Systematic Review

Apical extrusion of debris with root canal instrumentation in primary teeth: A systematic review

Drishti Kaushal, Srinivas Gosla Reddy[1], Krishna Prasad Biswas[2], Ashutosh Dixit[1], Rebecca Chowdhry[1], Ashi Chug[1]

Department of Dentistry, Division of Pedodontics and Preventive Dentistry, All India Institute of Medical Sciences, [1]Department of Dentistry, All India Institute of Medical Sciences, Rishikesh, Uttarakhand, [2]Department of Dentistry, ESIC Medical College, Patna, Bihar, India

ABSTRACT

Aim: This study aimed to systematically review available literature of *in vitro* studies on apical extrusion of debris through rotary instrumentation in comparison to manual instrumentation in pediatric endodontics, and also to perform a comparison between various rotary instrumentation systems for assessment of debris extrusion. **Materials and Methods:** A comprehensive search was conducted on PubMed, Medline, Cochrane Library, Embase, Scopus, and Google Scholar without any language restriction and year of publication. A planned search strategy was made for PubMed and applied to other databases. After full-text reading, 7 articles were selected for quantitative synthesis. Modified CONSORT checklist of items for reporting *in vitro* studies of dental materials was used for quality assessment of included studies. **Results:** Root canal preparation with rotary instrumentation led to lesser apical debris extrusion than manual instrumentation. Self-adjusting file system was associated with the least debris extrusion among all included studies, followed by ProTaper Next, Kedo-S, ProTaper, K3, Mtwo, Revo-S, and Wave One. **Conclusion:** More apical debris extrusion was seen with manual instrumentation than rotary instrumentation. Furtrhermore, variance in debris extrusion was seen with different rotary file systems.

KEYWORDS: Apical debris extrusion, primary teeth, root canal instrumentation

Address for correspondence:
Dr. Krishna Prasad Biswas,
Department of Dentistry, ESIC Medical College,
Bihta, Patna - 801 103, Bihar, India.
E-mail: endokrishnabiswas@gmail.com

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Introduction

Preservation of primary teeth is of paramount importance. Primary teeth play an inherent role in mastication, phonation, and leading permanent successors into their respective position. Their early loss may contribute to spatial changes which might be responsible for malocclusion, aberrant tongue position, and hampering of development of normal anatomical jawbone and musculature surrounding them.[1-3] Persistent chronic inflammation and peri-radicular involvement may thus necessitate endodontic intervention to prevent their early loss.[4]

For a successful pediatric endodontic therapy, chemomechanical preparation of root canals of teeth is followed by obturation with a suitable material.[5,6] Root canal preparation of primary teeth has conventionally been carried out by manual instruments. The introduction of nickel–titanium rotary files for pediatric endodontic instrumentation has led to many

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benefits including an increased efficiency for shaping and debridement of canals, reduced procedural time, decreased manual fatigue of treating practitioner, decreased chairside time, fatigue of the child, and reduced procedural errors involved with traditional instrumentation.[7-9]

However, root canal instrumentation leads to unavoidable pushing out of dentinal shavings, necrotic debris, pulpal fragments, microorganisms, and irrigating solutions out of the root canal into the periapical region.[10,11] Primary teeth may be prone to increased debris extrusion due to physiological root resorption leading to enlargement of apex.[12,13] Periapical extrusion of debris after canal instrumentation may trigger undesirable consequences of postoperative pain, inflammation, flare-ups, delayed healing of periapical tissue, and a possibility of damage to a permanent successor.[10,11]

Although mostly all root canal preparation techniques are associated with the risk of debris extrusion, debris extrusion may be controlled by the design of the file system and the technique used for instrumentation.[14] For measuring debris extrusion, *in vitro* quantification by Myers and Montgomery method has been found to be one of the most popular methods.[15] Many *in vitro* studies have been pursued to evaluate debris extrusion by manual as well as rotary file systems in pediatric endodontics; hence, the aim of the present study was to assess and compare the amount of debris extrusion seen with manual instrumentation in comparison to rotary instrumentation while performing pediatric endodontics. Furthermore, comparison of amount of apical debris extrusion by various rotary file systems used for instrumentation of primary teeth was additionally aimed for.

Materials and Methods

The review was carried out by following Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA).[16] The protocol was registered in the PROSPERO database with registration number CRD42020204614.

