ORIGINAL RESEARCH

Carisolv as an endodontic irrigant in deciduous teeth: An SEM study

Parul Singhal, Usha Mohan Das[1], Deepak Vishwanathan[1], Anita Singhal[2]

Department of Paedodontics and Preventive Dentistry, H.P. Govt. Dental College and Hospital, Shimla, [1]VS Dental College and Hospital, Bangalore, Karnataka, [2]Department of Oral Pathology and Microbiology, H.P. Govt. Dental College and Hospital, Shimla, India

ABSTRACT

Aim: Root canal irrigation plays an important role in the debridement and disinfection of the root canal system. "The purpose of this study was to evaluate the efficacy of Carisolv™, 1% sodium hypochlorite (NaOCl) gel, and 1% NaOCl solution as root canal irrigants in deciduous anterior teeth."

Materials and Methods: Thirty-six extracted deciduous anterior teeth were used. Root canals were flooded with NaOCl solution in Group A, NaOCl gel in Group B and Carisolv™ in Group C and incubated for 30 min. Scanning electron microscope photomicrographs of canal wall debris in the apical, middle and coronal thirds were scored.

Results: The results showed that regardless of irrigation regime, canals were consistently cleaner in the coronal and middle thirds than in the apical thirds. NaOCl solution, NaOCl gel, and Carisolv™ had comparable activity at coronal third and middle third of root canals. At the apical third, NaOCl solution cleaned canals better than NaOCl gel and Carisolv™. Carisolv™ cleaned debris better than NaOCl gel at the apical third.

Conclusion: Carisolv™ can be used as an adjunct to root canal preparation.

Received : 06-10-10
Review completed : 20-01-11
Accepted : 25-10-11

Key words: Carisolv™, irrigant, NaOCl gel, scanning electron microscope

The main goal in root canal treatment is to eliminate infection and substrate from the root canal system[1-3] and to prevent its recurrence. Pulp therapy has been suggested since 1932 as a method for maintaining primary teeth, which would otherwise be lost.[4] This procedure still proves to be complicated and has remained controversial for a number of reasons in the pediatric population. Mainly, the perceived difficulty of behavior management and uncertainty about the effects of root canal filling material and instrumentation on the succedaneous teeth, anatomic situations like the often complicated, curved and tortuous root canals and closeness of the advancing tooth buds, make the treatment more difficult.[5] Despite the outstanding advancement reached in all fields of dental research, search for the ideal irrigant solution still challenges endodontics and therefore great effort has been focused on assessing the potential of different substances for root canal irrigation.[6] Conventional root canal treatment includes mechanical instrumentation in combination with antimicrobial and tissue solvent irrigation to dissolve and dislodge debris, and create a clean environment compatible with periapical health. In the case of deciduous teeth, extensive dentine removal is probably undesirable, placing greater emphasis on irrigants for cleansing. Sodium hypochlorite is most widely recommended endodontic irrigant because of its excellent tissue solvent and antimicrobial properties in concentrations between 0.5 and 5.25%,[7] but it is known to cause serious damage when allowed to enter periradicular tissues even in small amounts.[8,9] Carisolv™ (MediTeam, Goteborg, Sweden) is a well researched product which is advocated for chemo mechanical removal of infected carious dentine.[10] A preliminary study showed that Carisolv had the potential to clean immature canals although it was less effective than undiluted house hold bleach.[1] In that study, Carisolv™ was not compared with lower concentrations of sodium hypochlorite that may be used more commonly in pediatric dentistry. The present study was undertaken to evaluate and compare the efficacy of Carisolv™, 1% NaOCl gel, and 1% NaOCl solution as root canal irrigants in deciduous teeth.

Address for correspondence:
Dr. Parul Singhal
E-mail: dr.parulsinghal@gmail.com

Access this article online	
Quick Response Code:	Website: www.ijdr.in
	DOI: 10.4103/0970-9290.99056

MATERIALS AND METHODS

The present *in vitro* study is a non randomized comparative study in which thirty six human deciduous anterior teeth, extracted for orthodontic purposes, were collected and stored in 0.2% chlorhexidine gluconate solution at room temperature. Teeth with at least 2/3rd root remaining were included in the study. All teeth were decoronated at the CEJ level using water cooled diamond disc. Commercially available 3% NaOCl solution was diluted (1:3) to 1% concentration using tap water;[11] NaOCl gel (1%) was prepared freshly, as it was not commercially available, a thickening agent, methylcellulose (Sigma Aldrich) was added to 1% sodium hypochlorite solution to prepare the sodium hypochlorite gel. The sodium hypochlorite solution was added drop by drop to methylcellulose powder and mixed in a mortar and pestle until uniform consistency of the gel was obtained.[12] Carisolv™ is presented in two syringes, and components from both are mixed together before using. Specimens were divided into three groups of twelve teeth each. Irrigants were introduced into the canals in each group, with a 25-gauge endodontic needle (Miraject, Hager Werken), attached to a Luer-Loc syringe. The needle was inserted carefully to the apical limit of the root, and the canal was back-filled until brim-full with following:

- Group A (Experimental Group I): 1% NaOCl solution
- Group B (Experimental Group II):1% NaOCl gel
- Group C (Experimental Group III): Carisolv™

Tooth roots were incubated at room temperature for 30 min then the root canals were rinsed with normal saline. The roots were then grooved with diamond disc longitudinally, before carefully splitting with an orthodontic wire cutter.

