

**How to Cite:**

Gade, V. J., Sedani, S., Asani, R., & Kusumbe, R. (2022). Comparative clinical evaluation of conventional syringe irrigation, endoactivator and endovac in reducing the microbial count from infected root canal: An in vivo study. *International Journal of Health Sciences*, 6(S3), 1664–1672. <https://doi.org/10.53730/ijhs.v6nS3.5720>

## **Comparative clinical evaluation of conventional syringe irrigation, endoactivator and endovac in reducing the microbial count from infected root canal: An in vivo study**

**Vandana J. Gade**

**Shweta Sedani**

**Reema Asani**

**Raksha Kusumbe**

**Abstract**---Root canal decontamination is a crucial step in achieving endodontic success. For this, absolute eradication of microbes from root canal is of paramount importance. This in vivo study aimed at comparing the Conventional, EndoActivator and EndoVac irrigation system in reducing intracanal bacterial load. 70 necrotic, single rooted teeth having chronic periapical lesions were selected for endodontic therapy and randomly assigned into three groups. Group 1 – 20 teeth treated using Conventional needle irrigation. Group 2 – 20 teeth treated using EndoActivator system. Group 3– 20 teeth treated using EndoVac system. After the surface disinfection, access opening was done. Groupwise irrigation with NaOCl (VISHAL DENTOCARE PVT.LTD.) and EDTA (AMMDENT CANALARGE) was done with each canal in between instrumentation. Data were obtained by culturing bacterial samples of root canal before and after chemomechanical preparation under both aerobic and anaerobic conditions and CFU was counted. Statistical analysis - Paired't' test was used for intragroup comparisons while ANOVA test followed by the “post hoc Games Howell test” for intergroup comparisons. Significant post-operative reduction in bacterial colony counts was seen with all the groups. EndoVac group had significantly higher mean log reduction in CFU counts than Conventional group. Statistically, significant difference was not found in mean log reduction in Colony Forming Unit counts between the EndoActivator & EndoVac group.

**Keywords**---endoactivator, endovac, disinfection.

## Introduction

Success in Endodontics depends upon accurate diagnosis of a diseased condition, a thorough chemomechanical preparation followed by apical and lateral fluid tight seal obturation of root canal system. Many developments have been made to preserve the natural dentition, but the main purpose of this field remains complete eradication of intracanal bacteria and their toxins.<sup>1</sup> The role of bacteria and their toxins in etiology and continuation of pulpal and periradicular disease have been confirmed by various research studies.<sup>2,3</sup> Thus eradication of infections during treatment should be carried out. But the complexities or the difficulties of root canal system are the major obstacles in achieving complete cleaning and shaping of canal. It was concluded that mechanical instrumentation alone cannot sufficiently disinfect the root canal system thoroughly. Peter & Wesselink showed that 35 % or more of the root canal walls do not come in contact even by modern rotary NiTi instrumentation techniques.<sup>4</sup> Thus, the strategies that cause maximum root canal disinfection should be employed. Every effort should be aimed at establishing chemomechanical protocols that support negative cultures. Various irrigation solutions, delivery systems and protocols are introduced recently in this regard. Two systems that have gained attention include EndoActivator and EndoVac system.

The EndoActivator (Dentsply / Tulsa Dental, Tulsa, OK) is a battery functioned, wireless sonic handpiece which has non-cutting polymeric tips. These activator tips are presented in three sizes i.e. yellow 15 / 02, red 25 / 04 and blue 35 / 04. They activate the irrigants in 3 speeds 2000, 6000 and 10000 rpm during treatment. EDTA and NaOCl are activated with this device after chemo-mechanical preparation.<sup>5</sup> The EndoVac, an apical negative pressure system (Discuss Dental, Smart Endodontics, Culver city CA) consists of Maser Delivery Tip, Macrocannula and Microcannula. Master Delivery Tip (MDT) delivers and evacuates the irrigant simultaneously. Macrocannula is capable to suction the irrigation from the chamber to the coronal & middle segments of canal. Microcannula has 12 microscopic offset holes at its apical 1mm and has the ability to evacuate the debris to full working length (WL). In vitro studies have confirmed that EndoVac system is better able to clean the apical third of the canal as well as better able to reduce the risk of apical extrusion of irrigants when compared to conventional irrigation.<sup>5,6,7,8</sup> Various in vitro studies have discussed about the ability of different irrigation techniques to clean the apical thirds of root canal. But very less is known about the efficacy of EndoActivator as well as EndoVac in vivo. Thus the present study was conducted to look for the antimicrobial efficacy of EndoActivator and EndoVac system.