Search strategy and selection criteria

A comprehensive search was conducted for relevant articles on five databases: PubMed, Medline, Cochrane Library, Embase, SCOPUS, and Google Scholar without any restriction of languages and year of publication. A planned search strategy was made for PubMed and then applied to other databases.

One of the search strategies used in PMC was ("root canal preparation"[MeSH Terms] OR ("root"[All Fields] AND "canal"[All Fields] AND "preparation"[All Fields]) OR "root canal preparation"[All Fields]) AND ("tooth apex"[MeSH Terms] OR ("tooth"[All Fields] AND "apex"[All Fields]) OR "tooth apex"[All Fields]) AND ("tooth, deciduous"[MeSH Terms] OR ("tooth"[All Fields] AND "deciduous"[All Fields]) OR "deciduous tooth"[All Fields] OR ("deciduous"[All Fields] AND "tooth"[All Fields])).

Furthermore, another search strategy used in PMC was (apical [All Fields] AND extrusion [All Fields] AND debris [All Fields] AND ("tooth, deciduous" [MeSH Terms] OR ("tooth" [All Fields] AND "deciduous" [All Fields]) OR "deciduous tooth" [All Fields] OR ("primary" [All Fields] AND "teeth" [All Fields]) OR "primary teeth" [All Fields]).

Two authors performed a literature search independently according to this predefined strategy. The titles and abstracts were evaluated for suitability of inclusion in the systematic review, and duplicates were removed by means of EndNote X 8.2 software for Windows (Clarivate Analytics, Philadelphia, PA, USA).

Inclusion and exclusion criteria

Inclusion criteria for studies were all *in vitro* studies in which pediatric endodontic intervention using rotary or manual instrumentation had been performed on extracted deciduous teeth of human patients of <10 years of age. This systematic review was conducted with a design following the population, intervention, comparison, outcomes, and study design. Studies were included only when they met the following criteria's:

- Population: Children with primary teeth up to 10 years of age
- Intervention: Root canal instrumentation of deciduous teeth with rotary file system
- Control: Manual instrumentation with manual files (k-files, h-files, and any other)
- Outcome: Debris extrusion seen through rotary instrumentation of primary teeth and its comparison with manual file instrumentation was kept as a primary outcome. In addition, a secondary outcome planned for assessment was the comparison of various file systems for debris extrusion if feasible as per the data extracted during the study.

Exclusion criteria

Studies in other languages and case reports were excluded from this review.

Data extraction

Search was conducted and studies found relevant were screened for eligibility against inclusion/exclusion criteria. Information and data are applicable to the following parameters: study, study type, journal, sample size, age group, groups, working length, irrigation solution used, method used, tooth type, and analysis used collected from the studies. If some data were missing in any individual study, then the primary authors were contacted to obtain it. From these included studies, comparative assessment and analysis have been provided.

Quality assessment

Quality assessment for the studies was performed using a modified CONSORT checklist of items for reporting *in vitro* studies of dental materials.[17] The checklist for data was assessed by two reviewers, DK and AC, independently. In the event of disagreement, the opinion of AC was taken as final. The items presented in checklist helped in the assessment of standard of reporting in different sections of paper.

Results

Search data

PRISMA flow diagram summarizing the process of selection of studies is presented in Figure 1. Electronic searches in 5 databases identified 602 publications, and after the removal of duplicates, 530 articles were screened for titles and abstracts, thus providing a total of 9 articles for full-text reading after exclusion of 521 articles. After full-text reading, 7 articles were finally selected for quantitative synthesis. Two studies were excluded from the study and reasons have been stated in PRISMA chart in Figure 1.

Study characteristics (study, study type, journal, sample size, age group, groups, working length, irrigation solution used, method used, tooth type, and analysis used) were extracted from 7 articles and listed in Table 1. Intercomparison of different file systems is presented in Table 2. The amount of debris extrusion seen with different file systems in each study is mentioned in Table 3. The quality of assessment of each article is presented in Table 4.

General characteristics of selected studies

A total of 494 extracted teeth of children up to 10 years of age were included in the selected group of studies and were either treated with rotary or manual instrumentation techniques.

