ORIGINAL RESEARCH

Comparison of Debridement Efficacy of Two Irrigating Systems Endovac and Conventional Needle in Primary Tooth Root Canals: An *In Vitro* Study

Preetika Yadav[1], Mandeep S Virdi[2], Chandrika Saini[3]

Abstract

Aim: The purpose of the study is to evaluate how well the Endovac system and conventional needle irrigation work to remove smear layers (SR) from primary teeth root canals.

Materials and methods: Fifty extracted human primary teeth were divided into two equal sections vertically, then positioned within an acrylic model that was secured with screws. Group A (Endovac), *n* = 25, and group B (traditional needle), *n* = 25. Next, a uniform irrigation technique was used in every tooth embedded in the study model. Sections were examined with a 100× magnification stereomicroscope and electron microscope. Statistical tests were used to analyze the data.

Results: Endovac removed the SR from the apical third of the root canal system more successfully than a traditional needle (<0.05).

Conclusion: Endovac has better performance than conventional needle irrigation in the removal of the SR in the deciduous teeth root canal system.

Clinical significance: (1) Removing the SR allows for more cleaning and disinfecting of root canal walls and better adaptation of root canal filling materials. (2) It is essential to remove the entire SR from the root dentin for successful endodontic treatment.

Keywords: Acrylic study model, Deciduous teeth, Endovac, Intracanal irrigation, Smear layer.

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Introduction

Developmental, esthetically pleasing, and functional issues arise from early primary tooth loss (PT). In order to avoid periradicular periodontitis, which can lead to an inflammatory vascular periodontium, root canal therapy is advised. Nonchemical substances and foreign bodies, such as cementum and dentin fragments, can enter the body through the root apex, lateral canal, and dentinal tubules, causing pain directly or indirectly. The morphology of PT root canals almost always includes fins, anastomoses, lateral canals, and apical deltas. These features are rarely straight. The radicular resorption-induced morphological differences and dentin apposition on the root canal, along with severely divergent, curved primary molar roots, impede the effectiveness of irrigation and instrumentation in chemomechanical debridement.[1]

Smear layer (SR) is an uneven surface of both organic debris and inorganic material sticking to the dentin.[2] It acts as a bacterial growth substrate and a barrier between obturating material and the root canal wall.[3] For clinical success, the hermetical sealing of resorbable fillings to the dentinal tubules and canal walls of PT is the main concern. Barcelos et al.[4] found that SR elimination leads to root canal treatment success in PT for a duration of 24 months in an *in vivo* study. Conventional needle irrigation is the most common method for root canal therapy, but the irrigant is limited to the apical part, isthmus, and lateral canals. Furthermore, pressure increases the risk of irrigation fluid leaking into the periradicular tissue, which can cause postoperative pain and tissue and tooth damage. Many authors consider the root canal as a "closed" root canal and its apex as a closed system.

Clinically, the root canal occurs at the apex of the filling system and the irrigation effect is adversely affected.[4] So irrigation with negative pressure has been used for debridement and disinfection enhancement of the apical aspect of the root canal system.

Endovac (Discus Dental, Culver City, CA, USA) is a sterile device developed by John Schoeffel. It creates negative pressure and draws fluid into the upper part of the dental chamber by suction of high vacuum. The system consists of a delivery tip, a micro delivery tip (MDT), a microcannula, and a macrocannula.[5]

The MDT delivers a large flow of water to the inlet while removing debris and excess fluid. The large cannula removes any remaining debris from the canal and delivers fluid through the MDT. The microcannula evacuates small particles and liquid from the root canal to the long working level (WL) by laser drilling.[6] It has been found that removal of the SR improves the fluid-tight seal of the root canal system. Less fluid is expelled into the apical region, and the risk of sodium hypochlorite (NaOCl) damage is reduced.[7]

[1–3]Department of Pediatric and Preventive Dentistry, PDM Dental College and Research Institute, Bahadurgarh, Haryana, India

Corresponding Author: Preetika Yadav, Department of Pediatric and Preventive Dentistry, PDM Dental College and Research Institute, Bahadurgarh, Haryana, India, Phone: +91 8397072442, e-mail: preetika122@gmail.com

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The aim of this *in vitro* study is to compare the removal of the SR using the Endovac system and the conventional needle irrigation method, using the same irrigating solution, in primary molar root canals.

Materials and Methods

Sample Selection

Fifty tooth roots with straight, mature, established root canals and similar anatomical dimensions were collected from the Pediatric and Preventive Dentistry Clinic of PDM Dental College, Bahadurgarh, Haryana, India. Only teeth with at least one nonresorptive root were selected, while roots with resorptive defects, fissures, or open apices were excluded. According to the Ethics Committee of PDM Dental College and PDM University Institute, all patients were informed about the purpose of the study and the use of their extracted teeth in this study, and their written informed consent was obtained.