## Methods

This study was a forthcoming, randomized clinical study. After obtaining approval from institutional ethical committee, sixty patients with age ranged from 20 - 50 years and indicated for routine endodontic therapy were selected. The patients with permanent single rooted teeth having periapical lesions ( $\leq 2$ mm) and pulp necrosis were assigned into three groups according to the randomization sequences i.e. Group I - "Conventional irrigation", Group II - "Irrigation using EndoActivator" and Group III - "Irrigation using EndoVac". The treatment protocol

was explained to the patient prior to obtaining the informed consent. Teeth were isolated under rubber dam and surface decontaminated using 5 % povidone iodine which was further inactivated by 5 % sodium thiosulphate solution. Canal was negotiated via access cavity that was prepared earlier. In case where multiple canals were negotiated, patients were excluded from the study.

Preflaring of canals was done to allow for the space for paper points. A number #15 K file was scraped against the walls of canal and the canals were fill up with microbe free saline to absorb the contents into 2 paper points for preoperative sample (S1). Standardized clinical chemo - mechanical preparation was followed for subsequent (postoperative) bacterial culture. This involved obtaining "working length" with the help of "apex locator" and confirmation using RVG. Chemomechanical preparation of the root canals was done with "rotary Protaper" upto "F3" in maxillary teeth and upto F1 in mandibular teeth. In Group I, the root canal irrigation was accomplished with 30 guage side vented needle and plastic syringe. The canals were rinsed with 2ml of 3 % "NaOCl" after each instrument. The needle was placed upto 3mm short of the working length. Subsequent to the last instrument used, "NaOCl" was left untouched in the canal for 60 seconds. Further followed by 5ml of 3 % NaOCl. Canals were then washed out with "5 % sodium thiosulfate" to neutralize the "NaOCl". After drying the canal, Master apical file was scraped against the walls and the contents were absorbed into 2 paper points for post-operative culture (S2). Final irrigation was performed as rinsing canal with 1ml of 17 % EDTA preceded by 5ml of 3 % NaOCl.

In Group 2, identical procedure was employed as in 1<sup>st</sup> Group except that the activation of irrigants was done in final irrigation. 5 ml of 3 % NaOCl was activated with EndoActivator tip at 10,000 rpm for 30 seconds followed by activation of 1ml of 17 % EDTA and further 5 ml of "3 % NaOCl". In Group 3, canals were rinsed out with "1ml of 3 % NaOCl" using MDT at each change of instrument. This was tailed by macroirrigation and three sequences of microirrigation. In first sequences, canals were flushed with "3 ml of 3 % NaOCl" by MDT and micro irrigation was performed at the apex for 18 seconds. 2<sup>nd</sup> cycle was performed with same steps using 3ml of 17 % EDTA and third cycle again by using 3ml of 3 % NaOCl. Microbial samples were obtained every time using two paper points for aerobic as well as anaerobic culture. S1 and S2 samples were obtained before and after chemomechanical procedures respectively. Canals were dried after the final instrumentation in each group and were filled with sterile saline.