In all studies, different types of rotary instrumentation techniques were compared to manual instrumentation techniques for assessing the amount of apical debris extrusion during root canal preparation. One study compared one rotary technique with a manual technique.[21] Three studies compared two different rotary techniques in comparison to manual techniques.[22-24] Two studies compared three different

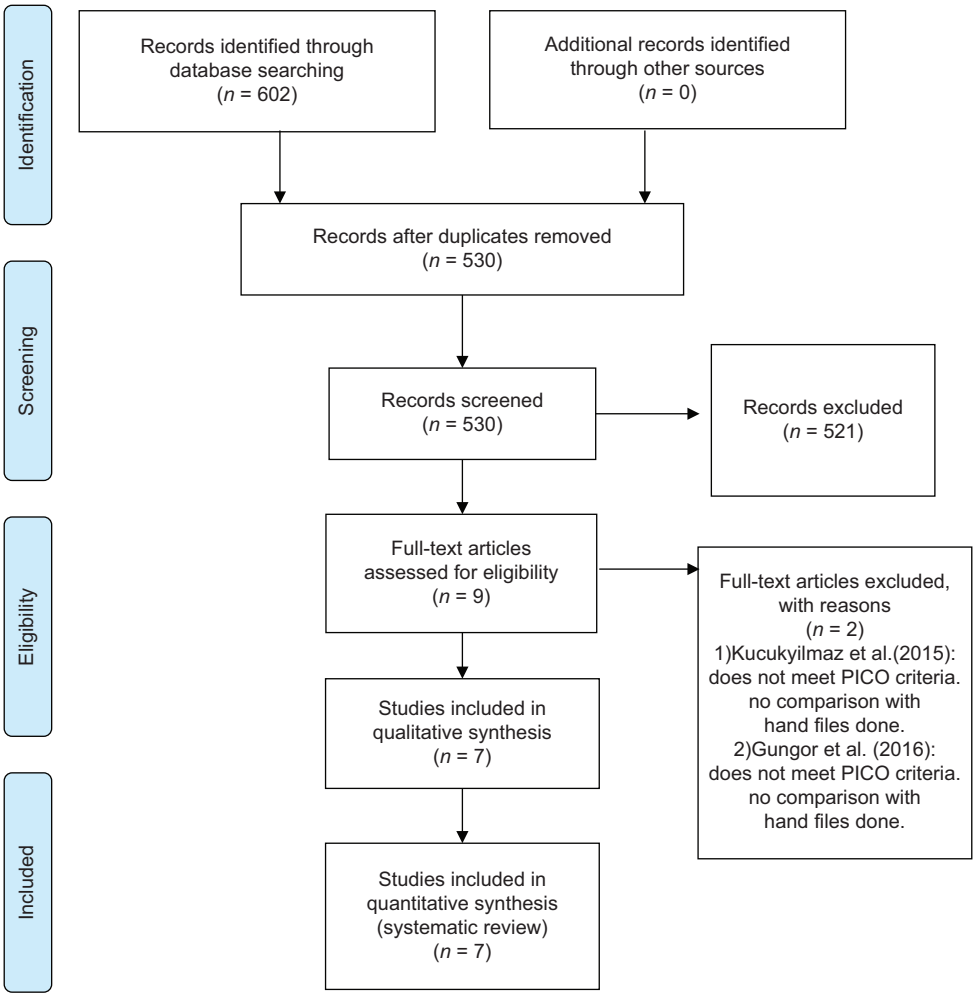

Figure 1: Preferred Reporting Items for Systematic Review and Meta-Analysis flow diagram for the study selection process