The specimens were immersed in SEM fixative (2% glutalradehyde) to preserve the canal wall debris for SEM analysis. After this procedure they were rinsed with normal saline and sequentially dehydrated in 10, 25, 50, 75, 90, and 100% alcohol at 15 min intervals. Specimens were then mounted on metal stub and then ion sputtered in an ion sputtering device (Fine Coat, JEOL, JFC- 1100 E, JEOL Technics Co.; Tokyo, Japan) for 5 min, before viewing under Scanning Electron Microscope (JEOL, JSM 840A, JEOL Technics Co; Tokyo, Japan). After a general survey of the entire canal wall, photomicrographs were taken at ×500 magnification of representative areas of coronal, middle and apical thirds of canals [Figures 1–3]. Images were captured for scoring. Images were read by one examiner who was an experienced clinical academician with no knowledge of sample group or treatment and were scored against the following five-point scale.[1,13]

- Score (1) Clean root canal wall, only few small debris particles.
- Score (2) Light coverage of debris, <25% tubules covered.
- Score (3) Moderate coverage of debris, >25% but <50% tubules covered.

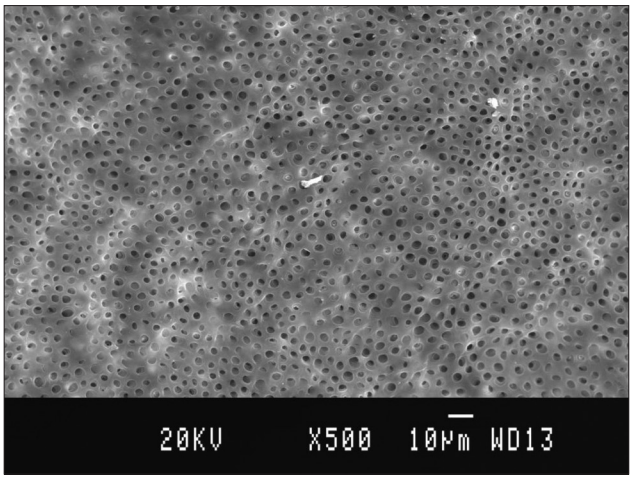

Figure 1: SEM photomicrograph (×500) at apical region after 30 min incubation with NaOCl solution 1% (score 1)

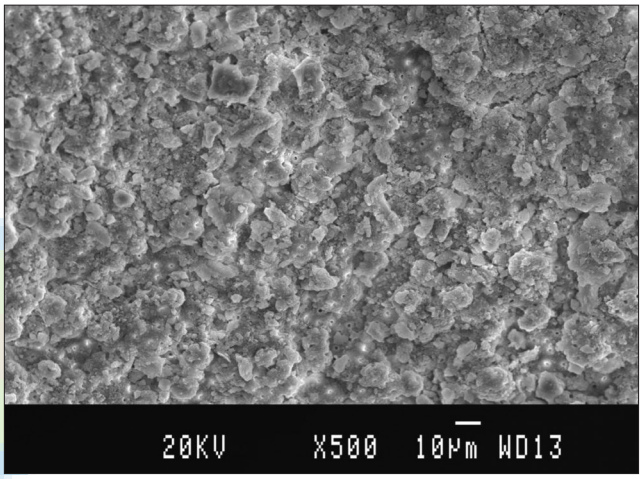

Figure 2: SEM photomicrograph (×500) at apical region after 30 min incubation with NaOCl gel 1% (score 4)

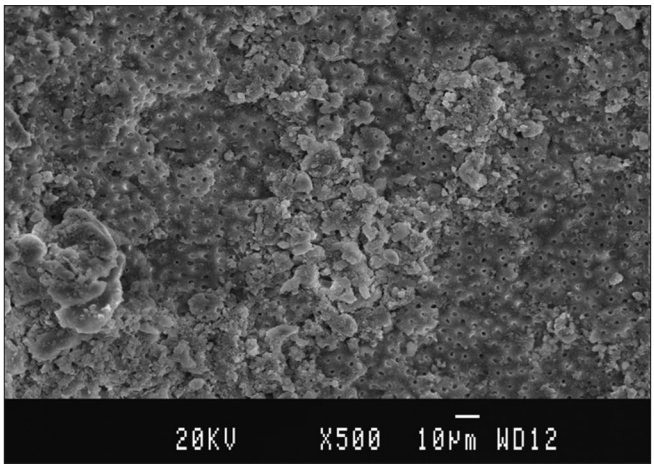

Figure 3: SEM photomicrograph (×500) at apical region after 30 min incubation with Carisolv™ (score 3)

- Score (4) Heavy coverage of debris, >50% but <75% tubules covered.
- Score (5) Complete or nearly complete root canal wall covered by debris.

