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A Comparison of the Efficacy of Turmeric Gel (2%) as Local Drug Delivery Agent with Scaling and Root Planing in the Treatment of Chronic Periodontitis: A Clinical Study

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Abstract: ***Periodontitis is one of the most prevalent chronic diseases in the world; with the primary etiological agent being pathogenic bacteria that reside in the subgingival area. Conventional periodontal therapy consists of mechanical debridement to disrupt the subgingival microbiota. The comprehensive mechanical debridement of sites with deep periodontal pockets is difficult to achieve. This has led to the adjunctive use of antimicrobial agents delivered either systemically or locally. As the systemic use of antimicrobial agents may cause several side effects like hypersensitivity, resistant strains, and super infections, their local administration has received considerable attention. Local drug delivery systems allow the therapeutic agents to be targeted to the disease site. Thus, the dose can be minimized, reducing the systemic absorption and subsequent risk of adverse side effects. Higher concentration of a therapeutic agent can be attained in subgingival sites by local drug delivery compared with a systemic drug regimen. For subgingival application, various antimicrobial agents have been tried, including tetracycline, metronidazole, and chlorhexidine, either on their own or in combination with scaling and root planing (SRP). Chlorhexidine (CHX) is a highly effective antimicrobial agent that is extensively studied and shown to be effective as a mouth rinse and also as a subgingival irrigant. Having shown broad spectrum of topical antimicrobial activity, it also shows substantivity, effectiveness, safety, and lack of toxicity.***

Keywords: Periodontitis, Curcumin, Turmeric, Scaling and Root planing

1. Introduction

Chlorhexidine is one of the most effective topical agents, which has long been used as an effective antimicrobial agent. The first sustained release dosage form of chlorhexidine diacetate for topical use was developed by Friedman and Goleb, which had shown effectiveness in reducing the periodontal probing depth, clinical attachment loss, and bleeding on probing.

India, definitely has a rich history of using plants for medicinal purposes. Turmeric (haldi), a rhizome of *Curcuma longa*, is a common antiseptic used in traditional system of Indian medicine. Curcumin (diferuloylmethane), being the main yellow bio active component of turmeric, has been shown to have a wide spectrum of biological actions which have been to beneficial to humans.

Currently, the use of herbal products in dentistry is ever increasing. This can be attributed to their easy availability, low cost and lesser side effects. One such herbal product is curcumin. Turmeric (haldi) is the rhizome of Curcuma longa belongs to Zingiberaceae family has been traditionally used in Indian medicine for several decades.

It has several components, which are collectively known as “curcumin.” The proven properties of Curcumin include anti inflammatory, antioxidant, antimicrobial, antiseptic, antimutagenic. Anti−inflammatory properties of curcumin is by inhibiting the prostaglandin biosynthesis from arachidonic acid and also by reducing the function of neutrophils during inflammation. Antioxidant property of curcumin is due to its ability to inhibit free radical formation. Antimicrobial effect of curcumin is due to its ability to inhibit the growth of various microorganisms. Hence, the aim of this study was to evaluate the efficacy of natural curcumin in the management of chronic periodontitis as local drug delivery in comparison to Scaling and root planing.

Turmeric is safe when taken by mouth or applied to the skin appropriately for up to as long as 8 months. Turmeric is possibly safe when it is used as an enema or a mouthwash in the short-term. Turmeric, as per research does not cause significant side effects, but some people can experience stomach upset, nausea, dizziness, or diarrhea. In one report, a person taking very high amounts of turmeric, almost over 1500 mg twice daily, experienced a dangerous abnormal heart rhythm. With that being said it is unclear if turmeric was the actual cause of this side effect. Until more is known, it is advisable to avoid taking excessively large doses of turmeric.

This study was conducted as turmeric or Curcumin is a herbal product. Time has come that we replace the other therapeutic modes of treatment causing side effects and are harmful for the body in the long run. Turmeric when applied locally over the gingival tissues does not cause any side effect or any adverse effect and is remarkably safe. It is safe to use turmeric for a long span causing no harm to the tissues. Hence local drug delivery using turmeric is safe and has provided better clinical outcome.

2. Review of Literature

Literature reports have shown that turmeric or curcumin has anti-inflammatory and antibacterial activities, suggesting its potential to be used as a subgingival agent. Safety evaluation studies have indicated that both turmeric and curcumin are well tolerated at a very high dose without any toxic effects. [1]

Hennessey (1973) reported that Gram-positive organisms are more sensitive than Gram-negative microbes and streptococci were more affected than staphylococci. Chlorhexidine [CHX] is also effective against Candida albicans in vitro; in vivo studies in man have confirmed its efficacy against fungal infections. [2,3]

Schiott (1976) suggested that CHX is one of the most effective topical agents, long been used as an effective antimicrobial agent. It is an antiseptic, which adheres to organic matter and demonstrates low toxicity when applied topically. Its efficacy as a topical rinse to inhibit dental plaque and gingivitis has been well-established in study periods for up to 2 years without evidence of development of any bacterial resistance.[4]

Noguchi et al. (1984) first reported on a degradable intra-pocket sustained release delivery system was the study by using hydroxypropyl cellulose films. Although this was the pioneering study in the development of a degradable system, the rapid degradation of the device and the short duration of drug exposure were distinct disadvantages.[5]

According to **Gendron (1999)** the mode of drug administration can exert an effect not only on the clinical parameters but also on subjective sensations patients experience during treatment. Chlorhexidine has many side effects, especially when administered as mouthwash, such as brown discoloration of teeth, fillings and oral soft tissues, mainly the tongue. Patients often complain of bitter and a little difficult to hide taste of chlorhexidine based preparations and have taste disorders following the use. However, these unpleasant sensations are compensated by beneficial effects of chlorhexidine therapy. Additionally, chlorhexidine compounds attenuate the adhesion of Porphyromonas gingivalis to epithelial cells and inhibit the activity of metaloproteinases (MMP) 2, 8 and 9, which is another antibacterial mechanism . Therefore, this compound should be more frequently used as a drug adjunct to classic periodontal therapy, especially in the forms allowing its direct application to the periodontal pockets. [4]

According to Barnett,(2003); van Zyl van Heerden,(2010) chlorhexidine was the first antimicrobial shown to inhibit plaque formation and prevention of gingivitis when a 0.2% mouthrinse was used daily, it provided a benchmark against which other antiplaque agents are compared still today. Chlorhexidine mouthwashes are frequently used in the prevention and treatment of gingivitis. However, subgingival plaque is not significantly disrupted when chlorhexidine is applied supragingivally therefore limiting its use in PD (Periodontal disease). A pilot study in which chlorhexidine was applied as a varnish following SRP in 12patients with chronic periodontitis revealed a reduction in pocket depths (between 0.7 - 1.37mm) and a gain in clinical attachment proving its potential in PD treatment.

Vinholis (2001) studied Subgingival utilization of a 1% chlorhexidine collagen gel for the treatment of periodontal pockets. author found promising results with reduction in gingival index , plaque index,bleeding on probing and gain in attachment level.[6]

Pietruska et al (2006) performed a study for clinical evaluation of periodontium following treatment with one of the drugs containing chlorhexidine gluconate (Corsodyl) as compared to professional tooth cleaning in patients with chronic periodontitis and conclude the results that the efficacy of the treatment of periodontitis by means of gel application to the pockets depends on both the possibility of achieving biologically significant concentration of the drug and on the adequately long drug maintenance in the periodontal pocket. [7]

Sruthima N. V. S. evaluated the efficacy of 1% curcumin (CU) solution and compared it with a conventional irrigant being 0.2% chlorhexidine (CHX) gluconate and a positive control being saline as an adjunct to thorough scaling and root planning. A total of 23 patients with non-adjacent probing pocket depths (PPDs) which were more than 5mm were randomly assigned to Chlorhexidine, Curcumin and positive control irrigation groups and subjected to randomized single blinded clinical control trial. The clinical parameters bleeding on probing, redness, plaque index, PPD and microbiological parameter N-benzoyl-DL-arginine-2-naphthylamide (BANA) test were evaluated at baseline, 1, 3 and 6 months interval. At 1 month evaluation, Curcumin group showed better results compared with the other groups. However, by the end of the study period Chlorhexidine group showed the best results with as light recurrence in the CU group. The results of BANA test showed similar results for both CU and CHX group throughout the study period. The results of this study show a mild to moderate beneficiary effect of CU irrigation when used as an adjunct to Scaling and root planing. [8]

