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Evaluate the Efficiency of Green Tea Gel in Improving the Pathophysiology in Chronic Periodontitis Patients Based on Local Drug Delivery as an Adjuvant to Scaling and Root Planing

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Abstract

Aim: To measure the change in depth of periodontal pockets after performing local drug delivery with GREEN TEA GEL and comparing it with chlorhexidine gel (Hexidine Gel).

Materials Method: A total of 20 chronic periodontitis patients participated based on the inclusion and exclusion criteria. Complete Scaling and Root Planing (SRP) was performed for all subjects and LDD was done using green tea gel on one site and with hexidine gel on contralateral site. Following parameters including Gingival Index (GI), Clinical Attachment Loss (CAL), and Probing Pocket Depth (PPD) were recorded at baseline and on the 28th day.

Results: During follow up being done on 28th , tooth sites which received green gel showed significantly lower mean scores (GI=1.72, p=0.006,CAL=1.60,p=0.003 and PPD=3.83 mm,) as compared to baseline (GI=2.00, CAL=1.90, and PPD=4.79).

Conclusion: Green tea gel was found be successful in reducing pocket depths and inflammation, after 4 weeks, in chronic periodontitis patients, when been used as an LDD agent as an adjuvant to SRP.

Keywords: Chronic periodontitis • Local drug delivery gel • Green tea extract

Abbreviations: SRP: Scaling and Root Planing; LDD: Local Drug Delivery; GI: Gingival Index; CAL: Clinical Attachment Loss; PPD: Probing Pocket Depth

Introduction

Chronic periodontitis is basically an inflammatory disease having an infectious a etiology resulting in loss of tooth supporting structures (periodontal ligament and alveolar bone). It is mainly associated with misbalance between commensal microbiota and host response and is clinically diagnosed by the loss of supporting structures and bleeding on probing from the pockets. Formation of biofilm (with abundance of microorganisms) on to the tooth structure basically leads to the inflammation of gingiva which leads to the formation of periodontal pockets, which ultimately progresses towards the wrecking of the supporting periodontal tissues [1]. Periodontal treatment aims at removing the biofilm formation on the tooth structures, thus prevent the inflammation and destruction of periodontal tissues. Mechanical debridement doesn't remove the pathogens from the base of pockets thus various local drug delivery systems (chips, gels, fibres, microspheres) are used as an adjuvant to SRP to inhibit the development of various periodontal pathogens or modulating the inflammatory response, thereby limiting the destruction of periodontal tissue [2,3].

Green tea is considered to be the one of the most popular beverages in the world obtained from Camellia sinensis. Green tea is basically a naturally occurring antimicrobial which is used in the form of dentifrices, chewing gums, mouth rinses and gum paints as part of a preventive periodontal maintenance regimen [3,4]. Green being rich in catechins which includes four major catechins namely Epigallocatechin-3-gallate (59%), epigallocatechin (19%), epicatechin-3-gallate (13.6%), and epicatechin (6.4%).4 various properties of catechin make green tea gel suitable for their use as local drug delivery agents.

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Actions of catechins include

- Best antioxidant
- Anti-bacterial
- Anti-inflammatory
- Inhibits elastase and collagenase
- Inhibits platelet aggregation
- Anti-viral
- Anti-mutagenic

Hence present study, attempts to prepare green tea gel and use it as local drug delivery (LDD) agents as an adjuvant to SRP and evaluate its efficacy in improving the clinical parameters (GI, CAL, and PPD) in chronic periodontitis patients [4,5].

Materials and Methods

A total of 20 individuals with chronic periodontitis were selected from the patients visiting the outpatient Department of Periodontics, Kanti Devi Dental College and Hospital, Mathura. An informed written consent was obtained from each individual.

