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Comparative evaluation of the efficacy of Triphala mouthwash and Curcumin mouthwash in the treatment of gingivitis – A randomized controlled study☆

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A B S T R A C T

Background: Numerous studies on Triphala and Curcumin mouthwashes were analyzed individually and no study has compared the efficacy of Triphala mouthwash to Curcumin mouthwash in the management of gingivitis. Although various mouthwashes have shown reduction of plaque and gingivitis the search is still on for an ideal mouthwash with minimum side effects and better patient acceptance.
Objectives: To access the efficacy of all the mouthwashes in the management of gingivitis.
Methods: By purposive sampling, 81 patients of both sexes with gingivitis were randomized by lottery method into 3 groups - A, B and C. Group A received scaling and Triphala mouthwash, Group B received scaling and Curcumin mouthwash and Group C underwent scaling and received Chlorhexidine mouthwash. Oral hygiene was assessed using Plaque, Gingival and Bleeding indices at baseline,7th day and 14th day. The inter-group comparisons were analysed using One-way analysis of variance (ANOVA) and multiple comparisons using Tukey's Honest significant difference test ($\alpha = 0.05$) and the intra-group comparisons for the indices across various time periods within each group were analysed using Repeated-measures ANOVA and Bonferroni-adjusted pairwise comparisons post hoc test ($\alpha = 0.05$). The statistical significance was set at $p \leq 0.05$.
Results: The study has shown that herbal mouthwashes are as effective as chlorhexidine in treating gingivitis although curcumin mouthwash showed a greater potential in reducing gingival inflammation.
Conclusion: Both Triphala and Curcumin mouthwashes were proven to be equally effective in reducing plaque, gingival and bleeding scores, although curcumin was better in reducing gingival inflammation. Hence herbal mouthwashes such as Triphala and Curcumin with no side effects can be considered as an alternative mouthwash to chlorhexidine.

1. Introduction

Although the oral cavity receives beneficial effects from various mechanical properties, it is highly susceptible to trauma, attack from microbes and various congenital ailments[1]. Dental plaque also known as microbial biofilm is the primary etiological factor causing gingivitis and consists of a wide range of bacteria. Various experimental studies have shown the association of plaque in the initiation and progression of gingival and periodontal disease.[1,2] Plaque-induced gingivitis is a reversible inflammatory condition of the oral cavity which when not treated over time can progress into periodontitis that can lead to edentulism eventually. Hence appropriate plaque control measures need to be strictly emphasized.

Conventional mechanical plaque control measures like scaling and root planning may not be sufficient for complete plaque removal due to inaccessibility in the plaque retentive areas, therefore chemical plaque control agents in the form of antimicrobial mouthwashes such as chlorhexidine have been used as adjuncts for a long period of time.[3] The overall antiplaque efficacy of an oral antimicrobial is based on its substantivity and biofilm penetration ability.[3–5] Among the chemical plaque controlling agents chlorhexidine is considered as the gold standard in prevention of gingivitis because of its diverse properties resulting in bacteriostatic and bactericidal activity.[6,8] However, its prolonged use leads to discoloration of teeth and differences in taste perception thereby limiting its use.[6] Hence, new insights have shown that there is a paradigm shift and interest towards the use of herbal products with minimal side effects to cure various diseases including conditions of the oral cavity.

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Fig. 1. Triphala mouthwash.

In this herbal renaissance era various ayurvedic medicines are preferred over the conventional drugs because of its natural substantial activity, advanced safety margins, and low cost.[7] Among the plant-derived natural products which are used as alternatives in treating various conditions of the oral cavity Triphala and Curcumin have gained attention. Triphala an Ayurvedic mixture of 3 herbal products is a Rasayana drug used in Indian system of medicine and has strong anti-oxidant, anti-inflammatory, analgesic, astringent, antimetastatic and immunomodulatory effects.[9–11]

Curcumin a natural spice containing polyphenols has been widely used in several systemic and oral conditions as it has anti-inflammatory, antimicrobial, ant-oxidant and wound healing properties[12–14]

Although there are studies on Triphala and Curcumin mouthwashes[15–22] that were analysed individually, no study has compared the efficacy of Triphala mouthwash to Curcumin mouthwash in the management of gingivitis. Hence the study aimed to evaluate the benefits of Triphala to Curcumin mouthwash against the gold standard chlorhexidine mouthwash in the management of gingivitis.