A study conducted by Shishodia S, Sethi G, Aggarwal BB in 2005 had stated that curcumin was been found to be at least 10 times more active as an antioxidant than even vitamin E. The antioxidant activity of curcumin could be mediated through antioxidant enzymes such as superoxide dismutase, catalase and glutathione peroxidase.[9]

A study conducted by Nomura Y, Tamaki Y, Tanaka T, Arakawa H, Tsurumoto A, Kirimura K et al in 2006 had stated in their study on screening of periodontitis with salivary enzyme tests, that among the biochemical test markers tested, salivary LDH level had the highest sensitivity and specificity and hence it LDH would be feasible as a useful parameter for the screening of periodontal disease.[10]

A study conducted by Zhou H, Beevers S, Huang S in 2011 had stated that curcumin was able to modulate the production of inflammatory cytokines such as TNF-α, IL-β and IL-6 and also enzymes such as COX-2,inducible nitric oxide synthase (iNOS), 5-LOX and phospholipases

A2(PLA2) thereby exhibiting potent anti-inflammatory property. [11]

A study conducted by Monica Nagpal and Shaveta Sood in 2013 has stated that turmeric is considered to be safe, non toxic and effective alternative for many conventional drugs due to its antioxidant, anti-inflammatory, antimicrobial properties. [12]

In a study by Platia et al, the comparison of the clinical efficacy of 0.12% Chlorhexidine and Turmeric as subgingival irrigants in patients of chronic Periodontitis were evaluated. 60 patients (both males and females) showing clinical evidence of chronic periodontitis were selected. A total of 60 patients suffering from chronic periodontitis were enrolled in the study. Before irrigation, complete scaling and root planing was done. Total of 60 patients were randomly and equally divided into 3 test groups. Test group 1comprised of Patients irrigated with 0.12% Chlorhexidine digluconate. Test group 2 comprised of Patients irrigated with freshly prepared 10%Turmeric solution. Test group 3 comprised of Patients irrigated with distilled water (control). All clinical parameters- Plaque index (Turesky- Gilmore-Glickman Modification of the Quigley Hein Plaque Index), Gingival index (Loe and Silness gingival index) and Periodontal pocket depth were assessed on day 0 after complete oral prophylaxis and again on day 7, 21 and 42. Irrigating solutions Chlorhexidine, Turmeric and distilled water were used. Out of the three subgingival irrigating solutions, good results were seen with Chlorhexidine, then with Turmeric and then for distilled water as an irrigating solution. Chlorhexidine has shown to be a potent therapeutic agent which has the properties of improving the periodontal status significantly. [13]

Anitha et al, evaluated the efficacy of natural curcumin in the management of chronic periodontitis as local drug delivery in comparison to synthetic conventional chlorhexidine, which is the gold standard. Thirty patients who had chronic periodontitis, with an age range of 20–50 years with probing pocket depth (PPD) of 4–6 mm were included. The contralateral sites were treated with Curcumin and chlorhexidine gel at baseline and day 15. The clinical parameters like Periodontal Probing Depth (PDD), clinical attachment level (CAL), gingival index (Loe and Silness) and plaque index (Turesky Gillmore modification of Quigley Hein) were recorded and colony forming units (CFU) were assessed microbiologically at baseline, 15 and 30 days. There was a significant reduction of the clinical parameters (PPD, CAL) and microbiological parameters CFU at 15 and 30 days for both the groups. The Curcumin group showed a greater reduction in the clinical parameters when compared with the convential chlorhexidine group. Both groups had a significant reduction in parameters when compared with baseline. Although curcumin has almost and totally equivalent benefit to chlorhexidine, curcumin being an ayurvedic herb with minimal side effects, is an excellent alternative to chlorhexidine.[14]

Behal et al compared the effect of experimental local-drug delivery system containing 2% whole turmeric (gel form) as an adjunct to scaling and root planing (SRP) with the effect achieved using Scaling and root planing alone by evaluating their respective effects on plaque, gingival inflammation, bleeding on probing pocket depth, relative attachment levels and trypsin-like enzyme activity of “red complex” microorganisms, namely, *Bacteroides forsythus, Porphvromonas gingivalis* and *Treponema denticola. 30* subjects with chronic localized or generalized periodontitis with pocket depth of 5 to 7 mm were selected in a split-mouth study design. Control sites received SRP alone, while experimental sites received SRP and experimental material (2% whole turmeric gel). Plaque index (PI), gingival index (GI), sulcus bleeding index (SBI), probing pocket depth (PPD), relative attachment loss (RAL), microbiological study of collected plaque sample for trypsin-like activity of “red complex” by BAPNA assay were the parameters recorded on day 0, 30 days and 45 days. Both groups demonstrated statistically significant low levels in PI, GI, SBI, PPD; and gain in RAL. Significant reduction in the trypsin-like enzyme activity of “red complex” (BAPNA values) was observed for both the groups when compared to the baseline activity. Greater reduction in the red complex was seen in all the parameters in the experimental group in comparison to the control group. The experimental local drug-delivery system containing 2% whole turmeric gel can be effectively used as an adjunct to SRP and is more effective than SRP alone in the treatment of periodontal pockets. [15]

Jaswal et al assessed and compared the clinical effects of topical subgingival application of 2% whole turmeric gel and 1% chlorhexidine gel as an adjunct to scaling and root planing (SRP) in patients suffering from chronic Periodontitis. Fifteen patients with localized or generalized chronic periodontitis with pocket depth equal to or more than 5-7 mm were selected. In each patient, on completion of SRP, three non adjacent sites in three different quadrants were randomly divided into three different groups, that is, Group I: Those receiving 2% turmeric gel subgingivally, Group II: Those receiving 1% chlorhexidine gel (Hexigel) subgingivally, and Group III: Scaling and Root Planing alone (control site). Plaque index (PI), gingival index (GI), probing depth (PD), and clinical attachment levels were determined at baseline, 30 days, and 45 days. Group II as a local drug system was better than Group III. Group I showed considerable improvement in all the clinical parameters as Group II. The experimental local drug delivery system containing 2% whole turmeric gel helped in lowering of probing depth and gain of clinical attachment levels. [16]

Anuradha et al compared the effects of the curcumin gel as an adjunct to subgingival scaling and root planning with the effect achieved using subgingival scaling and root planning alone. 30 patients either male or female with chronic localized or generalized periodontitis in the age group of 25 to 60 years with pocket depth of 5-7 mm affecting at least two nonadjacent sites were in the inclusion criteria. In the experimental site SRP was performed, followed by placement of the curcumin gel and periodontal pack application. In the control site, subgingival scaling alone was performed followed by periodontal pack application. Parameters included were: Plaque index (PI), gingival index (GI), probing depth (PD) and clinical attachment loss. These parameters were recorded on day 0, 30 and 45 days. Considerable reduction in mean was observed in PI, GI, PD and gain in clinical attachment level were demonstrated in

both the groups from baseline to 45 days. However, statistical considerable reduction was seen in PI at baseline and 30th day and GI at 30th day. This gave a conclusion that Curcumin can be effectively used along with scaling and root planning. [17]

Nagasri et al stated that Curcumin (turmeric) is a naturally occurring anti inflammatory product with many biologic and medicinal properties and advantages. Its therapeutic applications have been studied in a variety of fields and conditions, but only few studies have evaluated the efficiency of curcumin as local drug delivery agent and in the treatment of periodontitis. The study evaluated the efficacy of the adjunctive use of curcumin with scaling/root planing as compared with scaling/root planing alone in the treatment of the chronic periodontitis. 30 patients with two sites in the contralateral quadrants which had probing pocket depths (PPDs) of ≥5 mm were selected. Full mouth scaling and root planing (SRP) was performed and was followed by application of curcumin gel on a single side subgingivally. Assessment of plaque index (PI), gingival index (GI), PPD, and clinical attachment levels (CALs) were done at baseline and at 4th week. Microbiologic assessment with polymerase chain reaction was done for *Porphyromonas gingivalis*, *Tanerella forsythia*, and *Treponema denticola* by collection of plaque samples. The results revealed that there was a significant lowering levels of in PI, GI, probing depth, CAL, and microbiologic parameters in test sites following SRP and curcumin gel application, when compared with SRP alone in control group. The local application of curcumin as an adjunct to scaling and root planing showed improvement in periodontal parameters and has a beneficial effect in patients with chronic periodontitis.[18]