A MAF was scraped against the wall and paper points were kept in canal for 1 minute. Before taking postoperative sample, root canals were flushed with 1 ml 10 % sodium thiosulfate to neutralize the NaOCl. Paper points were transferred to tubes containing 10 ml of BHI, broth for aerobic and 10 ml of thioglycollate broth for anaerobic culture. Samples were transferred to microbiological laboratory within 60 minutes. Tubes were vortexed in vortex mixture. After 5 fold serial dilutions, aliquots of 0.1 ml plated on nutrient agar plates. They were incubated at 37 degree Celcius for 24 hours for aerobic culture. For anaerobic culture, they were kept in Gaspak jar and incubated for a week. Based on the known dilution factors the CFU were counted.

## Statistical analysis

Analysis were performed by software SPSS version 14. Due to high variance of bacterial numbers the data was normalized by a “log<sub>10</sub> transformation” of each CFU count before statistical evaluation. To compare the reduction of bacteria from preoperative to postoperative sample (Intragroup), paired ‘t’ test was applied. For calculating the mean reduction in CFU counts for each group (Intergroup), ANOVA with post hoc Games Howell test was utilised. The level of significance was same at 0.05 for all analysis. The null hypothesis stated that the “mean log reduction of CFU count” across each group was same.

## Results

Groupwise comparison by the post hoc Games Howell test preceded by ANOVA test,

Group I compared to Group II,  $p = 0.282$  (non significant)

Group I compared to Group III,  $p = 0.004$  (significant)

EndoVac had significantly higher reduction of CFU than Conventional group while there was no noteworthy difference between Conventional and EndoActivator group.

Group II versus Group III,  $p = 0.258$  (non significant)

No noteworthy variation was seen between EndoActivator and EndoVac group.

Table 1

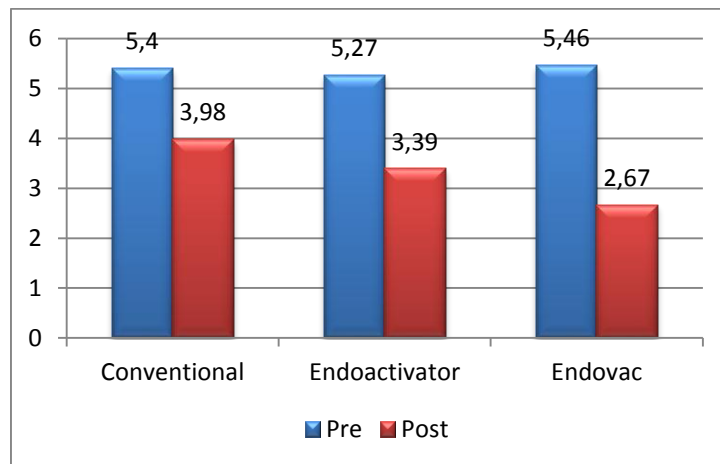
		Log preoperative		Log postoperative		p-value
		Mean	SD	Mean	SD	
Groups	Conventional	5.40	.16	3.98	.45	<0.001 sig
	EndoActivator	5.27	.30	3.39	1.22	<0.001 sig
	EndoVac	5.46	.11	2.67	1.48	<0.001 sig

Table 2

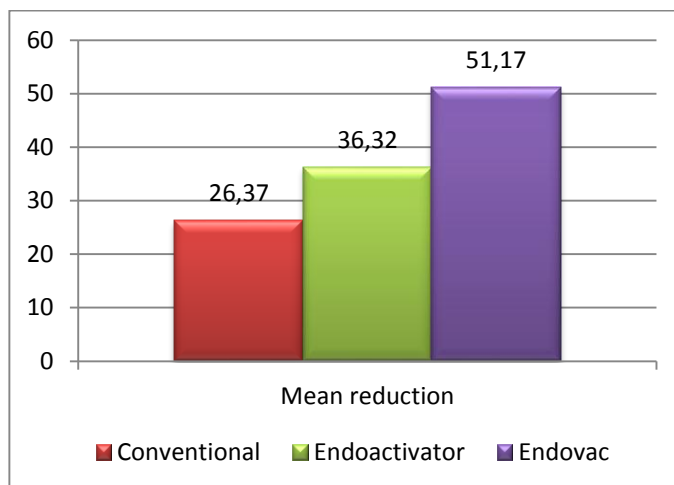
	Conventional		EndoActivator		EndoVac		p-value
	Mean	SD	Mean	SD	Mean	SD	
Reduction	26.37	7.59	36.32	23.00	51.17	27.04	<0.001 sig