Preparation of green tea gel

Green tea gel was prepared by COLD TECHNIQUE in the Rajiv Academy for Pharmacy, Mathura, India. Green tea leaves were used for the preparation of gel which was obtained from, WAGH BAKRI GREEN TEA. 1 g/100 ml of solution of distilled water and green tea leaves were taken. Fractional distillation of the green tea leaves was done to get the pure extract (2-3 days). 1.5% weight/volume of Carbopol 934p was added to the extract and it was then mixed on a Magnetic Stirrer. The preparation was stored at 4°C overnight. Then the gel was dispensed in syringe for local drug delivery.

Study design

This research included a split-mouth randomized controlled study design.

Categorization of the study patients was done into two groups

1. **Group A (test):** 20 patients, treated with scaling and root planing (SRP), received green tea gel as LDD agent in the periodontal pocket.
2. **Group B (control):** 20 patients, treated with SRP received hexidine gel as LDD agent in periodontal pockets.

The right and left quadrants were coded and teeth satisfying the inclusion criteria with probing pocket depth of 4-6 mm were selected and recorded by the principal investigator. All subjects underwent phase I therapy including SRP at the first visit, and baseline scores for Gingival Index (GI), Clinical Attachment Loss (CAL), and probing pocket depth (PPD) were recorded. Only one investigator performed the clinical evaluations throughout the study. Prepared green tea gel and hexidine gel were placed into the periodontal pocket randomly in either quadrant by the operating investigator. The quadrant receiving green tea gel was coded for the test group, and the contralateral quadrant receiving hexidine gel was coded for the control group. The clinical parameters including Gingival Index (GI), Clinical Attachment Loss (CAL), and Probing Pocket Depth (PPD) were recorded at baseline, prior to local delivery of green tea gel in Group A and of hexidine gel in Group B and recording of parameters was done after 28 days of LDD treatment.

The local drug delivery

After performing complete scaling and root planing and irrigating with saline in both the groups, Green tea gel and Hexidine gel were locally delivered into the periodontal pockets in Group A patients and Group B patients respectively with the help of a blunt cannula syringe. Patients were advised to avoid chewing hard, sticky foods and brushing or using any interdental aids at the drug-delivered site for a week.

Inclusion criteria

- Patients diagnosed as having Chronic Periodontitis based on the presence of local factors, associated clinical findings.
- Patients with probing depths of 4-6 mm in >30% of sites.
- Patients willing to engage in following study and maintain regular follow ups.

Exclusion criteria

- Patients having systemic disease due to the harmful effects of green tea caffeine.
- Patients who have received any tropical or systemic antimicrobial treatment in the past 6 months, or any mouthwash.
- Patients who have undergone periodontal treatment in last 6 months.
- Patients who are pregnant and lactating mothers.
- Smokers

Statistical analysis

- All the required data were obtained and sent for statistical analyses using SPSS version 18.0 IBM SPSS.
- $P<0.05$ was considered to be statistically significant.
- Paired t-test was used for the comparison of clinical parameters of test and control groups from baseline to 28 days (Tables 1-3).
- Independent sample t-test was used for intergroup comparison of both the groups (Table 4).

Results

Statistical analysis of clinical parameters included in present study such as Gingival Index (GI), Clinical Attachment Loss (CAL), Probing Pocket Depth (PPD), showed statistical significant results from baseline to 28th day.

Gingival index (Table 1)

Mean GI at baseline

- Test group-2.00
- Control groups-2.00

Mean GI after 28 days

- Test group-1.72
- Control groups-1.60

The result showed highly significant difference, statistically in gingival index

Table 1. Means of gingival index at baseline and after 28 days for both the test and control groups.

Group	Duration	N	Mean	S.D	t-test	P-Value	Inferences
GI	Baseline	20	2	0.21	3.258	0.006	S
	Green tea gel	20	1.72	0.18			
GI	Baseline	20	2	0.21	6.298	0	S
	Hexigel	20	1.6	0.11			
GI	Green tea gel	20	1.72	0.18	2.691	0.019	S
	Hexigel	20	1.6	0.11			

Table 2. Means of clinical attachment level at baseline and after 28 days for both the test and control groups.