3. Material and Methods

This clinical study was carried out in the Department of Periodontics, Rural Dental College & Hospital, Loni from September 2015 to September 2017. The study consisted of 60 patients aged 20 to 65 visiting the Out Patient Department of Periodontology of Rural Dental College

Inclusion criteria:

1) Patients within age group of 25 to 65 years.
2) Systemically healthy individuals.
3) Patients with chronic generalized periodontitis (mild and moderate)

Exclusion criteria:

1) Patients with systemic illnesses (i.e., diabetes mellitus, cancer, human immunodeficiency syndrome, bone metabolic diseases, or disorders that compromise wound healing, radiation, or immunosuppressive therapy),
2) Smoking
3) Chronic alcoholism and history of alcoholic beverages
4) Pregnancy or lactation,
5) Use of NSAIDs, steroids or antibiotics / antimicrobials within 3 months prior to recruitment for study,
6) Periodontal therapy received in the past 6 months.
7) Aggressive Periodontitis

Ethical clearance was obtained from the institutional Ethical Committee of Rural Dental College, Loni. After the study was explained including the benefits, risks and alternate treatment, written informed consent was obtained from those who agreed to participate in the study.

Group:

The split mouth study was conducted for duration of 6 months and has two parallel arms

- **Test Group:-** Patients received locally delivered turmeric gel 2% after one week of performing SRP (Scaling and Root Planing)
- **Control Group:-** Patients where only SRP was performed.

Confidentiality:

Separate case sheet for patient data was maintained

Methods of sampling:

Random Selection

- **Sample size**

60 patients in test group
60 patients in control group

- **Study conduct**

Parameters that will be evaluated are:
Probing depth
Clinical attachment level
Modified sulcus bleeding index

Assessment of Patients:

Assessment of patients was done based on various clinical parameters which were measured at BL (at patient's first visit to the dept), 1 month, 3 months and 6 months.

Study conduct:

The present study was a randomized controlled clinical study for a period of 12 months with a minimum of 60 patients in each group. It will be conducted in Rural Dental College & Hospital, Loni.

Study Period:

12 months starting from the time of approval of the study.

Sample Size:

The split mouth study comprised of 60 patients divided into 2 groups, each group will contain 60 specimens.

Statistical Analysis:

Statistical Analysis was done by descriptive statistics a Mean, standard deviation, percentage, etc. Student t test and Chi-Square test will be applied.

Amendment of Protocol:

No change in the study procedure was affected without the mutual agreement of the investigator, dentist and ethical committee.

Procedure

After patient enrolment by an examiner, patients were randomly assigned to either test or control group.

Systemically healthy patients with chronic Periodontitis with sites showing PD>4mm, CAL >4mm, with no history of periodontal therapy or use of antibiotics in the preceding 6 months were included.

The subgingival scaling was performed using ultrasonic scalers along with root planing of the control and test subjects by using area specific Gracey curettes. Before irrigation with the assigned irrigants probing depth and relative attachment level of the test and the control subjects were recorded using Williams graduated probe with a stent and the value obtained was taken as baseline value.

Placement of turmeric gel:
After thorough scaling and root planing clinical parameters were recorded, turmeric gel was injected into the periodontal pockets using a disposable 1 ml syringe with a blunt canula. Periodontal dressing was placed after the placement of gel. The periodontal dressing (Coe Pak) was placed to prevent the turmeric gel from being expressed out of the gingival sulcus or the periodontal pocket.

Patients were in instructed to refrain from:
1) Chewing hard or sticky foods
2) Brushing near the treated areas for 12 hours
3) Using interdental aids for 1 week
4) Periodontal dressing was given to the patient immediately after placement of the gel.
5) A soft diet was recommended for 1 week post operatively.

Adverse effects were noted at recall visits and any supra gingival deposits were removed.

Follow up:
Follow up was done at interval of 1, 3 and 6 months and all the parameters will be re evaluated.

Figure 1: Material Used

Figure 2: Gracey curettes

Figure 3: Cast fabricated

Figure 4: Stent fabricated

4. Observations

1) Statistical analysis

Descriptive statistics were expressed as mean ± standard deviation (SD) for each group. The change in mean scores of various parameters over a period of 3 months in each group was analyzed using Repeated measures ANOVA test. Intergroup comparison was done using unpaired t test. Before and After comparison was done using paired t test or Post hoc Test. In the above tests, p value less than or equal to 0.05 ($p<0.05$) was taken to be statistically significant.

All analyses were performed using SPSS software version 17.

Analysis of the variance was done for evaluating Pocket depth reductions, Clinical attachment levels and Modified Bleeding Index were recorded on different post-treatment days. Inter group comparisons were done utilizing analyses of variance. Observed power at each point of time was 1, revealing the adequacy of sample size

5. Observations and Results

Table 1: Showing Descriptive statistics for Age (Mean ± SD) among both the groups

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. Deviation
Age	120	31	61	45.15	6.449
Valid N (list wise)	120				

Table 2: Showing Frequency Distribution for Gender among Study

Sex					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	54	45.0	45.0	45.0
	Female	66	55.0	55.0	100.0
	Total	120	100.0	100.0	

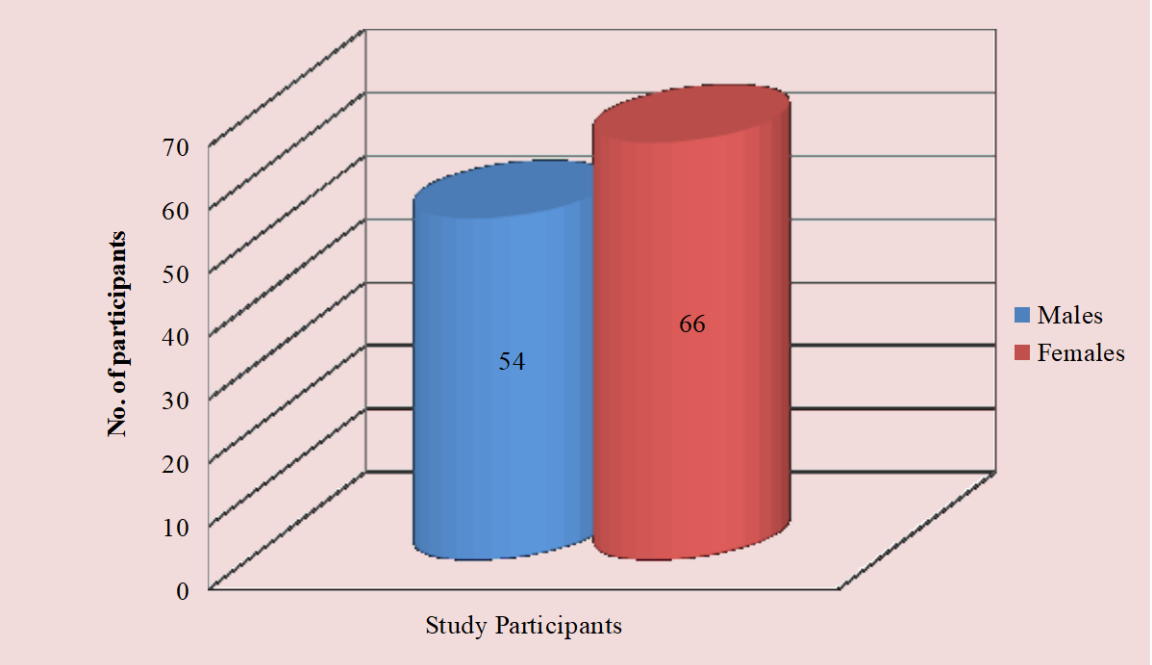

Chart 1: Frequency Distribution for Gender among Study

Table 3: Group wise Age Distribution (Mean ± SD) among both the groups

Descriptive Statistics						
group		N	Minimum	Maximum	Mean	Std. Deviation
Curcumin group	age	60	31	61	44.80	6.441
	Valid N (list wise)	60				
SRP group	age	60	31	61	45.50	6.492
	Valid N (list wise)	60				

