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ORIGINAL ARTICLE

Comparative Evaluation of Green Tea Catechin, a Local Drug Delivery System, as an Adjunct to Scaling and Root Planing with Scaling and Root Planing Alone in Chronic Periodontitis: A Microbiological Study

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ABSTRACT

Introduction: To evaluate the adjunctive use of locally delivered green tea catechin with scaling and root planing compared with scaling and root planing alone in the management of chronic periodontitis.

Materials and methods: Twenty patients with two sites in the contralateral quadrants with probing pocket depth of 5 to 7 mm were selected. Each of the sites was assessed for the sulcus bleeding index and relative clinical attachment level at baseline, 30 and 45 days, and for microbiological analysis at baseline and 45 days. Test sites received scaling and root planing along with green tea catechin gel and control sites received scaling and root planing alone.

Results: The intragroup comparison results showed significant reduction of the clinical parameter from baseline to 30 days and from baseline to 45 days and for microbiological analysis from baseline to 45 days, which were statistically significant within both the control and test groups. Intergroup comparison of clinical and microbiological parameters showed a statistically more significant reduction in the test group.

Conclusion: In our study, it can be concluded that green tea catechin local delivery along with scaling and root planing is more effective than scaling and root planing alone.

Keywords: Chronic periodontitis, Green tea catechin, Local drug delivery, Scaling and root planing.

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INTRODUCTION

Periodontitis describes a group of related inflammatory diseases resulting in the destruction of the tissues that support the tooth.

The standard treatment for periodontitis is scaling and root planing, but it is difficult to eliminate complete subgingival bacteria and calculus due to complex anatomy of teeth and mechanical limitation due to the size of instrument to reach in deep pocket.[1]

Local drug delivery system is designed to deliver agents into the base of the periodontal pocket to retain therapeutic levels for a prolonged period of time. This nonsurgical therapy can halt the periodontal disease and limit the extent of surgical intervention needed in future.[2]

Green tea extract is a naturally occurring antimicrobial agent obtained from *Camellia sinensis.* Green tea extract has been used in the form of chewing gums, mouth rinses, gum paints, and dentifrices as part of a preventive periodontal maintenance regimen.[3]

The most important green tea polyphenols are tannins and flavonoids. The main flavonoids present in green tea include catechins. The four major catechins are Epigallocatechin-3-gallate (59%), epigallocatechin (19%), epicatechin-3-gallate (13.6%), and epicatechin (6.4%).[4,5]

Green tea also contains carotenoids; tocopherols; ascorbic acid; minerals, such as Cr, Mn, Zn; and certain phytochemical compounds.[4,5] Numerous studies in a variety of experimental animal models have demonstrated that catechin possesses antioxidant, antimutagenic, anti-inflammatory, antibacterial, antiviral, and above all cancer-preventive properties.[4-6] Lin et al[7] in 2003 have said that green tea possesses most highest epigallocatechin among all the teas. Green tea showed antimicrobial effects against black pigmented Gram-negative anerobic rods and its catechin also inhibited collagenase activity, thus limiting tissue destruction.[8]

In this study, green tea catechin was tried as a local drug delivery agent as it possesses antioxidant, antimicrobial, and anti-inflammatory properties to evaluate its effect

on clinical and microbiological parameters in chronic periodontitis patients.

MATERIALS AND METHODS

A total of 20 individuals with chronic periodontitis were selected from the patients visiting the Outpatient Department of Periodontology, Bharati Vidyapeeth Deemed University, Dental College and Hospital, Pune. An informed written consent was obtained from each individual.

On the day of the treatment, before the procedure, a short case history including specific clinical parameters, such as sulcus bleeding index[9] and clinical attachment level[10] using UNC-15 probe, was recorded. A custom-made acrylic stent was used to standardize the measurement of the clinical parameters. Subgingival plaque samples were taken from pocket with the help of curette before scaling and root planing. The sites were divided into two different quadrants having a probing depth of 5 to 7 mm. Experimental site scaling and root planing was performed and gel containing green tea catechin (1% of drug) was used as a local drug delivery. Control site scaling and root planing was performed. After the procedure, both the experimental site and control site were covered with periodontal dressing. The patients were given oral hygiene instructions.