2. Materials and methods

The patients who reported to the out-patient Department of Periodontology were selected. By purposive sampling, patients of both sexes who fulfilled the inclusion criteria and those who had given informed consent were enrolled in the study. Randomization was done by lottery method and patients were allocated into 3 groups (A), (B), and (C) (flow chart).

Group A – scaling followed by Triphala mouthwash
Group B- scaling and Curcumin mouthwash
Group C – scaling and Chlorhexidine mouthwash

Inclusion Criteria comprised of **s**ystemically healthy patients within the age group of 20–40 both males and females, previously untreated gingivitis, patients with gingival index score of 2 and 3, subjects who were willing to follow the study procedure and instructions.

Exclusion Criteria comprised of patients on medications such as antibiotics and any anti-inflammatory drugs for 3 months, patients using orthodontic appliance**,** allergy to any material in the study**,** alcoholism**,** immunocompromised patients**, s**mokers**,** pregnant and lactating women**,** intellectually disabled individuals.

2.1. Sample size

The sample size was calculated based on the expected difference between the groups, adjusting the alpha error for multiple comparisons[5]. Thus, assuming a power of 90 % with 95 % Confidence interval, the minimum calculated sample size for each group with a clinically important difference of 0.5 and standard deviation of 0.5 was **27** achieving a total of 81.

Fig. 2. Curcumin mouthwash.

2.2. Study design

It was a parallel arm, double-blinded (patient and calibrated examiner who performed randomization and assessed the clinical parameters), randomized controlled clinical study. By purposive sampling, 27 subjects per group were selected. The randomization process was performed by an examiner blinded to the study. The allocation was concealed within opaque envelopes with numbers on them until immediately before treatment to determine which subjects would fall into the 3 groups.

After examination and completion of initial therapy (Scaling), subjects were instructed to rinse with their respective mouthwash twice daily, 30 min after brushing and further instructed to avoid eating and drinking for 30 min after the use of mouthwash. Individuals were also asked to refrain from any other oral hygiene aids.

At each appointment on baseline 7th, 14th day postoperatively, Plaque Index, Gingival Index, Bleeding Index were recorded.

2.3. Ethical clearance and informed consent

The study protocol was approved by the Institutional Ethical Committee (REF: VMSDC/IEC/Approval no. 251). The participants were provided with informed consent. All principles observed in the Declaration of Helsinki (1964, revised in 2008) on experimentation involving humans were observed.

2.4. Materials used in the study

- Commercially available Triphala powder which was formulated into mouthwash.
- Commercially available curcumin mouthwash
- Commercially available chlorhexidine mouthwash

2.5. Preparation of triphala mouthwash[23,35]

A 6 % Triphala mouthwash was prepared by dissolving 60 g of pure Triphala powder in 1 L of distilled water to obtain 6 % of the extract. Sweetening agent and flavouring agent like glycerine (2 ml) and pudina hara (1 ml) respectively were added to the solution in order to improve the patient compliance. The solution was brought to boil for 10 min, cooled and then filtered. The solution was then transferred to dark-coloured bottles and labelled.

2.6. Procedure

The duration of the study was 3 months. The subjects underwent initial therapy (Scaling) after which they were given one of the mouthwashes chosen by lottery method. They were instructed to rinse with the respective mouthwash twice daily, 30 min after brushing and further instructed to avoid eating and drinking for 30 min after use. The subjects were also asked to refrain from any other oral hygiene aids during the study. They were asked to report back on manifestation of any allergic reactions like irritation, itching etc. Patients were recalled on 7th and 14th day for gingival evaluation (Figs. 1–3).

Fig. 3. Chlorhexidine mouthwash.

2.7. Clinical data collection

All the clinical parameters were assessed by a calibrated examiner who was masked to the treatment provided and the following were assessed.

- Plaque index (PI) – Silness and Loe H, 1964[24]
- Gingival Index (GI)- Loe H and Silness J, 1963[24]
- Bleeding Index (BI) – Ainamo and Bay, 1975[25]

2.8. Statistical analysis

Data were entered into Microsoft Excel and analyzed using IBM SPSS Statistics for Windows, Version 20 (IBM Corp., Armonk, N·Y., USA). Normality was checked using the **Shapiro-Wilk test which showed a normal distribution.** The inter-group comparisons for Plaque index, Gingival index and Bleeding index scores were analysed using One-way analysis of variance (ANOVA) and multiple comparisons using Tukey's Honest significant difference test ($\alpha = 0.05$).