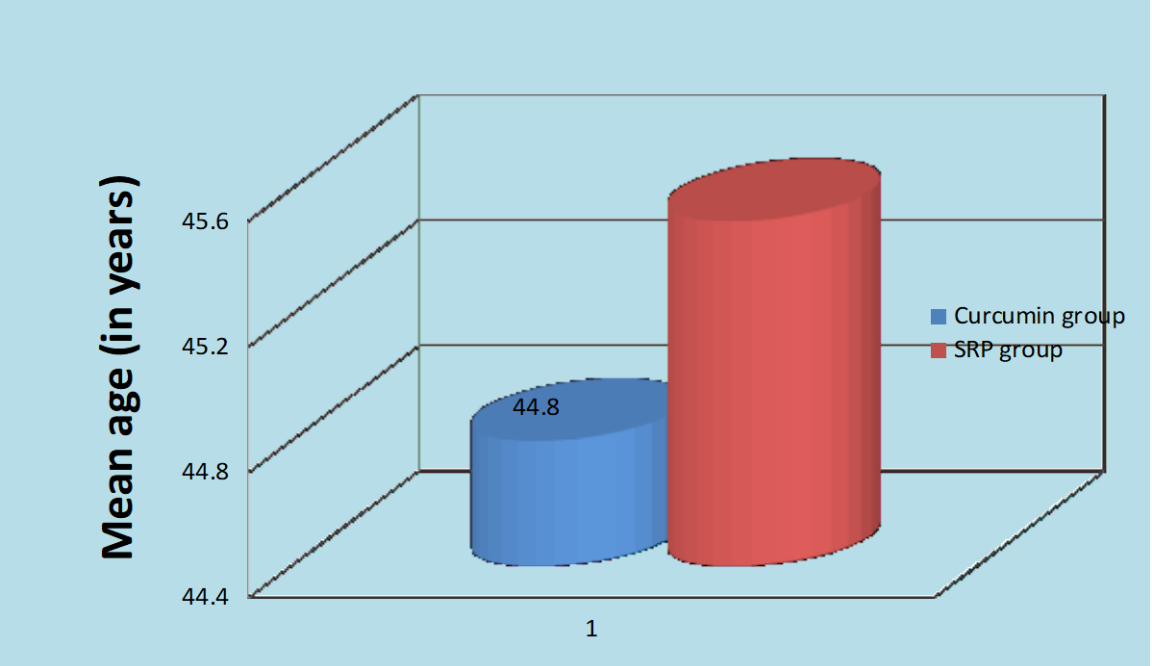

Chart 2: Age Distribution for Gender among two groups

Table 4: Frequency Distribution for Gender among both the groups

Gender						
group			Frequency	Percent	Valid Percent	Cumulative Percent
Curcumin group	Valid	Male	27	45.0	45.0	45.0
		Female	33	55.0	55.0	100.0
		Total	60	100.0	100.0	
SRP group	Valid	Male	27	45.0	45.0	45.0
		Female	33	55.0	55.0	100.0
		Total	60	100.0	100.0	

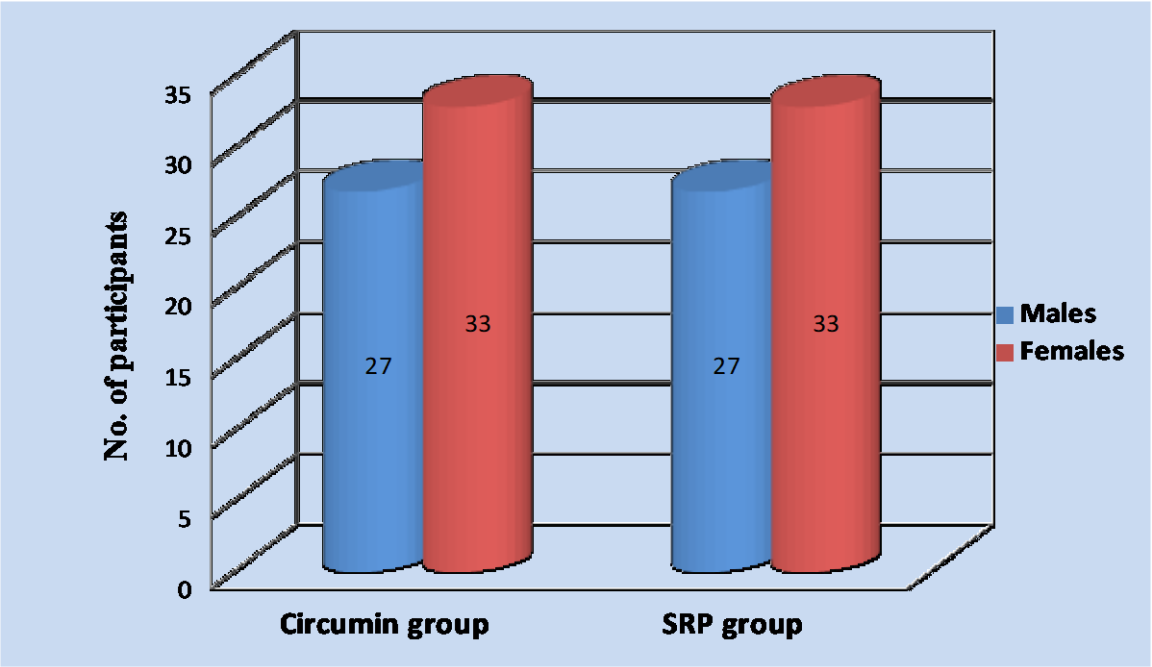

Chart 3: Frequency Distribution for Gender among two groups

Table 5: Descriptive statistics (Mean± SD) for Probing Depth at Baseline 1month 3 Month and 6 month among both the groups (Curcumin group and SRP group)

Descriptive Statistics						
group		N	Minimum	Maximum	Mean	Std. Deviation
Curcumin group	Pd baseline	60	5	9	6.58	1.211
	pd1month	60	4	6	5.03	.258

	pd3month	60	4	6	4.37	.551
	pd6month	60	3	5	3.23	.465
	Valid N (list wise)	60				
SRP group	Pd baseline	60	4	9	6.18	1.214
	pd1month	60	3	8	5.15	1.102
	pd3month	60	3	7	4.47	1.016
	pd6month	60	3	6	4.03	.956
	Valid N (list wise)	60				

Table 6: Descriptive statistics (Mean± SD) for CAL at Baseline 1month 3 Month and 6 month among both the groups (Curcumin group and SRP group)

Descriptive Statistics						
Group		N	Minimum	Maximum	Mean	Std. Deviation
Curcumin group	Cal baseline	60	4	6	5.75	.474
	cal1month	60	4	6	5.28	.490
	cal3month	60	3	4	3.25	.437
	cal6month	60	3	3	3.00	.000
	Valid N (list wise)	60				
SRP group	Cal baseline	60	4	9	6.37	1.248
	cal1month	60	3	8	5.43	1.140
	cal3month	60	3	7	4.85	1.005
	cal6month	60	3	7	4.40	1.123
	Valid N (listwise)	60				

Table 7: Descriptive statistics (Mean± SD) for M Sulcular Bleeding Index at Baseline 1month 3 Month and 6 month among both the groups (Curcumin group and SRP group)

Descriptive Statistics						
Group		N	Minimum	Maximum	Mean	Std. Deviation
Curcumin group	msbibaseline	60	1	3	2.50	.537
	msbi1month	60	1	3	1.78	.454
	msbi3months	60	0	2	1.35	.577
	msbi6month	60	0	2	.65	.633
	Valid N (listwise)	60				
SRP group	msbibaseline	60	1	3	2.50	.537
	msbi1month	60	1	3	1.92	.561
	msbi3months	60	0	3	1.37	.637
	msbi6month	60	0	2	.97	.581
	Valid N (listwise)	60				

Table 8: Change in Probing Depth in the Curcumin group over 6 months by Repeated Measures ANOVA

Probing Depth	Baseline	1 month	3 months	6 months	P value (Repeated measures ANOVA)
Mean	6.58	5.03	4.37	3.23	<0.001*
SD	1.211	0.258	0.551	0.465	

Post Hoc,
Baseline to 1 month, p **<0.001***
1 month to 3 months, p **<0.001***
3 month to 6 months, p **<0.001***
Baseline to 6 month, p **<0.001***
1 month to 6 month p **<0.001***
*p≤0.05 is statistically significant