The patients were recalled after 7 days for the removal of the dressing. The patients were recalled after 30 days for the recording of clinical parameters and after 45 days for the recording of both clinical and microbiological parameters. Subjective and objective criteria were assessed after 7, 30, and 45 days.

RESULTS

Comparison of Mean Sulcus Bleeding Index Scores within Each Group

Control Sites

The mean sulcus bleeding index score reduced from 3.75 to 2.55 on 30th day and 1.55 on 45th day. This reduction in mean score was statistically significant on 30th day as well as on 45th day when compared with baseline (Table 1).

Table 1: Intragroup comparison of mean sulcus bleeding index

	Control group (n = 20)		*Experimental group (n = 20)*	
	Mean ± SD	*Paired comparison*	*Mean ± SD*	*Paired comparison*
0 day	3.75 ± 0.71	–	4.00 ± 0.72	–
30th day	2.55 ± 0.60	z = 4.179 p = 0.000*	2.10 ± 0.44	z = 4.089 p = 0.000*
45th day	1.55 ± 0.51	z = 4.093 p = 0.000*	1.10 ± 0.30	z = 4.030 p = 0.000*

SD: Standard deviation; *: Statistically significant as p<0.05; NS: Statistically nonsignificant as p>0.05

Experimental Sites

The mean sulcus bleeding index score reduced from 4.00 to 2.10 on 30th day and 1.10 on 45th day. This reduction in mean score was statistically significant on 30th day as well as on 45th day when compared with baseline.

Intragroup observations showed the reduction of sulcus bleeding index for both the treatment groups, which was statistically significant.

Comparison of Percentage Reduction of Mean Sulcus Bleeding Index Scores between Two Groups

Favorable results by 15% on the 30th day and 13.1% on the 45th day were seen in relation with experimental group when compared with control group (Table 2).

Comparison of Mean Relative Attachment Level Scores within Each Group

Control Sites

The gain in mean relative attachment level was 1.05 on 30th day and 1.87 on 45th day. This gain in mean score was statistically significant on 30th day as well as on 45th day when compared with baseline (Table 3, Graph 1).

Experimental Sites

The mean relative attachment level was 2.15 on 30th day and 3.07 on 45th day. This gain in mean score was statistically significant on 30th day as well as on 45th day when compared with baseline.

Intragroup observations showed statistically significant gain in relative attachment level for both of these treatment groups.

Comparison of Percentage Gain in Mean Relative Attachment Level Scores at 30th Day and 45th Day between Two Groups

The percentage gain of clinical attachment levels between 0 and 45 days for the control was 21.0% and for

Table 2: Intergroup comparison of mean sulcus bleeding index

	Control group		*Experimental group*		*Inter group comparison (p-value)*[!]
	Mean	*SD*	*Mean*	*SD*	
% change at 30th day	32.0	8.1	47.0	9.4	z = 4.159 p = 0.000*
% change at 45th day	59.0	10.6	72.1	6.1	z = 3.950 p = 0.000*

SD: Standard deviation; *:Statistically significant as p<0.05; NS: Statistically nonsignificant as p>0.05

experimental group was 34.3%, which was also statistically significant. Favorable results by 8.8% on the 30th day and 13.3% on the 45th day were seen in relation with experimental group when compared with the control group (Table 4).

It has been observed that no adverse effects like discomfort, burning sensation, and dryness/soreness were reported by the subjects as recorded with the help of the subjective criteria. No evidence of staining of teeth and ulcer formation was observed as recorded with the help of objective criteria.