Model Preparation

Each tooth is decoronated, and the root length is standardized to 10 mm. The roots are embedded in an acrylic model and screwed together to form a closed system (Figs 1 and 2).

Fig. 1: Endovac apparatus

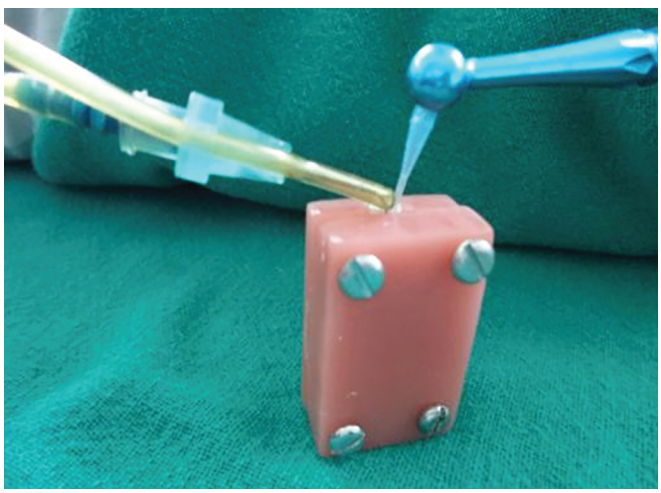

Fig. 2: Study model

Root Canal Instrumentation

Working level was confirmed. The teeth sample was divided into two equal-sized groups according to the irrigation method: group A for Endovac (Discus Dental, Culver City, California, USA) and group B for syringes. Only one root was used per tooth; each root embedded in the model was prepared using NiTi Field KedoS files/variable taper, moving coronally down to the apical large E1 files, according to the manufacturer's instructions, using 1 mL of 2.5% NaOCl for each transfer case. A 27-gauge needle was used for irrigation measurement.

Experimental Groups

Twenty-five tooth samples were in each group. The final rinse time per tooth for group A (Endovac) and group B (needle) was the same, 6 minutes, with an average flow of 5 mL/min. The total volume of water administered per flow was 30 mL.

2.5% NaOCl, 17% EDTA, and 0.9% sterile saline were the irrigating solutions in the study.

Group A (Endovac Group)

The experimental group received irrigation with 2.5% NaOCl for 30 seconds using a large cannula and then allowed the canal to fill with fluid for a duration of 30 seconds. Three water cycles were performed using a microcannula placed on a long run of 6 seconds, a 2 mm short run of 6 seconds, and a long run of 6 seconds. The first cycle was 2.5% NaOCl for 30 seconds, followed by soaking for 30 seconds. The second cycle was 17% EDTA for 1 minute, followed by soaking for 1 minute. The third cycle was 2.5% NaOCl for 1 minute, followed by soaking for 1 minute.

Group B (Conventional Needle Irrigation Group)

A 27-gauge needle, 2 mm shorter than the canal's working length, was inserted into the canal, and 2.5% NaOCl was injected into the canal. The solution was worked for 60 seconds, followed by soaking for 60 seconds. Normal saline was flowed into the root canal for 1 minute and then soaked for 1 minute.

Microscopic Evaluation

The acrylic sample is unscrewed and examined under a stereomicroscope and scanning electron microscope (Fig. 3).

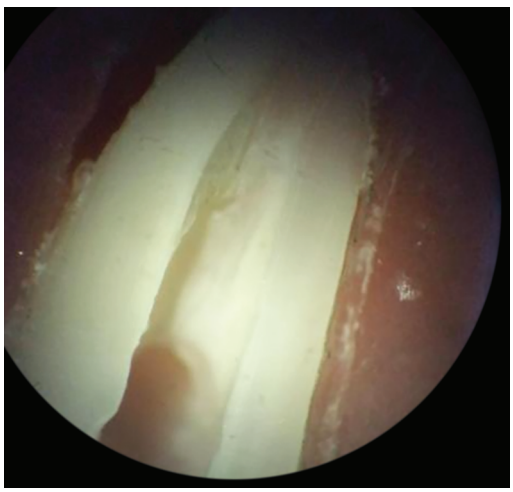

Fig. 3: Debris and SR removal using endovac negative pressure system (group A)

A 5-level scoring system described by Hulsmann et al. was used for the degree of SR removal (Figs 4 and 5).[8]

Statistical Analysis

SPSS 15.0 software was used. SEM results were analyzed using inter and intraexaminer reliability.