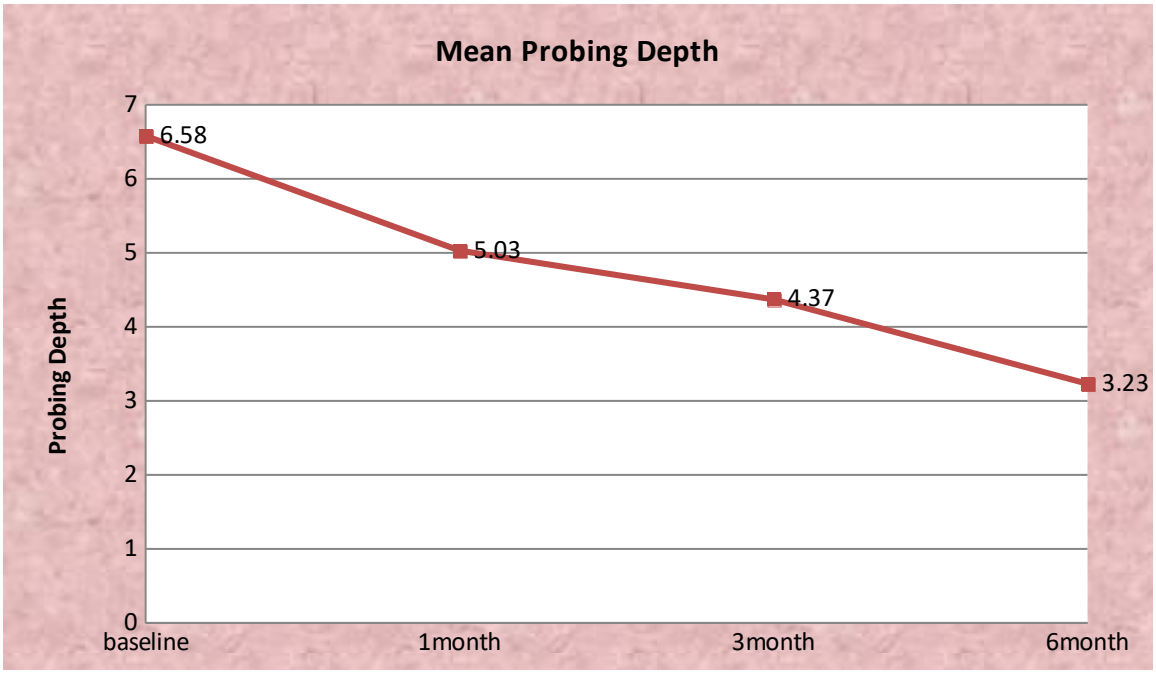

Chart 4: Change in Probing Depth in the Curcumin group

Table 9: Change in CAL score in the Curcumin group over 6 months by Repeated Measures ANOVA

CAL Score	Baseline	1 month	3 months	6 months	P value (Repeated measures ANOVA)
Mean	5.75	5.28	3.25	3.00	<0.001*
SD	0.474	0.490	0.437	0.000	

Post Hoc, Baseline to 1 month, p **<0.001***
1 month to 3 months, p **<0.001***
3 month to 6 months, p **<0.001***
Baseline to 6 month, p **<0.001***
1 month to 6 month p **<0.001***
*p≤0.05 is statistically significant

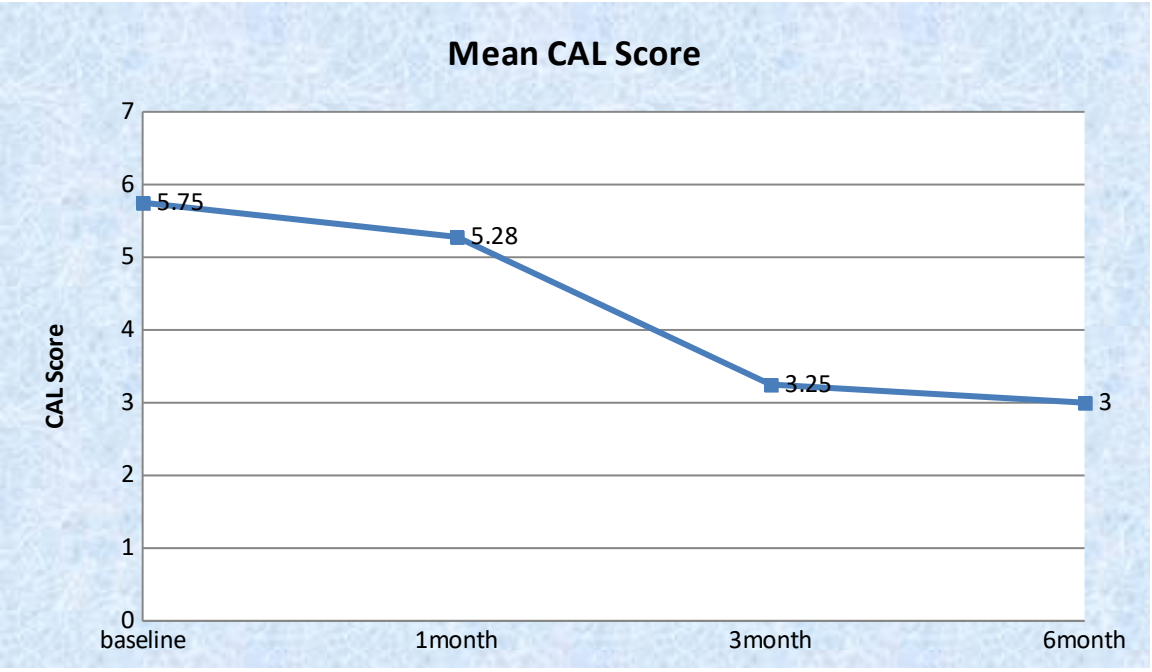

Chart 5: Change CAL Score in the Curcumin group

Table 10: Change in Sulcus Bleeding Index in the Curcumin over 6 months by Repeated Measures ANOVA

Sulcus Bleeding Index score	Baseline	1 month	3 months	6 months	P value (Repeated measures ANOVA)
Mean	2.50	1.78	1.35	0.65	**<0.001***
SD	0.537	0.454	0.577	0.633	

Post Hoc,
Baseline to 1 month, p **<0.001***
1 month to 3 months, p **<0.001***
3 month to 6 months, p **<0.001***
Baseline to 6 month, p **<0.001***
1 month to 6 month p **<0.001***
*p≤0.05 is statistically significant

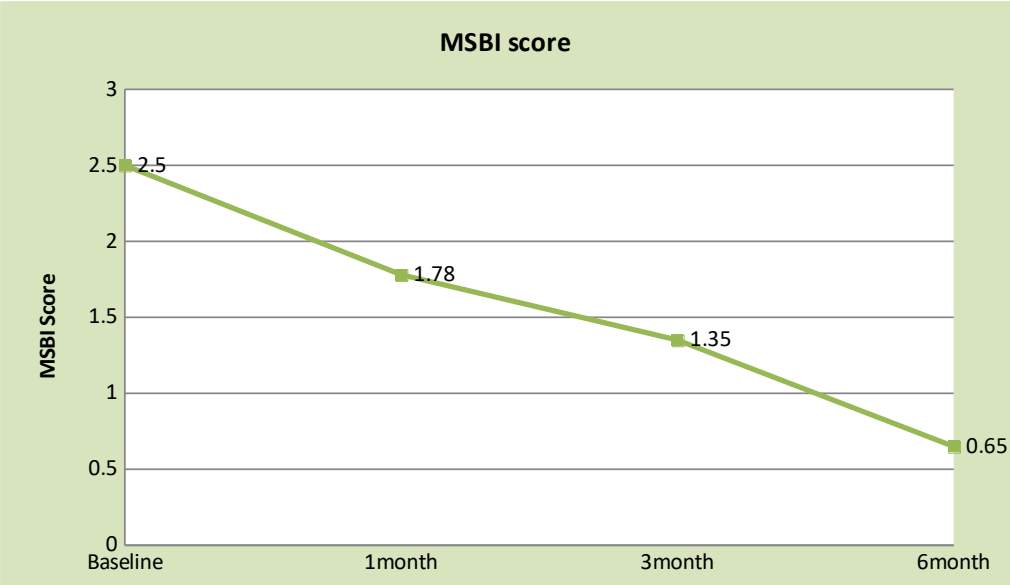

Chart 6: Change M SBI Score in Curcumin group

Table 11: Change in Probing Depth in the SRP group over 6 months by Repeated Measures ANOVA