Table 1: Characteristics of studies evaluated for systematic review

Study	Study type	Journal	Sample size	Age group (years)	Groups	Working length	Irrigant used	Method used	Tooth type	Analysis used	Result
Topçuoğlu *et al.* (2016)[18]	*In-vitro* study	International Journal of Pediatric Dentstry	60	4-6	HF group (stainless steel K-file) Mtwo group PTN group Revo-S group	−1	Distilled water	Myers and Montgomery method	Mandibular molars	One-way ANOVA and Tukey's *post hoc* test	HF were associated with Greater debris extrusion Compared to the Mtwo and Revo-S groups (P<0.05) PTN group extruded Less debris than Mtwo and Revo-S groups (P<0.05)
Thakur *et al.* (2017)[11]	*In-vitro* study	The Journal of Contemporary Dental Practice	120	Not mentioned.	Group 1: HF (K-files) Group 2: PTU files Group 3: PTN, Dentsply Tulsa Dental Group 4: SAF, ReDent-Nova, Ra'anana, Israel	−1	Bidistilled water	Myers and Montgomery method	Primary mandibular molars	One-way ANOVA and Tukey's *post hoc* test	SAF were associated with Significantly lesser debris extrusion apically followed by PTN then PTU (P<0.05). The samples instrumented with HF Were associated with maximum amount of debris extrusion among all tested groups (P<0.001)
Buldur *et al.* (2018)[19]	*In-vitro* study	European Journal of Pediatric Dentistry	160	5-8	Two groups; Group 1 - Nonresorbed teeth Group 2 - Resorbed teeth Four subgroups in each group a. ProTaper b. ProTaper Next c. SAF d. HF (K-files)	−1	Bidistilled water	Myers and Montgomery method	Primary mandibular second molars	One-way ANOVA and Bonferroni *post hoc* t-test	The amount of apically extruded debris was significantly less In nonresorbed group Compared to the resorbed group (P<0.05). Regardless of Resorption, PTN and SAF extruded significantly less debris than ProTaper and HF (P<0.05) No statistically significant difference was observed between PTN and SAF (P>0.05)
Madalena *et al.* (2018)[20]	*In-vitro* study	Pesquisa brasileira em odontopediatria e clinica integrada	25	Not mentioned	Group 1: Manual technique (K-files) Group 2: Wave one system	+1	Sodium hypochlorite	Myers and Montgomery method	Primary molars	One-way analysis of variance (ANOVA) and Tukey's *post hoc* test	Although instrumentation with Wave one system presented a Lower mean final weight than those instrumented by manual technique, there was no statistical difference in the amount of extruded debris by both techniques (P=0.8704)
Preethy *et al.* (2019)[21]	*In-vitro* study	Journal of clinical and diagnostic research	36	4-7	Group 1: Stainless steel hand K- files (Dentsply Maillefer, Ballaigues, Switzerland) Group 2: K3 (Sybron Dental, West Collins, CA, USA) Group 3: Kedo-S (Reeganz dental care Private., Ltd., India)	−1	Distilled water	Myers and Montgomery method	Primary canines	One-way ANOVA and Tukey's *post hoc* test	Apical debris extrusion Is more with K-files when compared to K3 and Kedo-S Rotary files (P=0.001, P=0.000)
Alnassar *et al.* (2019)[22]	*In-vitro* study	Dental and medical problems	48	Not mentioned	Group 1: HF (K-file) Group 2: PTN group Group 3: WO group	−1	Distilled water	Myers and Montgomery method	Primary mandibular molars	One-way analysis of variance (ANOVA) and Tukey's *post hoc* test	Highest apically extruded debris was seen with HF group There were statistically Significant differences between PTN and manual file Group and also between WO and manual file group (P<0.05)

Contd...

Table 1: Contd...

Study	Study type	Journal	Sample size	Age group (years)	Groups	Working length	Irrigant used	Method used	Tooth type	Analysis used	Result
Asif *et al.* (2019)[23]	*In-vitro* study	Contemporary clinical dentistry	45	5-8	Group 1: HF (Dentsply Maillefer, Ballaigues, Switzerland) including stainless steel K -files Group 2: ProTaper files (Dentsply Maillefer, Ballaigues, Switzerland) Group 3: Kedo-S files (Reeganz Dental Care Private Ltd., India)	−1	Distilled water	Myers and Montgomery method	Deciduous canines	One-way analysis of variance (ANOVA) and Tukey's *post hoc* test	Instrumentation with Kedo-S rotary files Produced statistically Significantly lesser Extrusion of the Apical debris Compared to instrumentation with ProTaper and HF ($P<0.05$)

HF: Hand files, ANOVA: Analysis of variance, PTU: ProTaper universal, SAF: Self-adjusting file, WO: Wave One, PTN: ProTaper Next

rotary instrumentation techniques in comparison to manual techniques.[11,18] A study subdivided the included teeth into two groups, resorbed and nonresorbed before further subdividing them into four subgroups which compared three different rotary instrumentation techniques in comparison to manual techniques.[20]

Rotary instrumentation technique versus manual technique

All seven studies included in the review evaluated the amount of debris extrusion seen with rotary technique and manual technique in primary teeth, out of which six studies with a higher certainty of evidence assessed that more debris extrusion was seen with manual instrumentation of canals in comparison to rotary instrumentation, as shown in Table 1.

