How to Cite:
Galande, S., Mattigatti, S., Wahane, K., Mahaparale, R., Yadav, N., & Raut, S. (2022). Analysis of apical extrusion of debris using one curve, Confi Taper, Trushape® 3D conforming and reciproc blue files: An in vitro comparative study. *International Journal of Health Sciences*, *6*(S6), 5581–5591. https://doi.org/10.53730/ijhs.v6nS6.10856

Analysis of apical extrusion of debris using one curve, Confi Taper, Trushape® 3D conforming and reciproc blue files: An in vitro comparative study

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Abstract---Aim: To evaluate and compare apical extrusion of debris using One Curve, Confi Taper, TRUShape®3D Conforming and Reciproc Blue file systems. Methods: 60 extracted single rooted

mandibular premolar human teeth were randomly divided into 4 groups (n=15). Premolars were instrumented using one of the following instruments ONE CURVE, CONFI TAPER, TRUShape® 3D CONFORMING AND RECIPROC BLUE FILES. Pre-weighted Eppendorf tubes were used to collect the apically extruded debris during instrumentation. Then the amount of debris collected was calculated by subtracting the weight of the Eppendorf tube before and after preparation. Then the data was analysed using Kruskal wallis test. At 0.5 significant level. Results: Some amount of debris extrusion was found with all the instruments from the apex. Highest amount of apical extrusion of debris was found in Reciproc Blue followed by Trueshape 3D Conforming, Confi Taper and least apical extrusion seen in One Curve. Conclusions: Under the limitations of this in-vitro study, the amount of apically extruded debris measured for the used instruments was REC Blue> Trueshape® 3D Conforming>ConfiTaper> One Curve.

Keywords---apical extrusion, one curve, reciproc blue, trueshape®3d conforming, confitaper

Introduction

Thorough root canal cleaning and shaping played pivotal role in successful endodontic treatment. Not only it ensures removal of the etiological factors from the root canal space but also it enhances three dimensional obturation of the prepared space with either lateral condensation, vertical condensation or thermoplasticized injected guttapercha.[1] During root canal procedures, It is reported in the literature that contaminated as well as non contaminated dentin and pulp tissue can provoke an inflammatory reaction when forced periapically. It is well known that that, if the canal contains antigens and a granuloma has antibodies. So when the contents are pushed through the canal, it will result in an antigen - antibody complexing. This reaction will cause impairement of the the cell membrane, resulting in prostaglandin release, bone resorption, amplification of the kinin system and ultimately pain for the patient.

Foraminal debridement is also important in cases of periapical lesion, as the apical portion of the root canal is a niche of bacterial colonizaion.[3] The apical extrusion of microbes into the periradicular tissues has the affinity to bring serious systemic diseases such as endocarditis, brain abscess, septicemia particularly in compromised patients.[4] Thus, besides bacterial major role in flare-ups, mechanical and chemical factors are also important for triggering of inflammation and post operative pain. Thus every effort is made to limit the periapical extrusion of intra canal material during treatment, to prevent the flare up phenomena.[3]If we take any instrument and technique per se, all may cause extrusion of the debris during canal preparation, irrespective of through control of working length[5,6] the amounts of extrusion is influenced by the kinematics and the design of the file[7].

Instrument design components are Taper, Flute, Blade, Land, Pitch, Rake angle, Helical angle, tip design and cross section.[8] Various studies were there to describe about the evaluation of apical debris extrusion caused by various available hand, rotary instruments which differs in their design. In my study the evaluation of apical debris extrusion during instrumentation in root canal was with ONE CURVE, CONFI TAPER, TRUSHAPE® 3D CONFORMING AND RECIPROC BLUE files which has different cutting edge, rake angles etc.