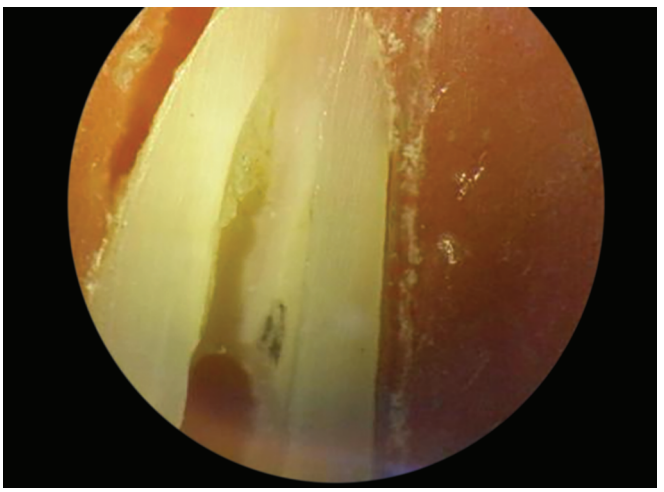

Fig. 4: Needle irrigation (group B)

Results

In the intragroup comparison, the mean CFU/mL was lower between Endovac and the combined system ($p > 0.05$). In the intergroup comparison, Endovac gave better results than traditional syringes ($p > 0.05$) (Table 1). Graphs were plotted comparing the SR removal at different levels in tooth root sections. At the coronal third, SR removal is almost the same for both Endovac and the conventional needle (Fig. 6). At the middle third, SR removal by Endovac is comparatively more than the conventional needle, but not statistically significant (Fig. 7). Endovac removes more root SR debris in the apical third of the root than the conventional needle (Fig. 8).

Discussion

Endodontic treatment helps prevent severe tooth decay and preserve function. Successful root canal treatment depends on a combination of appropriate instrumentation, root canal irrigation, and sealing. Clean root canals, along with a three-dimensional (3D) seal, lead to the success of the treatment. The root canal system is debrided during the biomechanical preparation.[9] Variations in primary teeth anatomy, such as curved and tortuous canals, and their close proximity to succedaneous tooth buds, contribute to the complexity of the procedure. Uncertainty about the effectiveness of root canals makes primary dental care a difficult task.[2] Intracanal irrigants improve waste management by removing debris,

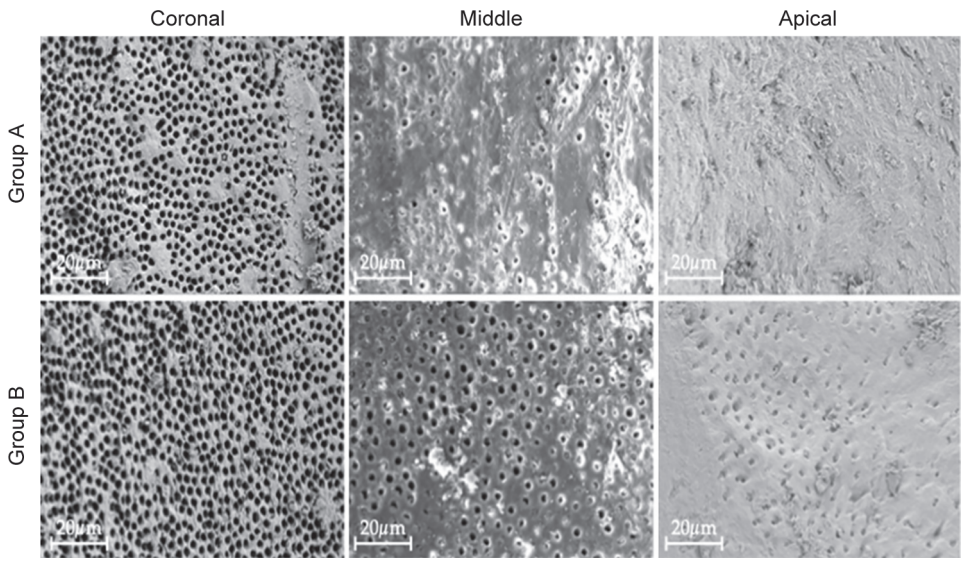

Fig. 5: Smear layer removal under electron microscope

Table 1: Scoring of SR removal at different levels in root canal

Groups	*Total score*	*Score 1 (%)*	*Score 2 (%)*	*Score 3 (%)*	*Score 4 (%)*	*Score 5 (%)*
Endovac						
Coronal	25	20	3	0	2	0
Middle	25	17	3	2	2	1
Apical	25	9	10	5	1	0
Conventional needle						
Coronal	25	15	3	4	2	1
Middle	25	11	6	3	4	1
Apical	25	0	0	9	11	6

loosening tissue, and disinfecting the root canal. Intracanal irrigants also improve mechanical irrigation by removing debris, tissue, and antibiotics from the root canal. Due to the unique internal geometry of primary teeth, including internal connectivity and horizontal anastomoses, dental implants play an important role in the endodontic treatment of children.