Intercomparison of various file systems for debris extrusion

On comparing all seven included studies, the amount of debris extrusion was least with self-adjusting file (SAF) followed by ProTaper Next, Kedo-S, ProTaper, K3, Mtwo, Revo-S, and Wave One in ascending order as observed in Tables 2 and 3. SAF was found to have the least association with debris extrusion among all files used for canal preparation, and Wave One was associated with maximum debris extrusion.

Quality assessment of selected articles

The selected articles were subjected to quality assessment using the modified CONSORT checklist of items for reporting *in vitro* studies of dental materials, presented in Table 4. It was observed that all included articles reported a structured summary, introduction with specific objective and hypothesis. Three studies did not clarify how the sample size was determined, only one study explained the method to generate random allocation sequence, all studies presented the statistical methods used to compare groups for primary and secondary outcomes and presented results in detail, but none of the study assessed estimate based on confidence interval. Six articles presented a very structured discussion along with highlighting limitations of the trial, any source of bias, imprecision or multiplicity of analysis.

Meta-analysis

Due to high heterogeneity between different categories of rotary file instrumentation used for instrumentation in comparison to manual instrumentation, a meta-analysis among selected studies was not considered.

Discussion

This review is based on the quantitative synthesis provided by seven clinical trials that assessed the apical extrusion of debris in primary teeth with rotary instrumentation in comparison to manual instrumentation. Limitations of the present review

Table 2: Inter-group comparison of different file systems used in articles included for systematic review

Study	Study type	Journal	Sample Size	Age group (years)	Groups	Tooth type	Result
Topçuog˘lu *et al*. (2016)[18]	*In-vitro* study	International Journal of Paediatric Dentistry	60	4-6	HF group (Stainless steel K-file) Mtwo group PTN group Revo-S group	Primary first mandibular molars	PTN group extruded lesser debris than Mtwo and Revo-S Groups (P<0.05) However, the difference. Between the Mtwo and Revo-S groups was not significant statistically (P>0.05)
Thakur *et al*. (2017)[11]	*In-vitro* study	The Journal of Contemporary Dental Practice	120	Not mentioned	Group 1: HF (K-file) Group 2: PTU file Group 3: PTN file Group 4: SAF	Primary mandibular molars	Samples instrumented with SAF Were significantly associated with less debris extrusion Followed by PTN, and then PTU (P<0.05)
Buldur *et al*. (2018)[19]	*In-vitro* study	European Journal of Pediatric Dentistry	160	5-8	Two groups; Group 1 - nonresorbed teeth (n=80) Group 2 - Resorbed teeth (n=80) Four subgroups in each group a. ProTaper (n=20) b. PTN (n=20) c. SAF (n=20) d. HF (K-File) (n=20).	Primary mandibular second molars	No statistically significant difference was observed Between PTN and SAF in the amount of extruded apical debris (P>0.05)
Preethy *et al*. (2019)[21]	*In-vitro* study	Journal of Clinical and Diagnostic Research	36	4-7	Group 1: Stainless steel hand K-files Group 2: K3 Files Group 3: Kedo-S files	Primary canines	There was no statistically significant difference between K3 and Kedo-S rotary files (P=0.069) in apical extrusion of debris
Alnassar *et al*. (2019)[22]	*In-vitro* study	Dental and Medical problems	48	Not mentioned	Group 1: HF (K-file) Group 2: PTN group Group 3: WO group	Primary mandibular molars	No statistically significant difference in the extruded debris was observed between the PTN and WO groups (P>0.05)
Asif *et al*. (2019)[23]	*In-vitro* study	Contemporary Clinical Dentistry	45	5-8	Group 1: HF (Stainless steel K -files) Group 2: ProTaper files Group 3: Kedo-S files	Deciduous canines	Instrumentation with Kedo-S rotary files significantly resulted in Lesser apical extrusion of debris Compared to ProTaper instrumentation (P<0.05)

PTU: ProTaper universal, WO: Wave one, PTN: ProTaper next, SAF: Self adjusting file, HF: Hand files

were inclusion of studies reported in the English language, case reports, and lack of randomized clinical trials on the present topic.

Several methodologies have been developed for the quantification of apically extruded debris. Six out of the seven articles included in this review used the Myers and Montgomery method. The Myers and Montgomery method has better advantages over other quantification methods as it allows for separate quantification of debris and irrigant extrusion and has also been stated to be the most used method in dental literature.[15,24] Despite several advantages of the Myers and Montgomery method, a few drawbacks associated with it are lack of an apical barrier formation, sensitivity of the analytical balance used, and exposure to moisture leading to hydration of debris.