Table 3

Comparison	p-value
Conventional Vs EndoActivator	0.282
Conventional Vs EndoVac	0.004*
EndoActivator Vs EndoVac	0.258



Graph 1– Bar chart showing Intragroup comparison of mean CFU for all groups.



Graph II – Bar chart showing intergroup comparison of mean reduction of CFU count.

## Discussion

Past studies have shown that bacteria in unreachable zones of canal system cannot be removed entirely by conventional chemo mechanical instrumentation as well as irrigation alone in one visit.<sup>9</sup> To overcome this, various techniques and devices were introduced. This study used culture assays to evaluate the reduction in microbial colony counts from the root canal system using “EndoActivator and EndoVac” and compared it with the Conventional irrigation. In present study, all methods showed notable reduction in the bacterial population in intragroup comparison i.e Preoperative CFU counts Vs Postoperative CFU counts (when calculated combined) in each group done by using paired sample t test. There was statistically significant reduction in Colony Forming Unit counts at postoperative period for all the groups.

When calculating the aerobic and anaerobic counts for each group, the greatest amount of mean reduction in aerobic CFU counts was seen with the EndoVac system followed by EndoActivator system followed by Conventional irrigation. While calculating reduction of anaerobic bacteria no significant difference was seen in mean anaerobic CFU reduction amongst all groups. The comparison of conventional irrigation with EndoActivator irrigation was not significant. The results are in support of Brito et al<sup>11</sup> who demonstrated in vitro that all three irrigation protocols showed similar results for reduction of *E. faecalis* population. These results are also in accordance with the results of Huffaker et al<sup>12</sup> who evaluated in vivo the bacterial reduction following a sonic and standard irrigation protocol. They found no difference in the negative cultures when standard irrigation and irrigation with EndoActivator was compared. The reason behind this being EndoActivator which has sonic energy creates only one node, has less acoustic stream. If canal wall is touched by instrument, the node in the immediate locality will be diminished, thereby reducing the efficacy in microbial elimination.

The outcome of the study are not in accordance with Sabins RA et al<sup>13</sup> who claimed in their study that sonic irrigation system when used as an adjunct to irrigation, removed bubble more effectively than conventional needle flushing but not better than passive ultrasonic irrigation. Results are also not in agreement with Ross P Mitchell.<sup>14</sup> In his study, EndoActivator performed markedly better than standard “needle irrigation”. The results also do not agree with the results of Luciana Magoin Blank – Goncalves et al<sup>15</sup> who showed that Passive Ultrasonic Irrigation and sonic activation eliminated more smear layer when compared to the conventional one.

Significant reduction in CFU count was seen when Conventional irrigation was compared with EndoVac system. Outcome agrees with the study by Hockett et al<sup>8</sup> and Neilsen and Baumgartner<sup>6</sup> when similar irrigation techniques were used. Our findings are also consistent with findings of Lei Yeng Jiang et al.<sup>16</sup> A clinical trial by Gondim E et al<sup>17</sup> concluded that post-operative pain was found to be less with EndoVac as compared to needle irrigation. The reason for this being EndoVac reduced the extrusion of NaOCl into periapical tissue. EndoVac allows a radicular circulation until working length with little risk of irrigant ejection. Studies by Albrecht LJ et al<sup>18</sup> have shown that traditional irrigation methods efficiently disinfect the middle and coronal and middle thirds of canal but not the apical third. Studies have also demonstrated that conventional irrigation leaves huge amount of debris congested in the irregularities of the canal system.