Comparison of Mean Total Microbial Count Scores within Each Group

Control Sites

The mean total microbial count reduced from $1259 \times 10^2 \pm 199 \times 10^2$ to $1004 \times 10^2 \pm 130 \times 10^2$ from 0 day to 45th day. This reduction in mean score was statistically significant on 45th day when compared with baseline (Table 5, Graph 2).

Experimental Sites

The mean total microbial count reduced from $8 \times 10^2 \pm 138 \times 10^2$ to $801 \times 10^2 \pm 80 \times 10^2$ from 0 day to 45th day. This reduction in mean score was statistically significant on 45th day when compared with baseline.

Table 3: Intragroup comparison of mean relative attachment level

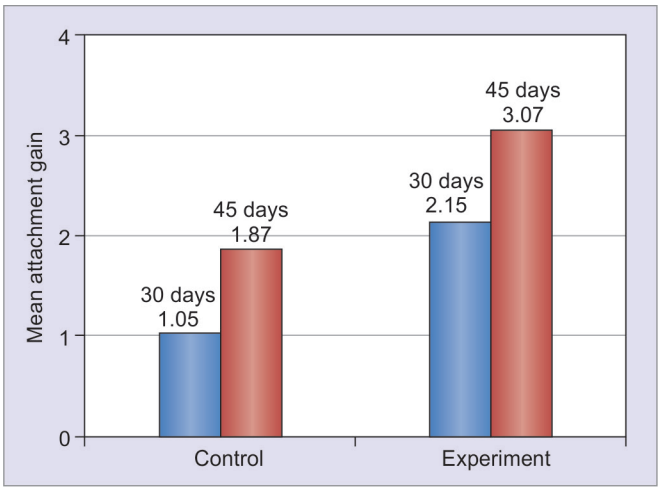
	Control group (n = 20)		*Experimental group (n = 20)*	
	Mean ± SD	*Paired comparison*	*Mean ± SD*	*Paired comparison*
0 day	9.15 ± 1.56	–	9.10 ± 1.58	–
After 30th day	7.90 ± 1.33	z = 4.177 p = 0.000*	6.95 ± 1.53	z = 4.130 p = 0.000*
After 45th day	7.02 ± 1.30	z = 4.052 p = 0.000*	6.02 ± 1.48	z = 4.027 p = 0.000*

SD: Standard deviation; *: Statistically significant as p<0.05; NS: Statistically nonsignificant as p>0.05

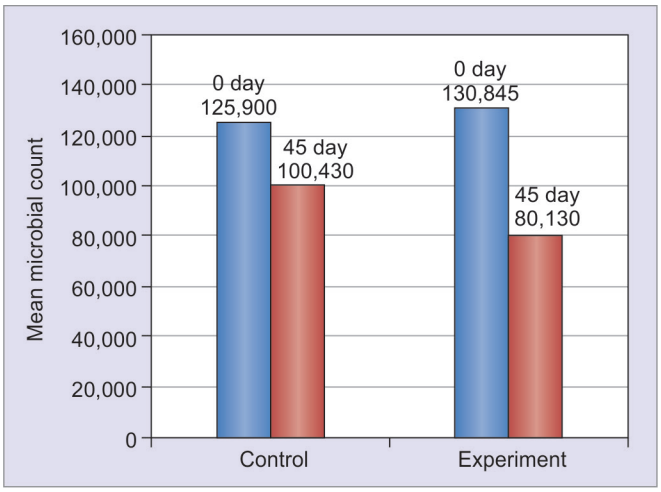
Table 4: Intergroup comparison of mean relative attachment level

	Control group		*Experimental group*		*Intergroup comparison (p-value)*[!]
	Mean	*SD*	*Mean*	*SD*	
% change after 30th day	15.2	7.0	24.0	5.6	z = 3.697 p = 0.000*
% change after 45th day	21.0	5.7	34.3	6.4	z = 4.903 p = 0.000*

SD: Standard deviation; *: Statistically significant as p<0.05; NS: Statistically nonsignificant as p>0.05