One Curve Files

One Curve is a single-use, heat-treated NiTi rotary file that enables shaping of the full length of the canal with a single instrument, directly to the apex. C-wire defines One Curve's personality traits as its own DNA. One Curve is a smart, efficient, and conservative instrument manufactured by Micro-Mega Company. The advantages of One Curve, single-file technology are Increased blade flexibility and more separation resistance resulted from C-wire heat treatment CM of NiTi material. Perfect taper and diameter for a final shaping that meets standards of an optimized cleaning and shaping preserves the original anatomy of the root canal.[9,10,11]

Confitaper NiTi files

Confitaper NiTi files (Confident sales Pvt. Ltd.) is a NiTi rotary file system that comes as a pack of 3 instruments 18.4%, 20.4% and 25.6%. they exhibit good elasticity and fracture resistance thus adaptable to most canal anatomies. X wire material ensure elasticity of files and thus enhances fracture resistance. It has a guiding tip with rounded end design which minimizes canal deviations and procedural errors. It shows high cutting efficiency and better elimination of debris owing to its triangular cross section.[12]

TRUShape 3D conforming files

TRUShape 3D conforming files is a recent rotary system that have a unique S-shaped design that is claimed to allow the file to conform to irregular and larger shapes than the files original size, the file compresses in small areas and springs in wide areas and creates an envelope of motion inside the root canal, the system comes in four sizes 20/.06, 25/.06, 30/.06, and 40/.06.[13]

Reciproc blue files

RECIPROC BLUE FILES (REC Blue, VDW) an updated system from reciproc (VDW, Munich, Germany) a single file system used in reciprocation. REC Blue presents design features similar to RECIPROC with an S-Shaped horizontal cross-section and two cutting edges, but the structure of the file has been improved with the new heat treatment to make it more flexible[14,15] this new heat treatment gives a Blue Colour to the file.

Methodology

Selection of teeth

According to convenient sampling scheme Sixty extracted human mandibular premolar Teeth, free of visible or detectable caries, cracks, and restorations, with single root canal and apical foramen were taken. This was verified by viewing their buccolingual and mesiodistal radiographs. Any Soft tissue remnants and calculus on the external root surface was removed using ultrasonic instruments.

Standardization of samples

15mm of the root was marked (Fig 1a) and a rotary diamond disc was used to decoronate the teeth, (Fig 1 b) standardizing the remaining portion of the root(15mm). (Fig 1c, Fig 1)