Probing Depth	Baseline	1 month	3 months	6 months	P value (Repeated measures ANOVA)
Mean	6.18	5.15	4.47	4.03	**<0.001***
SD	1.214	1.102	1.016	0.956	

Post Hoc,
Baseline to 1 month, p **<0.001***
1 month to 3 months, p **<0.001***
3 month to 6 months, p **<0.001***
Baseline to 6 month, **p <0.001***
1 month to 6 month p **<0.001***
*p≤0.05 is statistically significant

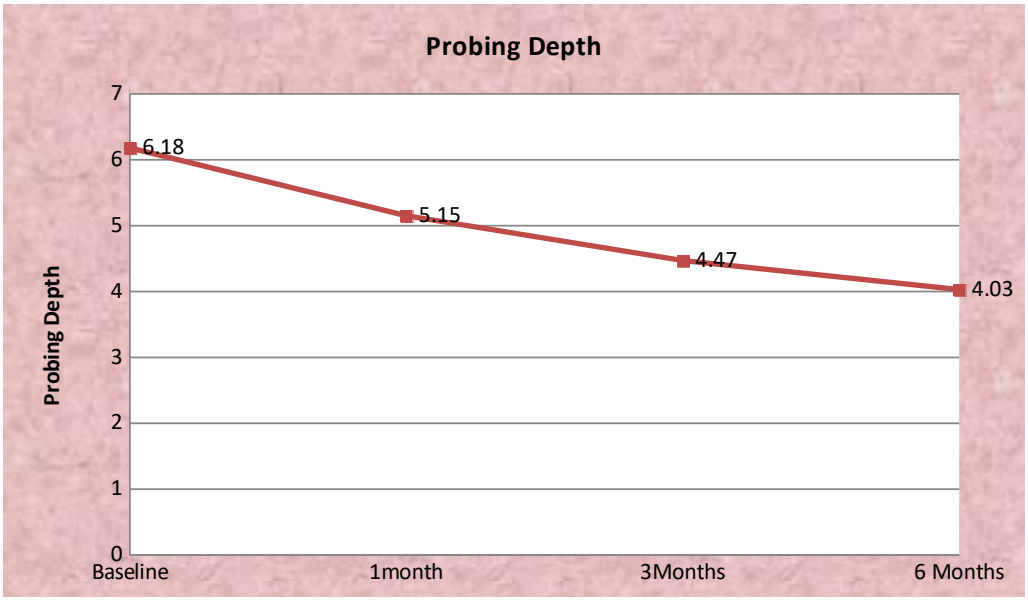

Chart 7: Change in Probing Depth over a 6 months in the SRP group

Table 12: Change in CAL score in the SRP group over 6 months by Repeated Measures ANOVA

CAL Score	Baseline	1 month	3 months	6 months	P value (Repeated measures ANOVA)
Mean	6.37	5.43	4.85	4.40	<0.001*
SD	1.248	1.140	1.005	1.123	

Post Hoc,
Baseline to 1 month, p **<0.001***
1 month to 3 months, p **<0.001***
3 month to 6 months, p **<0.001***
Baseline to 6 month, p **<0.001***
1 month to 6 month p **<0.001***
*p≤0.05 is statistically significant

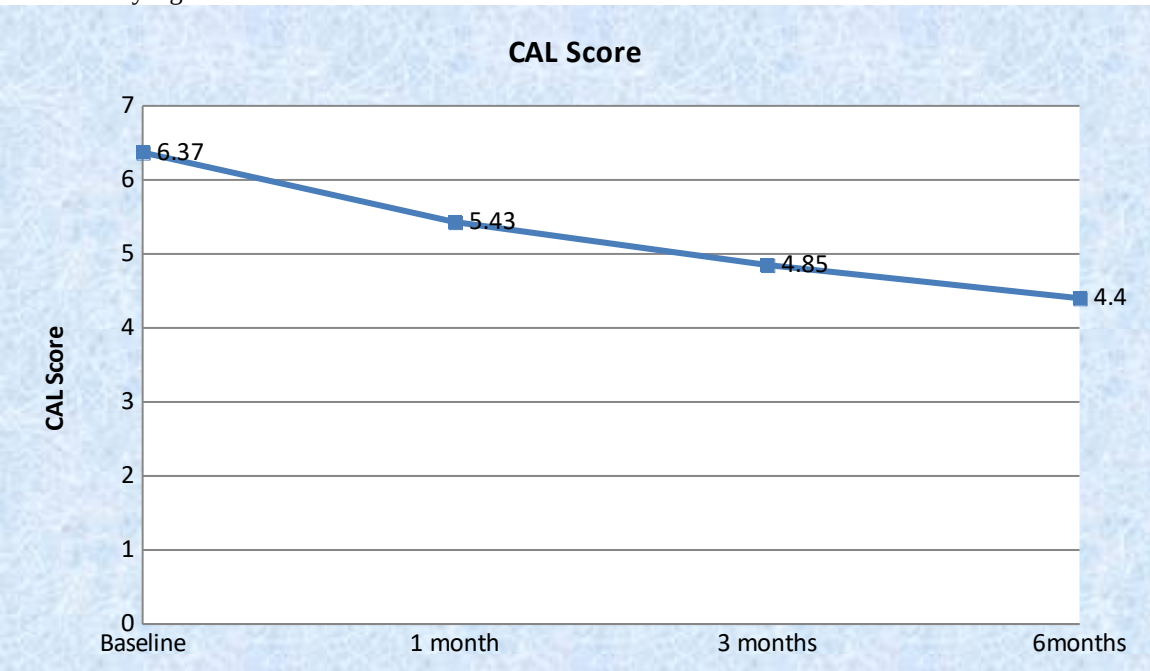

Chart 8: Change in CAL score over 6 months in the SRP group

Table 13: Change in Sulcus Bleeding Index in the SRP group over 6 months by Repeated Measures ANOVA

Sulcus Bleeding Index score	Baseline	1 month	3 months	6 months	P value (Repeated measures ANOVA)
Mean	2.50	1.92	1.37	0.88	<0.001*
SD	0.537	0.561	0.637	0.581	

Post Hoc,
Baseline to 1 month, p **<0.001***
1 month to 3 months, p **<0.001***
3 month to 6 months, p **<0.001***
Baseline to 6 month, p **<0.001***
1 month to 6 month p **<0.001***
*p≤0.05 is statistically significant

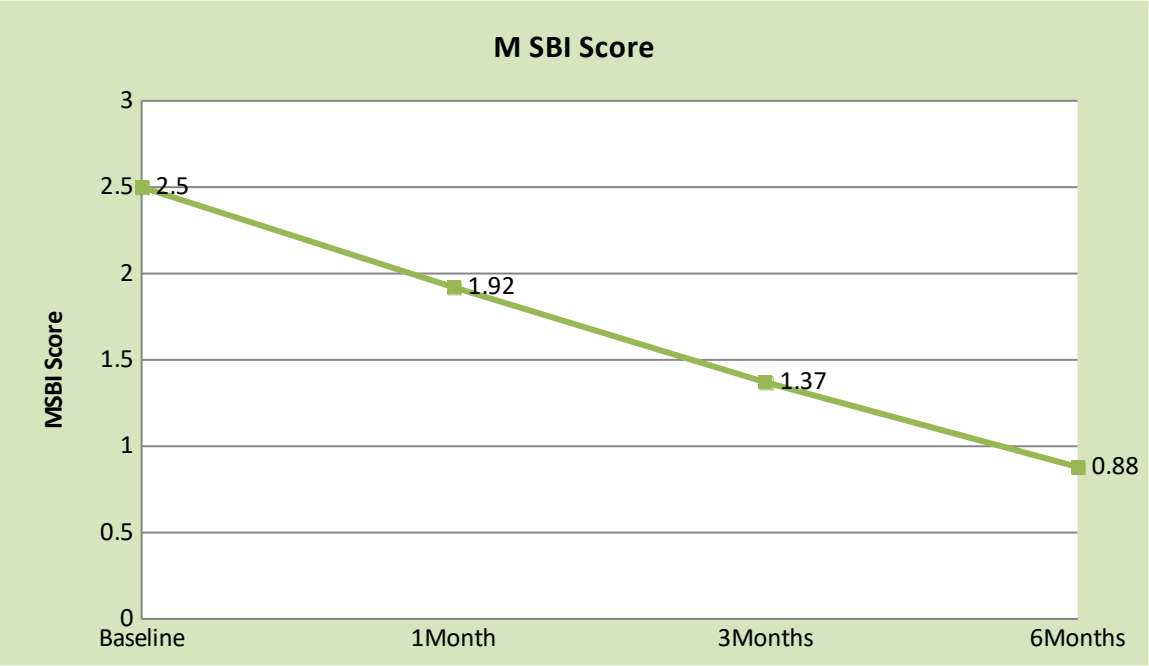

Chart 9: Change in M SBI over a 6 months in the SRP group

Table 14: Intergroup comparison of change in Probing Depth scores among various interval of time by Independent 't' Test