Graph 1: Gain in relative attachment level



Graph 2: Total microbial count

Table 5: Intragroup comparison of mean total microbial count

	Control group (n = 20)		*Experimental group (n = 20)*	
	Mean ± SD	*Paired comparison*	*Mean ± SD*	*Paired comparison*
At 0th day	$1259 \times 10^2 \pm 199 \times 10^2$	–	$1308 \times 10^2 \pm 138 \times 10^2$	–
At 45th day	$1004 \times 10^2 \pm 130 \times 10^2$	z = 3.920 p = 0.000*	$801 \times 10^2 \pm 80 \times 10^2$	z = 4.920 p = 0.000*

SD: Standard deviation; *: Statistically significant as p<0.05; NS: Statistically non-significant as p>0.05

Intragroup observations showed statistically significant reduction of total microbial count for both the treatment groups.

Comparison of Percentage Reduction of Mean Total Microbial Count Scores at 45th Day between Two Groups

Favorable results by 19.5% on the 45th day were seen in relation with experimental group when compared with the control group (Table 6).

Table 6: Intergroup comparison of mean total microbial count

	Control group		Experimental group		Inter group comparison (p-value)!
	Mean	SD	Mean	SD	
% change at 45th day	19.0	11.4	38.5	5.2	z = 4.382 p = 0.000*

SD: Standard deviation; *: Statistically Significant as p<0.05; NS: Statistically Non-significant as p>0.05

DISCUSSION

Green tea possesses the highest amount of epigallocatechin among all the teas. Periodontal diseases are considered as infections affecting the periodontium with bacterial etiology, an immune response, and tissue destruction. Green tea showed antimicrobial effects against black pigmented Gram-negative anerobic rods and its catechin also inhibited collagenase activity, thus limiting tissue destruction.[8]

In our study, intragroup observations showed the reduction of sulcus bleeding index for both the treatment groups, which were statistically significant. There are no studies in the literature with green tea catechin as local drug delivery, which have evaluated its effect on bleeding on probing but it has been evaluated with other formulations of green tea. A study was carried out by Rassameemasmaung et al[11] to determine the effect of green tea mouthwash on oral malodor, plaque, and gingival inflammation. Gingivitis subjects who had over 80 ppb of volatile sulfur compounds (VSC) in the morning breath were randomly assigned into green tea or placebo mouthwash group. At baseline, VSC, plaque Index, and papillary bleeding index were recorded. After the use of assigned mouthwash twice daily for 4 weeks, findings similar to that described in our study that green tea mouthwash could significantly reduce papillary bleeding index were obtained. Statistically, more significant reduction of sulcus bleeding index were seen in the experimental group. Similar results were observed with other formulations of green tea catechin. A study was carried out by Jenabian et al[12] to assess the efficacy of green tea mouthwash and compared with normal saline. Twenty-five students were recruited in each arm of the study. Both the mouthwashes of 5 mL of each were used for five consecutive weeks. Gingival index, plaque index, and bleeding index were recorded at baseline and five consecutive weeks. Similar to our results, bleeding index showed higher improvement for green tea group.

The intragroup observation showed statistically significant gain in relative attachment level for both of these treatment groups. These observations are similar to that of Gadagi et al[13] who evaluated the efficacy of green tea catechin strips in chronic periodontitis patients associated with and without diabetes mellitus. In each patient, test and control sites were identified for the placement of green tea and placebo strips respectively. Gingival index, probing pocket depth, and clinical attachment level were examined at baseline, 1st, 2nd, 3rd, and 4th weeks. They found statistically significant gain in clinical attachment level in both of the groups. These observations are similar to that of Chava and Vedula[14] who prepared thermoreversible sustained-release green tea catechin gel and tested for its *in vitro* release characteristics. Then *in vivo* split mouth study was conducted and green tea and placebo gels were placed at test and control sites respectively, as an adjunct to phase I periodontal therapy. The assessment of relative clinical attachment level was done at baseline and at 4 weeks. Significant gain was achieved in clinical attachment level from baseline to 4th week at the test sites.