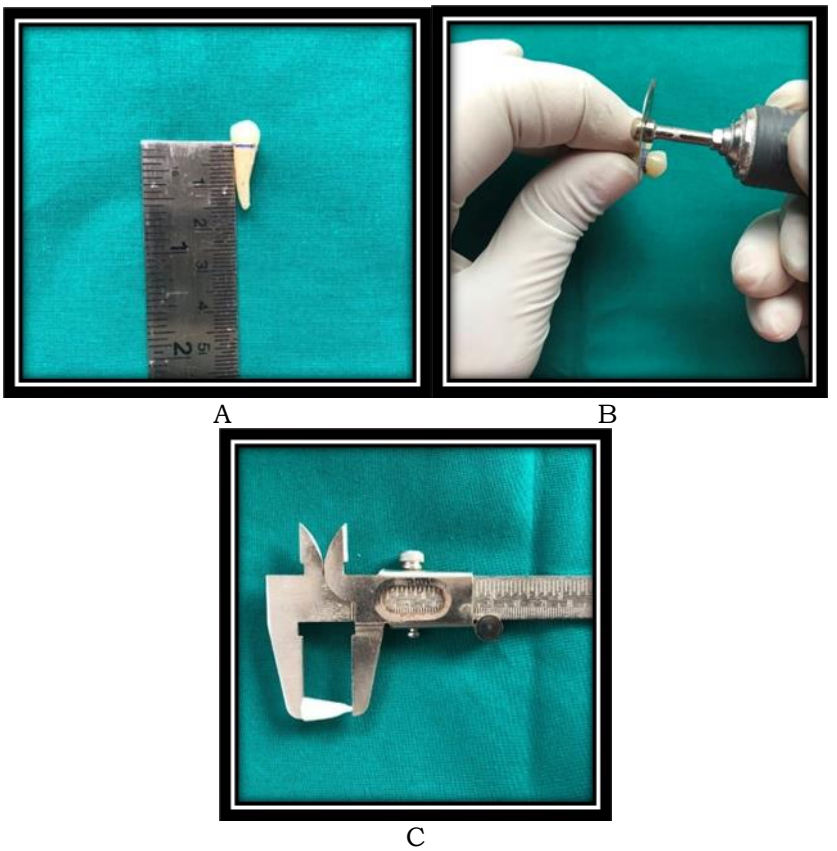


Fig 1. Standardization of samples: (a) Marking 15mm on root from the apex (b) Decoronation using a diamond disc and slow speed handpiece (c)Vernier caliper was used to measure length of sample (15mm)

Root canal preparation

The occlusal surface was flattened to standardize the working length (WL) of all

teeth to 15mm.

Apical patency

Conventional straight line access preparation was performed and apical patency was confirmed by inserting a no 15-file through apical foramen. The file was inserted into the canal until its tip is slightly visible at the apical foramen and WLs was set by deducting 1mm from the initial length. The sixty teeth which were selected for study was randomly assigned to four groups for instrumentation as follows (n=15).

- GROUP 1-One Curve
- GROUP 2-Confi Taper
- GROUP 3-Reciproc Blue
- GROUP 4- TRUShape® 3D Conforming Files

Root canals was prepared using all systems files according to manufacturer's instructions. Five ml of distilled water was used as irrigant in between the files and throughout the instrumentation for all the groups.

Initial weighing of Eppendorf tube

Before assembling the whole apparatus, the Eppendorf tube was weighted by placing them in an electronic weighing machine. Three consecutive measurements will be taken for each tube and the mean measurement for each tube will be considered to be its weight.

Debris collection apparatus

According to the study done by Myers and Montgomery (1991) the debris collection apparatus was built.The Eppendorf tubes was placed in the glass vial and the opening was sealed with modeling wax. The modeling wax was sealed to the mouth of the glass vial with a heated instrument. The teeth then inserted in the Eppendorf tubes till the cementoenamel junction and the wax was sealed with cyanoacrylate (super glue) to prevent leakage of the irrigating solution through the hole. The 27 gauge needle was placed alongside the tooth into the Eppendorf tubes to balance the internal and external pressure. An aspirator was used to suction excess irrigating solution overflowing from the tooth crown. Aluminium foils was used to cover the glass vials to prevent any operator bias during the instrumentation procedure.

Collection of apically extruded debris

Once instrumentation was complete, the cover, needle, tooth was removed. The debris adhered to root surface was collected by washing the apical part with 1mL distilled water in the tube. Before weighing the dry debris, the tubes were stored in an incubator at 70^0 C for 5 consecutive days to evaporate the distilled water.

Calculation of the debris weighed

The Eppendorf tubes was weighed using the same analytical balance to obtain the final weight of the tubes including the extruded debris. Three consecutive weights was obtained and the mean was considered. The amount of apically extruded debris was calculated by subtracting the initial weight of the tube from the final weight.

Fig 2. Eppendorf Tubes with extruded debris after drying the irrigant

Observation and Results

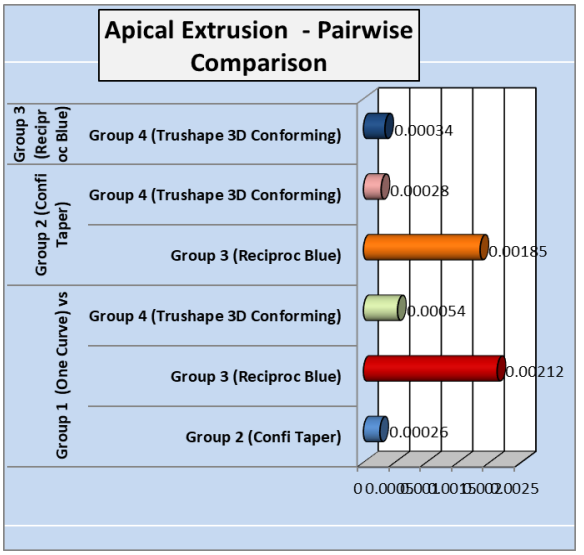
Table 1
Overall comparative statistics of apical extrusion of debris using One Curve, ConfiTaper, TRUShape ® 3D Conforming and Reciproc Blue file systems using One way Anova 'F'test