	Period of study			
	Baseline	**1 month**	**3 months**	**6 months**
Curcumin group	6.58 ± 1.211	5.03 ± 0.258	4.73 ± 0.551	**3.23** ± 0.465
SRP group	5.75 ± 0.474	5.28 ± 0.490	3.25 ± 0.437	**3.00** ± 0.000
p value	**0.073**	**0.426**	**0.504**	**<0.001**

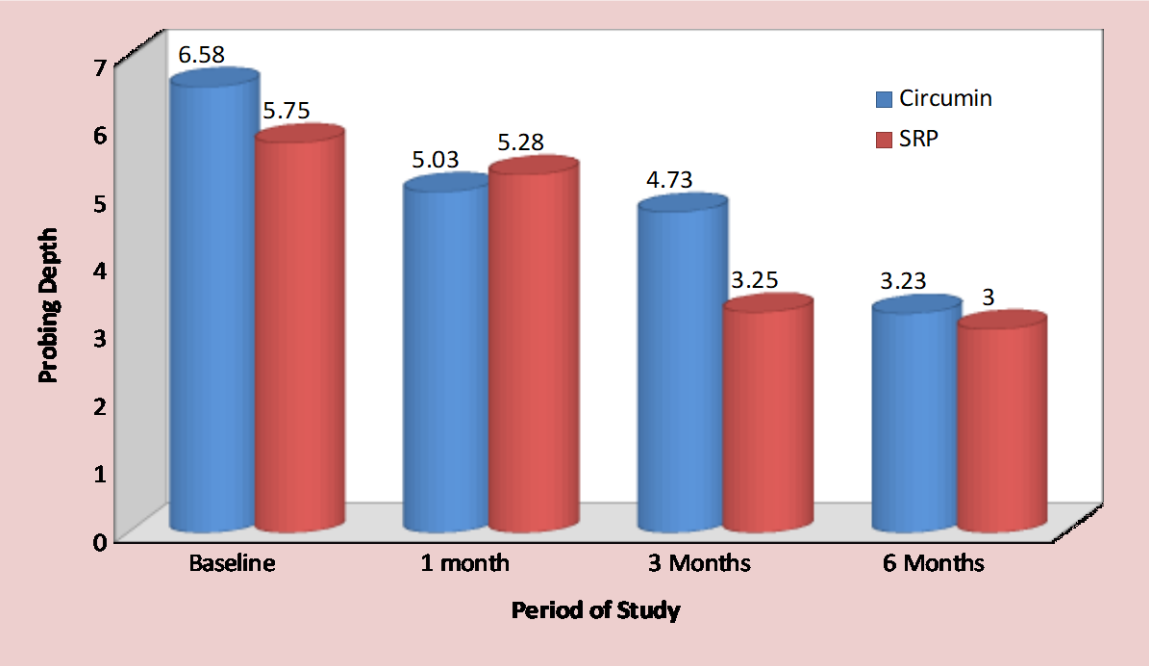

Chart 10: Comparing Probing Depth over a 6 months Among Two Groups

Table 15: Intergroup comparison of change in CAL scores among various interval of time by Independent 't' Test

	Period of study			
	Baseline	1 month	3 months	6 months
Curcumin group	5.75 ± 0.474	5.28 ± 0.490	3.25 ± 0.437	3.00 ± 0.000
SRP group	6.37 ± 1.248	5.43 ± 1.140	4.85 ± 1.005	4.40 ± 1.123
p value	**0.001**	**0.351**	**< 0.001**	**< 0.001**

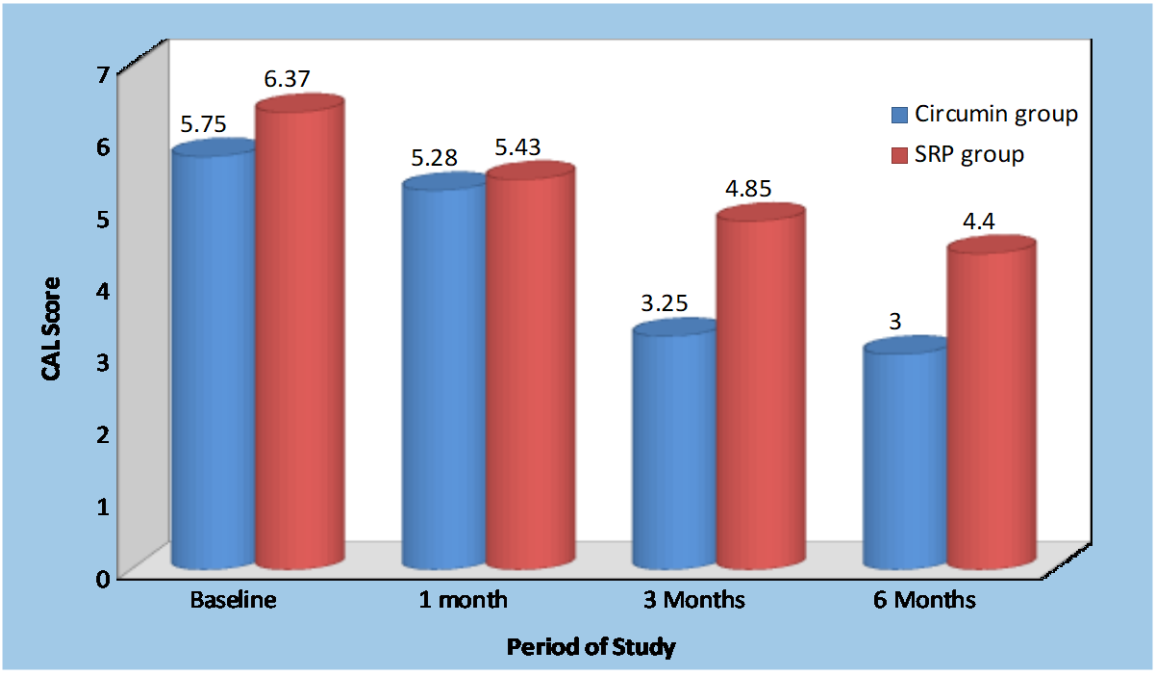

Chart 11: Comparing CAL scores over a 6 months interval Among Two Groups

Table 16: Intergroup comparison of change in M Sulcular Bleeding Index among various interval of time by Independent't' Test

	Period of study			
	Baseline	1 month	3 months	6 months
Curcumin group	2.50 ± 0.537	1.78 ± 0.454	1.35 ± 0.577	0.65 ± 0.633
SRP group	2.50 ± 0.537	1.92 ± 0.561	1.37 ± 0.637	0.97 ± 0.581
p value	**1.000**	**0.155**	**0.881**	**0.005**