Standardization of apical foramen, by assuring a working length of <1 mm from the apical foramen, significantly reduced the amount of apically extruded debris.[25,26] Six *in vitro* studies included in the present review established this working length except for one which established its patency 1 mm beyond apical foramen and also substantiated it by stating that lesser debris extrusion was observed on instrumenting 1 mm beyond apex despite causing patent discomfort and an additionally associated risk of damage to the permanent tooth germ.[25,27]

Distilled water was preferred for irrigation of canals in most of the studies, as it avoids any factors that may add to increasing the weight of apically extruded debris.[15]

The amount of debris extrusion seen with rotary instrumentation was observed to be higher than manual instrumentation in primary teeth. Rotary instrumentation of the canal may lead to an early coronal flaring with the crown down technique increasing guidance of debris towards canal orifice through its rotational motion than pushing it apically, as seen with quarter pull motion used with manual K-file instrumentation, contributing to apical piston formation and debris extrusion.[27,28] Furthermore, smaller taper of K-files (0.02%) and lesser space availability in apical region contribute to it.[29,30]

Various factors influence the apical extrusion of debris during instrumentation. Majorly, each file system has a unique cross-sectional design and kinematics, which influence the amount of debris extruded. ProTaper Next has a rectangular cross-section with a unique design with offset center of mass and

Table 3: Amount of debris extrusion with different file systems in each study

Study (debris extrusion)	HF			PTN			ProTaper file system			Kedo-S system		
	n	Mean	SD	*n*	Mean	SD	*n*	Mean	SD	*n*	Mean	SD
Topcuoglu *et al.* (2016)	15	0.00261	0.00065	15	0.00085	0.00037						
Thakur *et al.* (2017)	30	0.00133	0.00012	30	0.00052	0.00008	30	0.00109	0.00005			
Buldur *et al.* (2018) Nonresorbed	20	0.001112	0.000203	20	0.000581	0.000254	20	0.001224	0.000627			
Buldur *et al.* (2018) Resorbed	20	0.001601	0.000592	20	0.000705	0.000286	20	0.001561	0.000606			
Madalena *et al.* (2018)	12	0.0204	0.0239									
Preethy NA *et al.* (2019)	12	0.0018893	0.00068844							12	0.0007627	0.00024159
Alnassar *et al.* (2019)	16	0.00379	0.00039	16	0.00262	0.00030						
Asif *et al.* (2020)	15	0.0018893	0.00068844				15	0.0014467	0.00033245	15	0.0007267	0.00024159

Study (debris extrusion)	SAF files			Wave one shape files			Mtwo file system			Revo - S file system			K3 file system		
	n	Mean	SD	*n*	Mean	SD	*n*	Mean	SD	*n*	Mean	SD	*n*	Mean	SD
Topcuoglu *et al.* (2016)							15	0.00148	0.00059	15	0.00167	0.00046			
Thakur *et al.* (2017)	30	0.00026	0.00004												
Buldur *et al.* (2018) Nonresorbed	20	0.00065	0.000271												
Buldur *et al.* (2018) Resorbed	20	0.000821	0.000335												
Madalena *et al.* (2018)				13	0.0255	0.0230									
Preethy NA *et al.* (2019)													12	0.0011500	0.00049162
Alnassar *et al.* (2019)				16	0.00242	0.00033									
Asif *et al.* (2020)															

SD: Standard deviation. SAF: Self-adjusting file, PTN: ProTaper next, HF: Hand files

Table 4: Quality assessment of the selected articles according to the modified CONSORT checklist of items for reporting *in vitro* studies of dental materials

Reference	Abstract	Introduction Background	Introduction Objectives	Methods Intervention	Methods Outcome	Methods Sample Size	Methods Randomization Sequence generation	Methods Allocation concealment
Topcuoglu *et al*. (2016)[18]	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Thakur *et al*. (2017)[11]	Yes	Yes	Yes	Yes	Yes	No	No	No
Buldur *et al*. (2018)[19]	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Madalena *et al*. (2018)[20]	Yes	Yes	Yes	Yes	Yes	No	Yes	No
Preethy *et al*. (2019)[21]	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Alnassar *et al*. (2019)[22]	Yes	Yes	Yes	Yes	Yes	No	No	No
Asif *et al*. (2020)[23]	Yes	Yes	Yes	Yes	Yes	Yes	No	No