	Mean	SD	One way Anova 'F' test	p value, Significance
Group 1 (One Curve)	0.003593	0.00039	F = 15.530	p <0.001**
Group 2 (Confi Taper)	0.003860	0.00093		
Group 3 (Reciproc Blue)	0.005713	0.00124		
Group 4 (Trushape 3D Conforming)	0.004140	0.00095		

p>0.05 – no significant difference *p<0.05 – significant **p<0.001 – highly significant

Highest amount of apical extrusion of debris was found in Group 3 (Reciproc Blue) followed by Group 4 (Trueshape 3D Conforming) , Group 2 (Confi Taper)

and least apical extrusion seen in Group 1 (One Curve). On overall comparative statistics of apical extrusion of debris using One Curve, Confi Taper, TRUShape ® 3D Conforming and Reciproc Blue file systems using One way Anova 'F' test, it was found that highly statistical significant (p<0.001) difference was found among the four groups.



Graph 1. Pairwise intergroup comparison of apical extrusion of debris using One Curve, Confi Taper, TRUShape ® 3D Conforming and Reciproc Blue file systems

On comparison of all groups with Group 1 (One curve), Group 2 (Confi Taper) and Group 4 (Trueshape 3D) have greater apical extrusion debris in weight as compared to Group 1 but the difference was not found to be of statistical significance (p>0.05). Group 3 (Reciproc Blue) have greater apical extrusion debris in weight as compared to Group 1 and the difference was found to be of highly statistical significance (p<0.001). On comparison of all groups with Group 2 (Confi Taper), Group 3 (Reciproc Blue) have greater apical extrusion debris in weight as compared to Group 2 and the difference was found to be of highly statistical significance (p<0.001). Group 4 (Trueshape 3D) have greater apical extrusion debris in weight as compared to Group 2 but the difference was not found to be of statistical significance (p>0.05).On comparison of all groups with Group 3 (Reciproc Blue) with Group 4 (Trueshape 3D Conforming), it was observed that Group 3(Reciproc Blue) have greater apical extrusion debris in weight as compared to Group 4 and the difference was found to be of highly statistical significance (p<0.001).

Discussion

The major objectives of root canal treatment are:

- Elimination of periradicular disease and promotion of healing where disease already exists through removal of vital and necrotic tissues from the main root canal.

- Formation of adequate space for irrigation and medication.
- Maintainance of the integrity and location of the apical canal anatomy.
- Avoidance of iatrogenic damage to the canal system and root structure.
- Facilitation of canal filling.
- Avoidance of further irritation and infection of the periradicular tissues.
- Conservation of sound root dentin to allow long term function of the tooth.[16]

During the process of removal of microbes from root canal system, there is a chance of extruding intracanal debris into the periradicular tissues, in spite of the strict control of the root canal length.[17] An endodontic flare up is explained as an acute exacerbation of a periradicular pathosis after the initiation or continuation of non surgical root canal treatment. The incidence may be from 2% to 20 % of cases.[75] A meta analysis of the literature showed the flare up frequency to be 8 - 14%. It was reported to range between 1.4% and 16%.,in another study[18] Mast cells discharging vasoactive amines into the periapical tissues initiate an inflammatory response or aggravate an existing inflammatory process.[19] Besides bacterial major role in flare-ups, mechanical and chemical factors are also responsible for unbidden consequences such as induction of inflammation and post operative pain. So decreasing the apical extrusion of debris can reduces postoperative reactions.[20]