Present results are not in agreement with Miller and Baumgartner<sup>19</sup> and Rekha Pawar et al<sup>20</sup> where no difference was found significantly when EndoVac and Conventional irrigation were compared. In Conventional irrigation with 30 gauge side vented needle, the needle penetration is limited to the depth of 2 mm from working length. Increased penetration closer to working length leads to periapical extrusion. Desai and Himel found that irrigation with EndoVac results in less extrusion than needle irrigation<sup>7</sup>. Lei Meng Jiang et al<sup>16</sup> suggested that apical negative pressure delivers the irrigant more effectively in apical areas of root canals than needle irrigation. The present study found no notable variance

between EndoActivator and EndoVac. The outcome is in agreement with C. Townsend et al.<sup>21 - 25</sup>

None of the procedures that were subjected in this study showed 100 % reduction of the microbes from root canal system. EndoVac system was better in reducing post-operative counts than Conventional needle irrigation and EndoActivator but EndoVac showed statistical significance only with Conventional syringe irrigation. Further research will be required to evaluate the efficacy of EndoActivator over other systems in vivo. These outcome mirror the difficulties linked with cleaning the complexities and apical third of root canals. Our goal is to find a technique that constantly render the root canals bacteria free completely with thorough disinfection of root canal system.

### **Conclusion**

Advent of newer devices have improved the efficacy of root canal debridement. EndoVac was found to be more effective and preferred method over Conventional system. Significant difference was not found in the in vivo antimicrobial efficacy between EndoActivator and Conventional group and between EndoActivator and EndoVac group. Further clinical studies with larger sample size for each group could better confirm the findings of this study. Further evaluation of the bactericidal, virucidal and fungicidal efficacy of both these systems is warranted.

### **References**

1. Mohammad Torabinejad. Endodontics: Colleagues for Excellence. - American Association of Endodontics. 2011.
2. Kakehashi S, Stanley HR, FitzgeraldRJ: The effects of surgical exposures on dental pulps in germ free and conventional laboratory rats. Oral Surg Oral Med Oral Pathol20: 340,1965.
3. SundqvistGK: Bacteriological studies of necrotic dental pulp [Dissertation], Umea University Odontol Dissertation no.7 1 - 94, 1976.
4. L. B. Peters & P. R.Wesselink. Periapical healing of endodontically treated teeth in one and two visits obturated in the presence or absence of detectable microorganisms. International Endodontic Journal, 35, 660 - 667, 2002.
5. Li - shaGu, Jong Ryul Kim, Junqi Ling, Kyung Kyu Choi, David H. Pashley, and Franklin R.Tay. Review of Contemporary Irrigant Agitation Techniques and Devices. JOE - Volume 35, Number 6, June 2009.
6. Nielsen BA, Baumgartner JC. Comparison of the EndoVac system to needle irrigation of root canals. J Endod2007;33:611-5.
7. Desai P, Himel V. Comparative safety of various intracanal irrigation systems. J Endod2009;35:545-9.
8. Hockett JL, Dommisch JK, Johnson JD, Cohenca N. Antimicrobial efficacy of two irrigation techniques in tapered and nontapered canal preparations: an in vitro study. J Endod2008;34:1374-7.
9. P. N. R Nair, Stephane Henry, Victor Cano, Jorge Vera. Microbial status of apical root canal system of human mandibular first molars with primary apical periodontitis after "one - visit" endodontic treatment. Oral Surg Oral Med Oral Pathol Oral RadiolEndod2005;99:231 - 52.