There was no restriction on time taken to read each image. A break of 5 min was taken after reading each image. Fifty four randomly selected images were re-read 1 week later to determine intra examiner consistency and Cohen's K scores were calculated. The final data were analyzed statistically using Kruskal–Wallis test and Mann–Whitney test.

RESULTS

Regardless of irrigation regime, canals were consistently cleaner in the coronal and middle thirds than in the apical thirds ($P<0.05$). NaOCl solution (1%), NaOCl gel (1%), and Carisolv™ had comparable activity at coronal third and middle third of root canals ($P>0.05$). At the apical third NaOCl solution (1%) cleaned better than both NaOCl gel (1%) and Carisolv™ ($P<0.001$, $P=0.034$, respectively). Carisolv™ cleaned better than NaOCl gel (1%) at the apical third ($P=0.001$). Mean debris scores and standard deviations for each group are shown in Table 1. Re-scoring of 54 random images yielded a Cohen's K score of 0.825 indicating a very high level of internal agreement.

DISCUSSION

The ideal root canal irrigant solution does not exist. An ideal root canal irrigant would be non-toxic to host tissues, antimicrobial and possess tissue solvent properties. Full strength (5%) sodium hypochlorite is regarded by many as the optimal irrigant.[7,14] The choice of concentration of NaOCl has been a matter of debate, the range extending traditionally from 0.5% to 5.25%.[15,16] Most regimes, especially in deciduous root canals involve a balance between canal cleaning and safety. There is therefore a need for continued research and development to devise novel regimes to control infection and remove substrate most effectively, whilst placing patient at minimal risk.[1] Carisolv™ is presented in two syringes, one containing 0.5% NaOCl and the other containing 0.1 M amino acids, gel substance, sodium chlorite, sodium hydroxide and a color indicator (erythrocin). When these components are mixed together, the amino acids bind with chlorine to form high pH chloramine which is a potent disinfectant with tissue solvent activity. Carisolv™ is considered as a harmless solution and it was found that direct contact with Carisolv™ for 3 min caused no or only a week inflammatory response on oral mucous membrane.[17]

Table 1: Mean debris score of three groups at coronal, middle and apical third

Group*	Coronal third (mean±SD)	Middle third (mean±SD)	Apical third (mean±SD)
Group A	2.00 ± 0.00	2.92 ± 0.67	3.17 ± 0.39
Group B	1.67 ± 0.49	3.08 ± 0.79	4.83 ± 0.39
Group C	1.67 ± 0.49	2.67 ± 0.65	3.75 ± 0.87

*Group A - 1% NaOCl solution, Group B - 1% NaOCl gel, Group C - Carisolv™, SD - Standard deviation

The irrigation regime used in the study was 30 min (regarded as a maximum appointment duration a child could reasonably tolerate in the dental chair). It was suggested in a previous study that Carisolv™ and NaOCl (1%) require wall contact for more than 10 min if they are to have a beneficial effect on wall cleanliness.[13] If exchange is not possible, it was recommended that Carisolv™ should maintain contact for at least 20 min and ideally for 30 min.[13] Carisolv™ is a gel which cannot be easily exchanged in volume like a liquid irrigant. Cost and the relatively small volume in which it is presented by the manufacturer also preclude high volume exchange. For these reasons, all the irrigants were compared in a comparable way by flooding the canals and allowing them to work on wall debris without further intervention.[13]

The present study was conducted to evaluate and compare the efficacies of Carisolv™ and 1% NaOCl gel with 1% NaOCl solution as a root canal irrigant in deciduous anterior teeth. Teeth were stored in 0.2% chlorhexidine gluconate solution at room temperature before and during the study, as 0.2% chlorhexidine gluconate lacks the tissue solvent activity and is a broad spectrum antimicrobial agent.[18]

Results of the present study were slightly different than the previous studies.[1,13] Both the previous studies were done in permanent teeth. Deciduous teeth show more complex and tortuous anatomy than their permanent counterparts. The findings obtained from permanent teeth have been assumed to apply to primary teeth,[1,13] but evidence suggests significant chemical and morphological differences between them.[19] It is important to evaluate treatments specifically for primary dentine, since it can not be assumed that permanent and primary dentine will respond to treatment in the same way. It is assumed that NaOCl 1% solution fared better at the apical third because of the better reach, due to the lack of viscosity. Whereas Carisolv™ was slightly better than NaOCl 1% gel at apical third because of formation of high pH chloramines, which is a potent disinfectant with tissue solvent properties. Further investigations are justified to assess the efficiency and role of these agents in safe debridement and disinfection of root canal system.