The amount of debris extruded varies with the working length, irrigation, instrument type, instrument design, kinematics, techniques used during instrumentation. Myers and Montgomery were the first to provide a standard methodology for weighing apical debris extrusion. They stated that instrumentation short of apex produced lower amount of apical debris extrusion (1991).[18] Quantity of debris differ with different preparation techniques because of various available designs of the file system and irrigation devices. The designs of a file includes tip design, taper, rake angle, radial land, helical angle, cross section. Each one of the design may impact the apical debris extrusion. Any system we use some amount of extrusion is seen [22,23] many newer file system are getting introduced every year in endodontics. In this study we have taken confitaper, REC Blue,TRUShape 3D Conforming files and OC, which is not yet been compared till now.

The number of instruments and kinematics may contribute to debris extrusion during instrumentation[24] All file system in our study showed some degree of extrusion of debris from the apex, which holds true in all file system[25,26]AED depends on many factors, like instrument types and size, instrument techniques and preparation end point and irrigation solution. OC file is a newly introduced file, there is no study in the literature, which can be used in directly comparing with the present results. OC Files have unique asymmetrical cutting pro file, which improves its snake like movement in to the canal and therefore may causal apically extruded debris and preserves the original canal shape[25,26.] In addition to safety tip of size 25, continuous taper o f 0.06 and variable pitch which reduces in strumpets screwing effects[25]. OC instruments which in corporate variety of different cross-sectional on the active length of the file has an improved cutting action. During the Rootcanal instrumentation more amount of dentine removal is recorded in OC because of its heat treatment, C-wire technology which increases the instrument flexibility and decreases the screwing effect.

TRUShape 3D conforming files is a recent rotary system that have a unique S-shaped design that is claimed to allow the file to conform to irregular and larger shapes than the files original size, the file compresses in small areas and springs in wide areas and creates an envelope of motion inside the root canal, the system comes in four sizes 20/.06, 25/.06, 30/.06, and 40/.06.[13] Confitaper NiTi files (Confident sales Pvt. Ltd.) is a NiTi rotary file system that comes as a pack of 3 instruments 18.4%, 20.4% and 25.6%. they exhibit good elasticity and fracture resistance thus adaptable to most canal anatomies. X wire material ensure elasticity of files and thus enhances fracture resistance. It has a guiding tip with rounded end design which minimizes canal deviations and procedural errors. It shows high cutting efficiency and better elimination of debris owing to its triangular cross section[12] which is in consistent with our and with the other studies too.

REC Blue used in reciprocating motion and are recommended for single use. Reciprocating motion improves the resistance of nickel titanium instruments to cyclic fatigue, back and forth motion of amplitude of 3mm. Horizontal cross-section is S-Shaped and two cutting edges, so greater cutting efficiency because of this it contributes to more extrusion of the debris from apex in our study. Ruddle et al in 2013 described that more number of files may be a factor for the greater amout of debris extrusion. Ustun et al in 2015 also reported the same.[39] So The number of instruments which was used during instrumentation may contribute to debris extrusion. Multiple file groups shows less extrusion than single file group which is in agreement with previous studies[25] but some studies shown there is no difference in the results using single or multiple files.

The amount of apical extrusion of debris is more with reciprocation movement compared to continuous rotation because reciprocation acts as a mechanical piston which increases AED[25] According to Tanalp (2014) to initiate a periapical response a smaller amount of extruded material is characterized by a bacterial content with high virulence and antigenic characteristics when compared to that of a high quantity of extruded material, despite lacking the specific threshold value of irritation. Thus every effort should be made to minimise the extrusion of debris during root canal treatment, which was there in the operators hand to maximum extent.

Conclusion

within the limitations of this in-vitro study, the amount of AED, for different file system tested was REC Blue> Trueshape® 3D Conforming>ConfiTaper> One Curve.

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