Group	Duration	N	Mean	S.D	t-test	P-Value	Inferences
CAL	Baseline	20	1.9	0.16	3.613	0.003	S
	Green tea gel	20	1.6	0.3			
CAL	Baseline	20	1.9	0.16	6.072	0	S
	Hexigel	20	1.43	0.28			
CAL	Green tea gel	20	1.6	0.3	7.995	0	S
	Hexigel	20	1.43	0.28			

Table 3. Means of probing pocket depth at baseline and after 28 days for both the test and control groups.

(a) Gram positives		
S.mutams	ATCC25175	0.75
S. mtis	ATCC903	>3.00
S. sanguinis	ATCC10556	>3.00
S. oralis	ATCC10557	>3.00
S. gordonil	ATCC10558	>3.00
A. naeslundii	ATCC12104	0.09
L. casei	IFO3353	>3.00
L. salivarius	T12711	>3.00
S. aureus	209P	0.38
MRSA	NUD-101	0.38
(b) Fungi		
C.albicans	NUD-201	0.38
(C) Gram negatives		
P.gingivalis	ATCC33277	0.09
P.intermedia	ATCC25611	0.05
P.nigrescens	ATCC33563	2.50
A.a	Y4	0.75
F.nucleatum	JCM6328	0.05
E.coli	12D-5203	>3.00
Minima inhibitory concentration of agar diffusion assay (MIC-ADM: mg/ml)		

Table 4. Antimicrobial activity of catechin gel.

(a) Gram positives		
S.mutams	ATCC25175	0.75
S. mtis	ATCC903	>3.00
S. sanguinis	ATCC10556	>3.00
S. oralis	ATCC10557	>3.00
S. gordonil	ATCC10558	>3.00
A. naeslundii	ATCC12104	0.09
L. casei	IFO3353	>3.00
L. salivarius	T12711	>3.00
S. aureus	209P	0.38
MRSA	NUD-101	0.38
(b) Fungi		
C.albicans	NUD-201	0.38
(C) Gram negatives		
P.gingivalis	ATCC33277	0.09
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P.nigrescens	ATCC33563	2.50
A.a	Y4	0.75
F.nucleatum	JCM6328	0.05
E.coli	12D-5203	>3.00
Minima inhibitory concentration of agar diffusion assay (MIC-ADM: mg/ml)		

at 28 days in the control group as well as in the test group as compared to baseline (Table 1).

Results of intergroup comparison between the groups did not show statistically significant results (Table 4).

Clinical attachment loss (Table 2)

Mean CAL at baseline

- Test group-1.90
- Control groups-1.90,

Mean CAL after 28 days

- Test group-1.60
- Control groups-1.43

The result showed highly significant difference, statistically in clinical attachment loss at 28 days in the control group as well as in the test group as compared to baseline.

Results of intergroup comparison between the groups did not show statistically significant results (Table 4).

Probing pocket depth (Table 3)

Mean PPDs at baseline

- Test group-4.79
- Control group-4.79

Mean PPDs after 28 days

- Test group-3.83
- Control group-3.28

The result showed highly significant difference, statistically in clinical attachment loss at 28 days in the control group as well as in the test group as compared to baseline.

Results of intergroup comparison between the groups did not show statistically significant results (Table 4).

Discussion

In present study, green tea gel tooth sites showed significantly lower mean scores ,GI=1.72, p= 0.006,CAL=1.60,p=0.003 and PPD=3.83 mm, as compared to baseline ,GI=2.00,CAL=1.90 and PPD=4.79, when evaluated at 28th day. These effects can be attributed to the antibacterial property of catechins [6]. Catechins gel (catechin –entrapped gel) acts as plaque control agent; gel form would basically allow catechins to retain in the pockets for a long time, thus preventing the growth of bacteria. Catechins perform there antibacterial activity by destroying the cell membrane of bacteria, resulting from the generation of hydrogen peroxide [6].