CONCLUSION

Within the limits of present *in vitro* study following conclusions are drawn:

- NaOCl solution (1%) is more effective irrigant for debris removal in deciduous root canals. It remains the most popular endodontic irrigant, provided that it is used with care and is contained in the root canal system.
- Carisolv ™ cleans deciduous root canals better than NaOCl gel (1%) and can be used as an adjunct to root canal preparation.

REFERENCES

1. Al-Kilani MG, Whitworth JM, Dummer PM. Preliminary *in vitro* evaluation of Carisolv as a root canal irrigant. Int Endod J 2003;36:433-40.
2. Nair PN, Sjogren U, Krey G, Kahberg K, Sundqvist G. Intraradicular bacteria and fungi in root filled, asymptomatic human teeth with therapy resistant periapical lesion: A long term light and electron microscopic follow up study. J Endod 1990;16:580-8.
3. Sjogren U, Figdor D, Persson S, Sundqvist G. Influence of infection at the time of root filling on the outcome of endodontic treatment of teeth with apical periodontitis. Int Endod J 1997;30:297-306.
4. Kubota K, Golden BE, Penugonda B. Root canal filling materials for primary teeth: A review of the literature. ASDC J Dent Child 1992;59:225-7.
5. Holan G, Fuks AB. A comparison of pulpectomies using ZOE and KRI paste in primary molars: A retrospective study. Pediatr Dent 1993;15:403-7.
6. Medici MC, Fröner IC. A scanning electron microscopic evaluation of different root canal irrigation regimens. Braz Oral Res 2006;20:235-40.
7. Zehnder M, Kosicki D, Luder H, Sener B, Waltimo T. Tissue dissolving capacity and antimicrobial effect of buffered and unbuffered hypochlorite solutions. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2002;94:756-62.
8. Hulsmann M, Hahn W. Complications during root canal irrigation: Literature review and case reports. Int Endod J 2000;33:186-93.
9. Gernhardt CR, Eppendorf K, Kozlowski A, Brandt M. Toxicity of concentrated sodium hypochlorite used as an endodontic irrigant. Int Endod J 2004;37:272-80.
10. Banerjee A, Watson TF, Kidd EAM. Dentine caries excavation: A review of current clinical techniques. Br Dent J 2000;188:476-82.
11. Frais S, Ng YL, Gulabivala K. Some factors affecting the concentration of available chlorine in commercial sources of sodium hypochlorite. Int Endod J 2001;34:206-15.
12. Ganesh C, Gopikrishna V, Prakash V, Kandaswamy D, Parameswaram A. Evaluation of nanolekage following deprotienization of dentine using varying concentrations and application times of sodium hypochlorite solution and gel- an *in vitro* conofocal laser scanning microscope study. J Conserv Dent 2005;8:27-36.
13. Rahman S, Whitworth JM, Dummer PM. Carisolv: An alternative to NaOCl in immature canals? Int Endod J 2005;38:448-55.
14. Abou-Rass M, Oglesby SW. The effects of temperature, concentration, and tissue type on the solvent ability of sodium hypochlorite. J Endod 1981;7:376-7.
15. Matsumoto T, Nagai T, Ida K, Ito M, Kawai Y, Horiba N, *et al*. Factors affecting successful prognosis of root canal treatment. J Endod 1987;13:239-42.
16. Baumgartner JC, Cuenin PR. Efficacy of several concentrations of sodium hypochlorite for root canal irrigation. J Endod 1992;18:605-12.
17. Arvidsson A, Stirling C, Sennerbyl L, Wennerberg A. Reactions in the oral mucous membrane after exposure to Carisolv™ - combined results from a clinical screening test in humans and an experimental study in rats. Gerodontology 2001;18:109-13.
18. Leonardo M, Filho T, Silva L. *In vivo* antimicrobial activity of 2% chlorhexidine used as a root canal irrigating solution. J Endod 1999;25:167-71.
19. Sumikawa DA, Marshall GW, Gee L, Marshall SJ. Microstructure of primary tooth dentine. Pediatr Dent 1999;21:439-44.

How to cite this article: Singhal P, Das UM, Vishwanathan D, Singhal A. Carisolv as an endodontic irrigant in deciduous teeth: An SEM study. Indian J Dent Res 2012;23:120-1.

Source of Support: Nil, **Conflict of Interest:** None declared.