The intra-group comparisons for the indices across various time periods within each group were analysed using Repeated-measures ANOVA and by Bonferroni-adjusted pairwise comparisons post hoc test ($\alpha = 0.05$). The statistical significance was set at $p \leq 0.05$.

Table 1
Plaque Index between experimental and control groups at baseline, 7th day and 14th day.

Plaque Index at	Groups	Mean ± SD	p-value
Baseline	I	2.02 ± 0.30	0.103
	II	2.20 ± 0.28	
	III	2.19 ± 0.39	
	Total	2.14 ± 0.34	
7th day	I	1.16 ± 0.33	0.401
	II	1.05 ± 0.32	
	III	1.18 ± 0.49	
	Total	1.13 ± 0.38	
14th day	I	0.24 ± 0.20	0.000[a]
	II	0.08 ± 0.09	
	III	0.50 ± 0.51	
	Total	0.28 ± 0.36	

I - Triphala mouthwash; II - Curcumin mouthwash; III - Chlorhexidine mouthwash.
[a] Statistically Significant ($p \leq 0.05$).

3. Results

The mean plaque index scores between the groups at baseline and 7th day are not statistically significant. At 14th day it was found to be statistically significant (0.000) Table 1.

Table 2
Post hoc Tukey's Test of plaque Index.

Dependent Variable	(I) Groups	(J) Groups	p-value
Plaque Index at Baseline	Triphala mouthwash	Curcumin mouthwash	0.135
		Chlorhexidine mouthwash	0.175
	Curcumin mouthwash	Triphala mouthwash	0.135
		Chlorhexidine mouthwash	0.990
	Chlorhexidine mouthwash	Triphala mouthwash	0.175
		Curcumin mouthwash	0.990
Plaque Index at 7th day	Triphala mouthwash	Curcumin mouthwash	0.543
		Chlorhexidine mouthwash	0.976
	Curcumin mouthwash	Triphala mouthwash	0.543
		Chlorhexidine mouthwash	0.418
	Chlorhexidine mouthwash	Triphala mouthwash	0.976
		Curcumin mouthwash	0.418
Plaque Index at 14th day	Triphala mouthwash	Curcumin mouthwash	0.175
		Chlorhexidine mouthwash	0.014
	Curcumin mouthwash	Triphala mouthwash	0.175
		Chlorhexidine mouthwash	**0.000**[a]
	Chlorhexidine mouthwash	Triphala mouthwash	0.014
		Curcumin mouthwash	**0.000**[a]

[a] Statistically significant.

Table 3
Gingival index.

Gingival Index at	Groups	Mean ± SD	p-value
Baseline	I	1.96 ± 0.37	0.014[a]
	II	2.25 ± 0.34	
	III	2.20 ± 0.38	
	Total	2.14 ± 0.38	
7th day	I	1.21 ± 0.31	0.002[a]
	II	0.86 ± 0.43	
	III	1.26 ± 0.54	
	Total	1.11 ± 0.47	
14th day	I	0.19 ± 0.24	0.001[a]
	II	0.08 ± 0.13	
	III	0.48 ± 0.59	
	Total	0.25 ± 0.41	

[a] Statistically Significant ($p \leq 0.05$).

When the plaque scores were analysed on the 14th day, no statistical significance was found between Triphala mouthwash to Curcumin mouthwash, but when compared to Chlorhexidine mouthwash it was shown to have statistically significance ($p = 0.014$). Similarly, when Curcumin was compared to chlorhexidine it was statistically significant ($p = 0.000$). Chlorhexidine against Triphala and Curcumin mouthwashes also showed statistical significance (Table 2).

The mean gingival index scores between the groups at baseline, 7th day and 14th day are all found to be statistically significant. Table 3.

Table 4 shows statistical significance of Triphala to curcumin mouthwash at baseline and 7th day. Similarly, when curcumin was compared to Triphala there was a statistical significance at baseline and 7th day. At 14th-day curcumin shows statistical significance when compared to chlorhexidine and Triphala ($p = 0.01$), ($p = 0.02$).

The mean bleeding index scores between experimental and control groups were not found to be statistically significant (Table 5).

Post hoc Tukey's Test of Bleeding Index between experimental and control groups at baseline, 7th day and 14th day were not statistically significant (Table 6).