Reference	Methods Implementation	Methods Blinding	Methods Statistical methods	Results Outcomes	Results Estimation	Discussion Limitations	Other information Funding	Other information Protocol
Topcuoglu *et al*. (2016)[18]	No	Yes	Yes	Yes	No	Yes	No	No
Thakur *et al*. (2017)[11]	No	Yes	Yes	Yes	No	Yes	No	Yes
Buldur *et al*. (2018)[19]	No	Yes	Yes	Yes	No	Yes	No	Yes
Madalena *et al*. (2018)[20]	No	No	Yes	Yes	No	No	No	Yes
Preethy *et al*. (2019)[21]	No	Yes	Yes	Yes	No	Yes	No	Yes
Alnassar *et al*. (2019)[22]	No	Yes	Yes	Yes	No	Yes	No	Yes
Asif *et al*. (2020)[23]	No	Yes	Yes	Yes	No	Yes	No	Yes

rotation, ProTaper Universal has a convex triangular cross-section and multiple files of increasing tapers over flutes, and a noncutting safety tip.[19] SAF is a single file system with a hollow design which lacks a metal core and instead has an abrasive surface operated with an in and out vibratory motion.[31] Wave One system has a convex triangular cross-section which works with reciprocal movements.[32] Kedo-S files have a triangular cross-section, negative rake angle, noncutting tip, and variable taper.[33] Mtwo files have an S-shaped cross-section. Revo-S has an asymmetrical cross-section.[18] K3 files have an asymmetric cross-section with unequal land width and flute width and depth.[34]

ProTaper Next was observed to extrude lesser apical debris than Mtwo and Revo-S due to its cross-sectional space which allows debris to travel towards coronal direction and avoids packing of debris laterally as compared to other files with centered mass and axis of rotation. Furthermore, lesser number of files for instrumentation in this file group was thought to be contributory for lesser extrusion.[18] The efficacy of SAF was found to be better than ProTaper Next due to their hollow nature, allowing continuous irrigation and pushing out of debris from canal orifice.[19] Studies also stated that in the apical portion of canal, more than 38% of canal cross-section is free for backflow of debris and irrigants.[11,35] Wave One and ProTaper Next file group also reported no statistically significant difference in the amount of debris extrusion.[22] No significant difference in efficacy of K3 system and Kedo-S file system was observed as both are single file system.[21] Kedo-S files were stated to be better and extruded less apical debris in comparison to ProTaper universal files as Kedo-S is a single file system whereas ProTaper is a sequential filing system.[23]

As per the present study observations, the amount of debris extrusion was least with SAF in measured fractions followed by ProTaper Next, Kedo-S, ProTaper, K3 Mtwo, Revo-S, and Wave One in ascending order. SAF was found to have the least association with debris extrusion among all files used for canal preparation and Wave One was inadvertently associated with maximum debris extrusion.

The present study demonstrated that apical extrusion of debris during root canal preparation from any file system is inevitable. However, manual instrumentation of root canals of primary teeth leads to a greater amount of apical debris extrusion than rotary instrumentation. Furthermore, different rotary instruments for root canal preparation are responsible for variation in amount of debris extrusion since apical extrusion of debris is inevitable in primary teeth due to resorption of roots during eruption of permanent successors leading to an increased apical patency, careful evaluation of file system being used for root canal preparation may prevent postoperative complications such as pain, delayed periapical healing, mid-treatment flare-ups, or damage to permanent tooth buds.[10,11]

Conclusion

The review found evidence that the use of rotary instrumentation techniques achieves lesser debris extrusion apically than manual instrumentation technique in primary teeth. A coherent conclusion from all articles revealed that rotary instrumentation

of primary teeth with different rotary file systems leads to variation in the amount of apical extrusion of debris based on their cross-section, number of files utilized for sequential canal preparation, and kinematics of each file on which they operate. SAF file system had the least debris extrusion among all included studied followed by ProTaper Next, Kedo-S, ProTaper, K3, Mtwo, Revo-S, and Wave One in ascending order of effective control of apical debris extrusion upon instrumentation of primary root canals. SAF was found to be most efficacious in prevention of debris extrusion among all file groups studied.

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Conflicts of interest

There are no conflicts of interest.

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