The results of this study showed that there was no difference between the Endovac group and the needle in the middle and coronal third of the root canal and that the entire SR was removed. Results were better with Endovac.[10] Although the total flow rate and contact were the same in both groups, this difference may be due to increased physical distribution throughout the working length, similar to previous studies by Abarajithan et al., and the hole in the microcannula allows full contact with the root canal wall.[11]

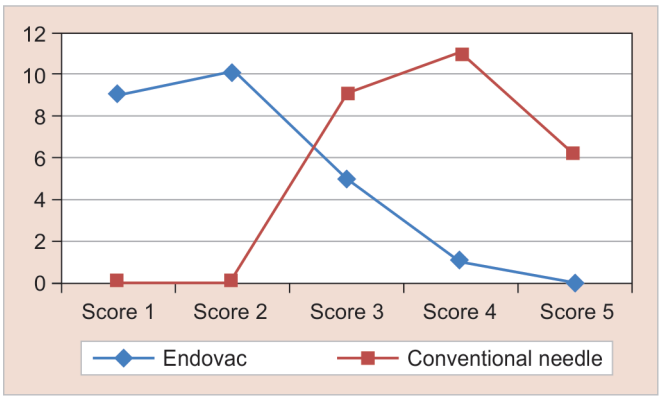

Fig. 6: Smear layer removal by endovac and conventional needle at apical third of root

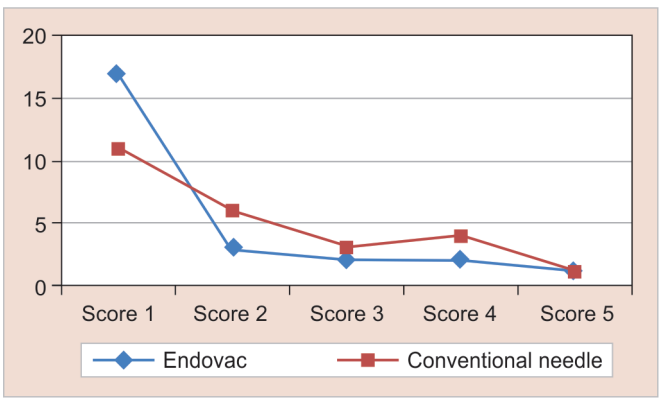

Fig. 7: Smear layer removal by endovac and conventional needle at middle third of root

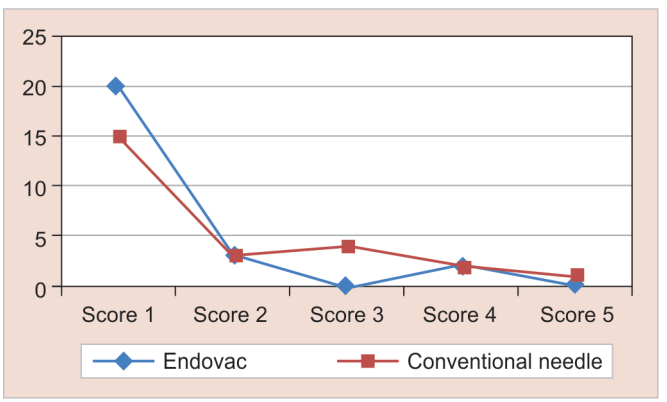

Fig. 8: Smear layer removal by endovac and conventional needle at coronal third of root

Single teeth with striated and straight conical apical anatomy were selected for this study. Since deciduous roots show various anatomical changes and irregularities, the selection limits the clinical validity of this study.

In this study, an *ex vivo* closed-ended root canal model was created and prepared using acrylic resin. Each tooth was decoronated and standardized with a root length of 10 mm. A chemically hardened acrylic resin model, having two equal parts, was used. In each part, each sectioned half of the root was embedded and screwed together to make a closed system to simulate an almost identical *in vivo* scenario.[12]

This results in apical gas entrapment and is called a "vapor lock effect," which prevents the irrigant from reaching the working length. This experiment helps provide a more direct comparison of two irrigation methods. Similar to Parente et al., in this study, Endovac was considered to be a good way to overcome the hydrodynamic problems present in closed root canals. The effectiveness of debridement increases with the increasing volume of detergent supplied. We performed a standardized irrigation procedure with a total irrigation time of 6 minutes, a rate of 5 mL/min, and a total volume of 30 mL. Irrigation and total treatment time are important factors in the treatment of children. The protocol used in our study appears to be clinically optimal.[13]

The results showed that the middle and coronal thirds had no significant difference in SR debridement in both groups. A significant difference was found in the middle and apical thirds.

Conclusion

Within the limits of this study, Endovac was found to be superior to conventional irrigation in removing SRs in the apical third of the first molar root canal system.

Clinical Significance

- Remove the SR to better clean and disinfect the root canal wall and improve the transfer of the root canal filling material.
- For the success of endodontic treatment, all contaminated layers of the root must be removed.

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