunders Company; 2002. Principles and Practice of Endodontics. p.222.
4. Shaheen NA. The efficacy of different single file systems in cleaning oval shaped root canal. *Tanta Dent J.* 2019;16:73-9
5. Duke F, Shen Y, Zhou H, Ruse ND, Wang ZJ, Hieawy A, Haapasalo M. Cyclic fatigue of ProFile vortex and

vortex blue nickel-titanium files in single and double curvatures. *J Endod.* 2015;41(10):1686–90.

6. Kiran K K, Hemant V, Pujar Madhu A, Tamase Aishwarya S, Umesh S, Comparative evaluation of shaping ability of trunatomy and protaper gold files in curved canals using cone beam computed tomography: An invitro study. *IP Indian J ConservEndod* 2021;6(2):101-105.
7. Alsilani R, Jadu F, Bogari F, Jan MA, AlhazzaiTY. Single file reciprocating system: A systemic review and meta-analysis of the literature: Comparison of r eciproc and WaveOne. *J Int Soc Prevent Comminit Dent.* 2016;6: 402-9.
8. Gutmann JL, Gao Y. Alternation in inherent metallic and surface properties of nickel titanium root canal intruments to enhance performance, durability and safety: A focussedreview. *IntEndod J.* 2012;45:113-28.
9. Saber SE, Nagy MM, Schafer E. Comparative evaluation of the shaping ability of WaveOne, Reciproc and OneShape single-file systems in severely curved root canals of extracted teeth. *Int Endod J.* 2015;48: 109–14
10. Hülsmann M, Rummelin C, Schäfers F. Root canal cleanliness after preparation with different endodontic handpieces and hand instruments: a comparative SEM investigation. *J Endod.* 1997;23(5):301-6.
11. Bürklein S, Hinschitza K, Dammaschke T, Schäfer E. Shaping ability and cleaning effectiveness of two single-file systems in severely curved root canals of extracted teeth: Reciproc and WaveOne versus Mtwo and ProTaper. *Int Endod J.* 2012;45(5): 449-61.
12. Poggio C, Dagna A, Chiesa M, Scribante A, Beltrami R, Colombo M. Effects of NiTi rotary and reciprocating instruments on debris and smear layer scores: an SEM evaluation. *J Appl BiomaterFunct Mater.* 2014 Dec 30;12(3): 256-62.
13. Foschi F, Nucci C, Montebugnoli L, et al. SEM evaluation of canal wall dentine following use of Mtwo and ProTaper NiTi rotary instruments. *Int Endod J.* 2004; 37(12): 832-839
14. Wadhvani KK, Tikku AP, Chandra A, Shakya VK. A comparative evaluation of smear layer removal using two rotary instrument systems with ethylenediaminetetraacetic acid in different states: a SEM study. *Indian J Dent Res.* 2011; 22(1): 10-15.
15. Bolanos OR, Jensen JR. Scanning electron microscope comparisons of the efficacy of various methods of root canal preparation. *J Endod.* 1980;6(11):815-22.
16. Prati C, Foschi F, Nucci C, Montebugnoli L, Marchionni S. Appearance of the root canal walls after preparation with NiTi rotary instruments: a comparative SEM investigation. *Clin Oral Investig.* 2004;8(2):102-10.
17. Fornari VJ, Silva-Sousa YT, Vanni JR, Pe´cora JD, Versiani MA, Sousa-Neto MD. Histological evaluation of the effectiveness of increased apical enlargement for cleaning the apical third of curved canals. *International Endodontic Journal.* 2020;49:88–94.
18. Haapasalo M, Endal U, Zandi H, Coil JM. Eradication of endodontic infection by instrumentation and irrigation solutions. *Endodontic Topics.* 2005;10: 77–102.
19. Paqué F, Ganahl D, Peters OA. Effects of root canal preparation on apical geometry assessed by micro-computed tomography. *J Endod.* 2009 J;35(7):1056-9.
20. Zmener O, Pameijer CH, Alvarez Serrano S, Hernandez SR. Cleaning efficacy using two engine-driven systems

- versus manual instrumentation in curved root canals: a scanning electron microscopic study. *J Endod.* 2011 Sep;37(9):1279-82.
21. Peters OA, Schönenberger K, Laib A. Effects of four Ni-Ti preparation techniques on root canal geometry assessed by micro computed tomography. *Int Endod J.* 2001;34(3):221-30.
  22. Taşdemir T, Aydemir H, Inan U, Unal O. Canal preparation with Hero 642 rotary Ni-Ti instruments compared with stainless steel hand K-file assessed using computed tomography. *Int Endod J.* 2005;38(6):402-8.
  23. Gekelman D, Ramamurthy R, Mirfarsi S, Paqué F, Peters OA. Rotary nickel-titanium GT and ProTaper files for root canal shaping by novice operators: a radiographic and micro-computed tomography evaluation. *J Endod.* 2009;35(11):1584-8.
  24. Hülsmann M, Gressmann G, Schäfers F. A comparative study of root canal preparation using FlexMaster and HERO 642 rotary Ni-Ti instruments. *Int Endod J.* 2003;36(5):358-66.
  25. Paqué F, Musch U, Hülsmann M. Comparison of root canal preparation using RaCe and ProTaper rotary Ni-Ti instruments. *Int Endod J.* 2005;38(1):8-16.
  26. Ramazani N, Mohammadi A, Amirabadi F, Ramazani M, Ehsani F. In vitro investigation of the cleaning efficacy, shaping ability, preparation time and file deformation of continuous rotary, reciprocating rotary and manual instrumentations in primary molars. *J Dent Res Dent Clin Dent Prospects.* 2016;10(1):49-56.
  27. Dhingra A, Nagar N, Sapra V. Influence of the glide path on various parameters of root canal prepared with WaveOne reciprocating file using cone beam computed tomography. *Dent Res J* 2015;12: 534-40.
  28. Yoo YS, Cho YB. A comparison of the shaping ability of reciprocating NiTi instruments in simulated curved canals. *Restor Dent Endod.* 2012;37(4):220-7.
  29. Bandekar S, Medha A, Patil S, Sathawane N, Aurangabdkar A. *In vitro* comparison of cleaning ability of OneShape and WaveOne rotary systems. *Int J Cur Res* 2016;10(8): 1-4.
  30. Katge F, Patil D, Poojari M, Pimpale J, Shitoot A, Rusawat B. Comparison of instrumentation time and cleaning efficacy of manual instrumentation, rotary systems and reciprocating systems in primary teeth: An in vitro study. *J Indian Soc PedodPrev Dent* 2014;32: 3-6.
  31. Carvalho MS, Sponchiado EC Junior, Garrido ADB, Garcia LDFR, Marques AAF. Histological evaluation of the cleaning effectiveness of two reciprocating single-file systems in severely curved root canals: Reciproc versus WaveOne. *European Journal of Dentistry.* 2015;9(1): 80-86.