In our study, intragroup observations showed statistically significant reduction of total microbial count for both the treatment groups. The observations of the present study coincide with those of Kudva et al[15] who observed clinical and microbiological effect of green tea catechin strips as an adjunct to scaling and root planing and compared it with scaling and root planing alone at baseline, 1st week, and 21 days. The microbiological analysis showed improvements within each group. A study was carried out by Hattarki et al[16] to check the efficacy of green tea catechin strips as a local drug delivery agent as an adjunct to scaling and root planing and compared it with scaling and root planing alone. They assessed the clinical parameters (probing pocket depth, gingival index, plaque index) and microbiological parameters (red complex organisms using polymerase chain reaction) at baseline, 1st and 5th week after treatment. Similar to our study, the microbial analysis showed improvements within each group throughout the study. Statistically more significant higher reduction was observed in the microbiological count in the experimental group. Similar results were obtained by Hirasawa[8] who evaluate the usefulness of green tea catechin for the improvement of periodontal disease by assessing clinical, enzymatic, and microbiological parameters. Hydroxypropylcellulose strips containing green tea catechin as a slow release local delivery system were applied in pockets in patients once a week for 8 weeks in both scaled and nonscaled groups. Similar to our study, black pigmented Gram-negative anaerobic rods decreased more in the experimental group.

Jayaprakash[13] carried out a study which incorporated green tea extract into hydroxypropyl methylcellulose and investigated its efficacy in chronic periodontitis patients associated with and without diabetes mellitus. In each patient at the test and control sites, green tea and placebo strips were placed. Gingival Index, probing pocket depth, and clinical attachment level were examined at baseline, 1st, 2nd, 3rd, and 4rth weeks. Microbiological analysis for *Porphyromonas gingivalis* and *Aggregatibacter actinomycetemcomitans* was performed at baseline and 4th week. Similar to our study, microbial analysis showed more reduction at the test site. Hattarki et al[16] performed a study to check the efficacy of green tea catechin strips as a local drug delivery agent as an adjunct to scaling and root planing and compared it with scaling and root planing alone. They assessed the clinical parameters and microbiological parameters (red complex organisms using polymerase chain reaction) which were recorded at baseline, 1st and 5th week after treatment. A significantly greater reduction in *Tannerella forsythia* at 1st and 5th week and *P. gingivalis* at 1st week was observed in the study group when compared with the control group. Similar to our study, the microbial analysis showed more reduction in the study group. Kudva et al[15] carried out a study to test green tea catechin as a local drug delivery agent. They observed clinical and microbiological effect of green tea catechin strips as an adjunct to scaling and root planing and compared it with scaling and root planing alone at baseline, 1st week, and 21 days. Intergroup comparison of microbiological results obtained between control and test sites showed a higher reduction in occurrence of *A. actinomycetemcomitans*, *Fusobacterium* species, *Capnocytophaga* species, and *Prevotella intermedia* in the test group. These results are similar to those of our study.

CONCLUSION

It can be concluded that the experimental local drug delivery system containing 1% green tea catechin gel can be used effectively as an adjunct to scaling and root planing and is more effective than scaling and root planing alone in the treatment of chronic periodontitis.

It is clear from our study that 1% green tea catechin gel along with scaling and root planing is effective in reducing sulcus bleeding index, resulting in clinical attachment gain. It also reduces the microbial count as evident from the microbiological study.

The local drug delivery system used in the present study is simple and easy to use. The syringe method allows ease of administration. The viscosity of the gel formulation can reduce clearance of the active agents from the periodontal pocket. It is also biologically accepted without any side effects and was well tolerated and accepted by all the subjects.

To elucidate the use of this local drug delivery system in the future, a long-term study could be carried out with a larger sample size. An attempt is required to find out the efficacy of 1% green tea catechin gel in comparison with other commercially available local delivery drugs.

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