The significant decrease in mean scores GI=1.72, p=0.006, CAL=1.60, p=0.003 and PPD=3.83 mm, as compared to baseline, GI=2.00, CAL=1.90, and PPD=4.79, when evaluated at 28th day can also be attributed to the anti-inflammatory effects, shown by EGCG which has the potential to inhibit the enzymes lypooxygenase and cyclooxygenase, which produce postagladin E2 that cause inflammation which can further lead to bone resorption. Catechins also have the potential to prevent bone resorption due to their anti-collagenase activity [7].Yun et al. reported that EGCG may prevent the alveolar bone resorption by inhibiting the expression of MMP-9 in osteoblasts and the formation of osteoclasts [8]. Morover Makimura et al. reported that tea catechins containing galloyl radical possess the ability to inhibit both eukaryotic and prokaryotic cell derived collagenase [9].

The mean PPD in present study for the test group (green tea gel) at baseline was 4.79 and after 28 days was 3.83, which showed statistically significant reduction in periodontal probing depth at 28 days as compared to baseline (Table 3). These results were in agreement with the study done by Chava et al. which reported significant reduction of pocket depth and inflammation, seen after 4 weeks, using thermoreversible green tea gel as LDD agent as an adjuvant to SRP [3]. The mean CALs in the test group (green tea gel) were 1.90 and after 28 days was 1.60 and 1.43, respectively, which showed statistically highly significant difference in clinical attachment loss at 28 days (Table 2). A study done by Madaan et al. reported significant decrease in periodontal pocket depth and increase in gingiva margin position and clinical

attachment loss with the use of green tea gel as an adjuvant to SRP in chronic periodontitis patients, which was in accordance of our study [10]

Rattanasuwan et al. showed a significant decrease in gingival inflammation and bleeding on probing at 3 months, with green tea gel when used as an adjunctive to SRP, which was in accordance of our study as in present study the mean of GIs in test group (green tea gel) showed statistically highly significant difference at 28 days (Table 1) [11].

The results of the study done by Romoozi et al. reported, chlorhexidine and green tea mouthwashes to be equally efficient in reduction of plaque index, which was in accordance to our study [12]. The intergroup comparison of GI, CAL and PDD gave non-significant results as both chlorhexidine and green tea gel were successful in improving the gingival index, clinical attachment loss and probing pocket depth suggesting that green tea gel can effectively be used as local drug delivery agents in chronic periodontitis patients, as an alternative for chlorhexidene gel, as staining as a side effect has been seen with chlorhexidine.

The proposed mechanisms to explain CHX staining are

- Chlorhexidine molecule degraded to parachloraanaline.
- Catalysis of mailard rections.
- Denaturation of protein with chromogens, metal sulphide formation.
- Precipitation of dietary compounds (anionic).

However the most conclusive todays evidence, favours the precipitation of dietary compounds onto adsorbed chlorhexidine molecule. According to various other studies it has been shown that, higher percentage of chlorhexidine, stronger anti-bacterial effect but higher will be the degree of staining. Recently a new preparation has been in markets, containing chlorhexidine with additional anti-discoloration system as the basic components and promises to prevent plaque formation as well as avoid staining. Two agents (sodium metabisulfate and ascorbic acid) are claimed to interfere with synergistic mechanism that causes pigmentation without reducing antiplaque activity, the contradictory findings are reported in few other studies stating that compromised antiplaque efficacy with ADS system [6].

Conclusion

In present study green tea gel and hexidine gel, were used as local drug delivery as an adjunctive to SRP, as a result both were found be effective in improving the clinical parameters (GI, CAL, PPD) of periodontitis significantly. Thus, green tea gel is a potentially effective local drug delivery agent in adjunct to conventional periodontal therapy in moderate to deep periodontal pockets. Green tea catechin gel having no known significant side effects can efficiently be used on a daily basis for the treatment of periodontitis. Although more studies are needed to be performed with greater sample size to explore the effect of green tea gel in to be used in patients with chronic periodontitis.

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Conflict of Interest

No conflict of interest.

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