The multivariate test results for time alone on plaque index, gingival index and bleeding index is found to be statistically significant, Wilks' lambda = 0.031, F (6,308) = 239.152, $p \leq 0.05$. This effect was qualified by a statistically significant time × group interaction effect as well. Wilks' lambda = 0.722, F (12,407) = 4.448, $p \leq 0.05$. (Table 7).

Table 4
Post hoc Tukey's Test of Gingival Index between experimental and control groups at baseline, 7th day, and 14th day.

Dependent Variable	(I) Groups	(J) Groups	p-value
Gingival Index at Baseline	Triphala mouthwash	Curcumin mouthwash	0.017
		Chlorhexidine mouthwash	0.057
	Curcumin mouthwash	Triphala mouthwash	0.017
		Chlorhexidine mouthwash	0.883
	Chlorhexidine mouthwash	Triphala mouthwash	0.057
		Curcumin mouthwash	0.883
Gingival Index at 7th day	Triphala mouthwash	Curcumin mouthwash	0.013
		Chlorhexidine mouthwash	0.913
	Curcumin mouthwash	Triphala mouthwash	0.013
		Chlorhexidine mouthwash	0.004
	Chlorhexidine mouthwash	Triphala mouthwash	0.913
		Curcumin mouthwash	0.004
Gingival Index at 14th day	Triphala mouthwash	Curcumin mouthwash	0.522
		Chlorhexidine mouthwash	0.017
	Curcumin mouthwash	Triphala mouthwash	0.022
		Chlorhexidine mouthwash	0.001
	Chlorhexidine mouthwash	Triphala mouthwash	0.017
		Curcumin mouthwash	0.001

Table 5
Bleeding Index between experimental and control groups at baseline, 7th day and 14th day.

Bleeding Index at	Groups	Mean ± SD	p-value
Baseline	I	0.74 ± 0.15	0.092
	II	0.85 ± 0.11	
	III	0.86 ± 0.31	
	Total	0.82 ± 0.21	
7th day	I	0.21 ± 0.12	0.085
	II	0.21 ± 0.12	
	III	0.33 ± 0.35	
	Total	0.25 ± 0.23	
14th day	I	0.03 ± 0.02	0.121
	II	0.02 ± 0.01	
	III	0.07 ± 0.18	
	Total	0.04 ± 0.10	

4. Discussion

It was a 3 month parallel arm randomized controlled clinical study where systemically healthy patients within the age group of 20–40 with previously untreated gingivitis and a gingival index score of 2 and 3 were treated. This was a comparative study where Triphala and Curcumin mouthwashes were compared for their efficacy with the gold-standard chlorhexidine. Patients of both sexes who fulfilled the inclusion criteria and written consent were enrolled in the study using purposive sampling. Patients allocated into 3 groups namely A, B, and C by randomization received 3 different mouthwashes. After examination and completion of initial therapy (scaling), Plaque, Gingival and Bleeding indices were noted.

The mean plaque index scores between experimental and control groups using one way ANOVA at 14th day is (0.24 ± 0.20- Group I, 0.08 ± 0.09- Group II, 0.50 ± 0.51- Group III) found to be statistically significant (0.000). (Table 1). This could be attributed to the maintenance of oral hygiene which could have led to the overall positive outcome. Various studies have shown the anti-plaque efficacy of Triphala,

Table 6
Post hoc Tukey's Test of bleeding Index between experimental and control groups at baseline, 7th day and 14th day.

Dependent Variable	(I) Groups	(J) Groups	p-value
Bleeding Index at Baseline	Triphala mouthwash	Curcumin mouthwash	0.158
		Chlorhexidine mouthwash	0.126
	Curcumin mouthwash	Triphala mouthwash	0.158
		Chlorhexidine mouthwash	0.993
	Chlorhexidine mouthwash	Triphala mouthwash	0.126
		Curcumin mouthwash	0.993
Bleeding Index at 7th day	Triphala mouthwash	Curcumin mouthwash	1.000
		Chlorhexidine mouthwash	0.127
	Curcumin mouthwash	Triphala mouthwash	1.000
		Chlorhexidine mouthwash	0.134
	Chlorhexidine mouthwash	Triphala mouthwash	0.127
		Curcumin mouthwash	0.134
Bleeding Index at 14th day	Triphala mouthwash	Curcumin mouthwash	0.948
		Chlorhexidine mouthwash	0.240
	Curcumin mouthwash	Triphala mouthwash	0.948
		Chlorhexidine mouthwash	0.134
	Chlorhexidine mouthwash	Triphala mouthwash	0.240
		Curcumin mouthwash	0.134

Curcumin and Chlorhexidine.