10. Siquiera JF Jr, Machado AG, Silveria RM, Lopes HP, de Uzeda M. Evaluation of the effectiveness of sodium hypochlorite used with three irrigation methods in the elimination of *E.faecalis* from the root canal, in vitro. *Int Endodontic J*. 1997; 30: 279 - 282.
11. Patricia R.R. Brito, Leticia C. Souza, Julio C. Machado de Oliveira, Flavio R.F. Alves, Gustavo De - Deus, Helio P. Lopes, LD, and Jose F. Siqueira. Comparison of the Effectiveness of Three Irrigation Techniques in Reducing Intracanal *Enterococcus faecalis* Populations: An In Vitro Study. *JOE - Volume 35, Number 10, October 2009*.
12. S. Kirk Huffaker, Kamran Safavi, Larz S.W. Spangberg and Blythe Kaufman. Influence of a Passive Sonic Irrigation System on the Elimination of Bacteria from Root Canal Systems: A Clinical Study. *JOE - Volume 36, Number 8, August 2010*.
13. Ronald A Sabins, James Johnson, John Hellstein. A comparison of the cleaning efficacy of short term sonic and ultrasonic passive irrigation after hand instrumentation in molar root canals. *JOE - Vol.29, No. 10. Oct 2003*.
14. Ross P. Mitchell, J. Craig Baumgartner and Christine M. Sedgley. Apical Extrusion of Sodium Hypochlorite Using Different Root Canal Irrigation Systems. *JOE -Vol, No, 2011*
15. Luciana Magrin Blank Goncalves et al. Qualitative analysis of the removal of the smear layer in the apical third of curved roots: Conventional irrigation versus activation systems. *JOE - Vol.37, No.9, Sept 2011*.
16. Lei - Meng Jiang, Bram Lak, Leonardus M. Eijsvogels. Comparison of the cleaning efficacy of different final irrigation techniques. *JOE - Vol 38, No.6, June 2012*.
17. Eudes Gondim, Frank Setzer, Carla Bertelli and Syngcuk Kim. Postoperative pain after the application of two different irrigation devices in a prospective randomized clinical trial. *JOE - Vol. 36, No.8, August 2010*.
18. Albrecht LJ, Baumgartner JC, Marshall JG. Evaluation of apical debris removal using various sizes and tapers of ProFile GT files. *J Endod 2004; 30:425-8*.
19. Todd A. Miller and J. Craig Baumgartner. Comparison of the Antimicrobial Efficacy of Irrigation Using the EndoVac to Endodontic Needle Delivery. *JOE - Vol 36, No.3, March 2010*.
20. Rekha Pawar, Abdullah Alqaied, Kamran Safavi, Jennifer Boyko. Influence of an apical negative pressure irrigation system on bacterial elimination during endodontic therapy: A prospective randomized clinical study. *JOE - Vol. 38, No.9, Sept 2012*.
21. Hegde SG, Tawani G, Warhadpande M, Raut A, Dakshindas D, Wankhade S. Guided endodontic therapy: Management of pulp canal obliteration in the maxillary central incisor. *Journal of conservative dentistry: JCD*. 2019 Nov;22(6):607.
22. Bhonde R, Ikhar A, Palsodkar P. Comparative Clinical Evaluation of Post Endodontic Pain in Retreatment Cases Using Calcium Hydroxide and Triple Anti Biotic Paste an Interventional Study. *International Journal of Pharmaceutical Research*.;11:1428 - 30.
23. Mukherjee P, Patel A, Chandak M, Kashikar R. Minimally invasive endodontics a promising future concept: A review article. *Int J Sci Stud*. 2017 Apr 1;5(1):245 - 51.

24. SamrudhiKhatod, Anujalkhar, PradnyaNikhade.Comparative Evaluation of Different Irrigation Techniques with Conventional Irrigation Technique for the Removal of Double Antibiotic Paste from Root Canal - An in vitro study, Int. J. Res. Pharm. Sci., 2020, 11(4), 5578 – 5583
25. Cameron Townsend and James Maki. An In Vitro Comparison of New Irrigation and Agitation Techniques to Ultrasonic Agitation in Removing Bacteria From a Simulated Root Canal. JOE –Volume 35. Number 7 July 2009.