Using post hoc analysis the plaque scores analysed at 14th day between the groups have shown that Triphala mouthwash when compared to chlorhexidine mouthwash is statistically significant ($p = 0.014$). Similarly, when curcumin was compared to chlorhexidine it was found to be statistically significant ($p = 0.000$). Chlorhexidine against Triphala and Curcumin showed statistical significance (Table 2).

The presence of tannins in Triphala could have effectively reduced the number of bacteria that is available for binding to the tooth surface thereby showing its antiplaque efficacy.[26]

The antiplaque efficacy of curcumin could be due to its strong antibacterial action (biofilm formation) as in various experimental and clinical studies.[27–31]

Chlorhexidine is bacteriostatic at lower concentrations and bactericidal at higher concentrations hence there is very strong evidence for the antiplaque effect of chlorhexidine mouthwash and can be used as adjunct to conventional oral hygiene methods.[32]

The mean gingival index scores between experimental and control groups at baseline, 7th day and 14th day showed statistical significance (0.014-Group I, 0.002- Group II, 0.001-Group III). (Table 3).

Post hoc Tukey's Test showed Triphala mouthwash when compared to curcumin mouthwash was statistically significant at baseline and 7th day. Similarly, when curcumin was compared to Triphala there was a statistical significance at baseline and 7th day. At 14th day curcumin showed statistical significance to chlorhexidine and Triphala (Table 4).

This is in accordance to various studies which showed that Triphala and Curcumin play important roles in the reduction of gingival inflammation due to the antiseptic, antibacterial, and anti-inflammatory effects of its components.[33] Although both the herbal mouthwashes are as efficacious as chlorhexidine in the reduction of gingivitis the results have shown curcumin to be superior in terms of reduction of gingival inflammation. This could be due to its great anti-inflammatory and antioxidant properties. According to Hu P it supresses inflammation by reducing the pro-inflammatory mediators.[34]

The mean bleeding index scores between experimental and control groups at baseline, 7th day, and 14th day are not found to be statistically significant (Table 5, Table 6).

The multivariate test results taking time alone in consideration between the groups on Plaque index, Gingival index and Bleeding index is found to be statistically significant, Wilks' lambda = 0.031, $F(6,308) = 239.152$, $p \leq 0.05$. This effect was qualified by a statistically significant time × group interaction effect as well. Wilks' lambda = 0.722, $F(12,407) = 4.448$, $p \leq 0.05$ (Table 7).

Intra-group comparison between the groups at various time periods at baseline, 7th day, and 14th day for assessment of Plaque Index, Gingival Index and Bleeding Index is found to be statistically significant.

4.1. Limitations and future recommendations

The mouthwashes were shown to be effective against plaque induced gingivitis although curcumin showed greater reduction of gingival inflammation compared to the other two mouthwashes. The limitations include small sample size in each group, non-assessment of safety and microbiological parameters, and improper oral hygiene practice by few patients. Variation in brushing techniques could have affected the results. As patients were given mouthwashes for in home use, failure of compliance could have resulted in bias.

5. Conclusion

The mouthwashes were found to be effective in reducing the Plaque scores, Gingival scores and Bleeding scores, although Curcumin showed greater results in suppressing gingival inflammation. Hence herbal mouthwashes with no side effects can be considered as an alternative to chlorhexidine. Further longitudinal studies are also required to rule out the superior effects of curcumin mouthwash in suppressing gingival inflammation compared to the other mouthwashes.

Conflict of interest

The authors have no conflict of interest.

Contribution of authors

Divya Bharathi. S- 1st author who did the study and collected articles for manuscript.

Aiswarya S. P. – 2nd author did the study, assisted in manuscript preparation, collection of photographs and statistics.

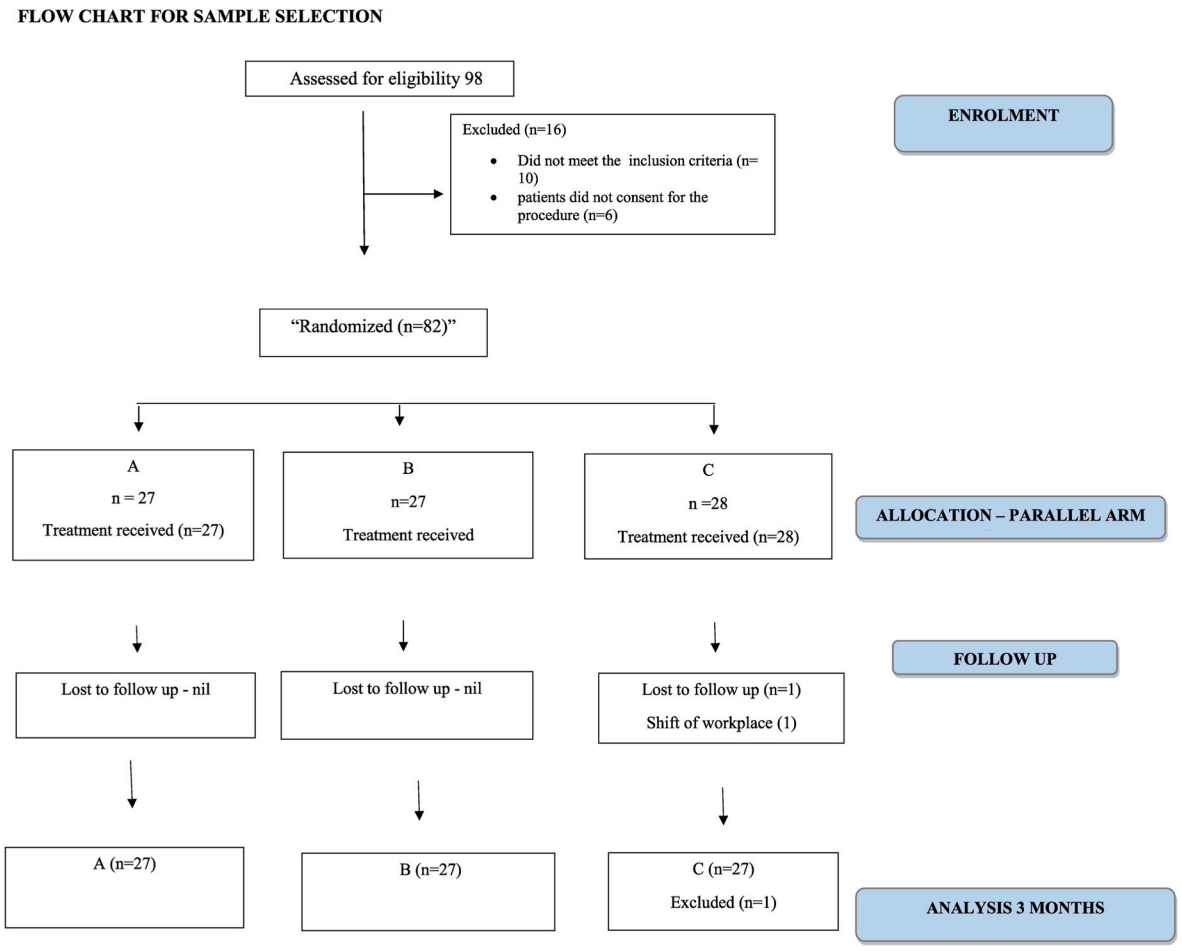
Dr. Archana R Sankar- Guide for the students, chose the topic, guided the students to carry forward the study, manuscript preparation, correction of manuscript.

Table 7
Multivariate test results for time (within-subjects factor) and time × group interaction.

Multivariate[a]						
Within Subjects Effect		Value	F	Hypothesis df	Error df	p-value
Time	**Wilks' Lambda**	0.031	239.152	6.000	308.000	0.000[a]
Time[a] Groups	**Wilks' Lambda**	0.722	4.448	12.000	407.737	0.000[a]

a. Design: Intercept + Groups
Within Subjects Design: Time

[a] Statistically Significant ($p < 0.05$); F – Repeated measures ANOVA.



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Patient's/Guardian's consent

The study protocol was approved by the Institutional Ethical Committee (REF: VMSDC/IEC/Approval no. 251). The participants were provided with written informed consent. All principles observed in the Declaration of Helsinki (1964, revised in 2008) on experimentation involving humans were observed.

Declaration of competing interest

The authors have no conflict of interest.

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