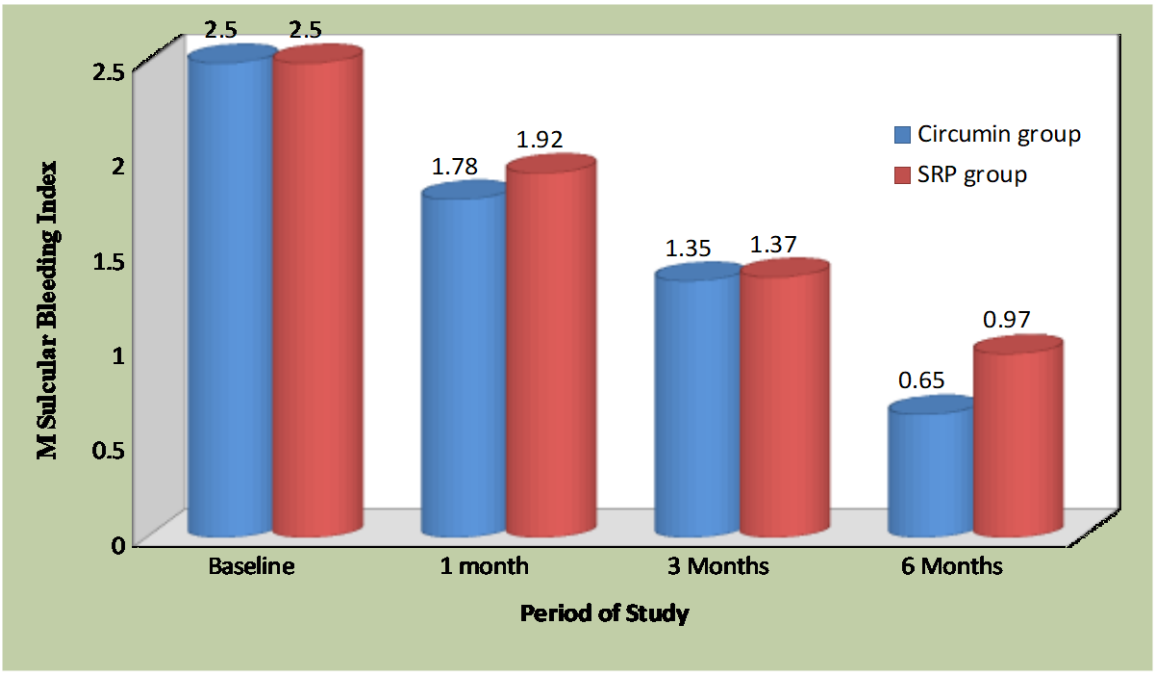

Chart 12: Comparing M SBI scores over a 6 months interval Among Two Groups

Table 17: Descriptive statistics (Mean ± SD) for mean difference EFFECTIVE CHANGE at 6 months and Baseline among all three parameters (probing Depth CAL and SBI) among two groups (Curcumin group and SRP group)

Descriptive Statistics						
Group		N	Minimum	Maximum	Mean	Std. Deviation
Curcumin group	PD DIFFERENCE	60	**-6.00**	**-1.00**	**-3.3500**	**1.21885**
	CAL DIFFERENCE	60	**-3.00**	**-1.00**	**-2.7500**	**.47389**
	Msbi DIFFERENCE	60	-3.00	.00	-1.8500	.70890

	Valid N (list wise)	60				
SRP group	PDDIFFERENCE	60	-4.00	-1.00	-2.1500	.68458
	CALDIFFERENCE	60	-4.00	-1.00	-1.9667	.73569
	Msbi DIFFERENCE	60	-3.00	.00	-1.5333	.65008
	Valid N (list wise)	60				

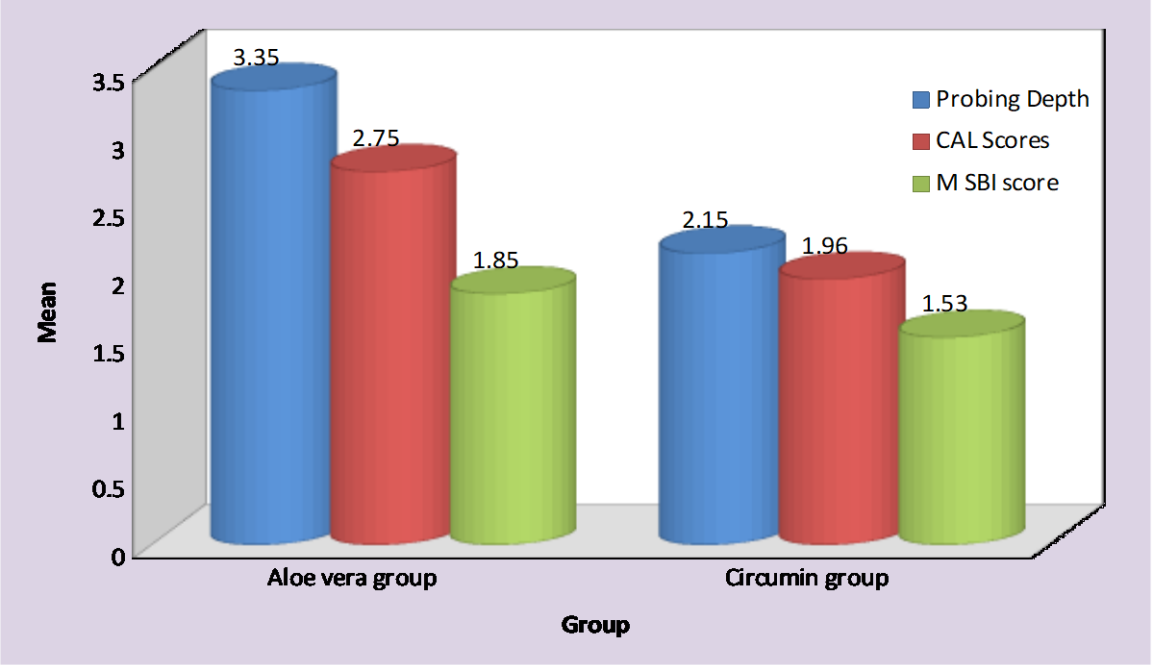

Chart 13: Effective Change (Absolute Difference achieved over 6months) among both the groups

Table 19: Comparing two groups for the effective change in Probing depth by Independent t Test

	Effective Change		
	Probing dept	**CAL**	**SBI**
Curcumin group	**-3.3500± 1.21885**	**-2.7500 ± 0.47389**	-1.8500 ± 0.70890
SRP group	-2.150 ± 0.68458	-1.9667 ± 0.73569	-1.5333 ± 0.65008
p value	**< 0.001**	**< 0.001**	**0.012**

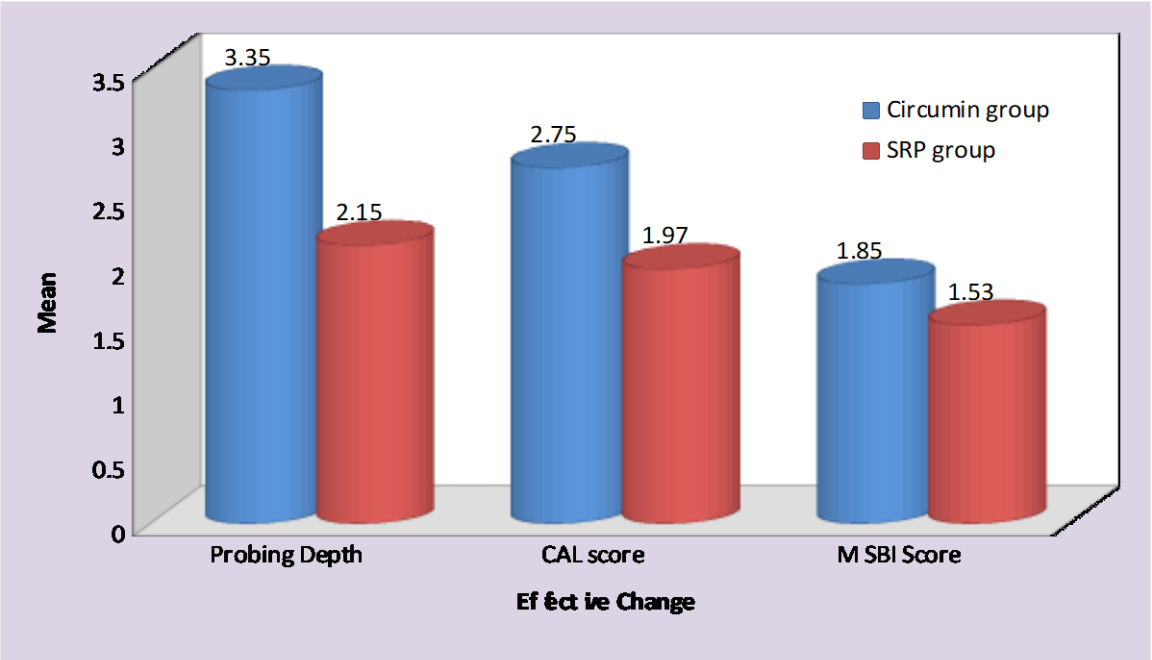

Chart 14: Comparing Effective Change (Difference achieved over 6months) among 3 Parameters in both the groups (Curcumin group and SRP group)

6. Results

Results were compared for both the groups over a period of 1 month, 3 months and 6 months from baseline. Analyzing the Probing depth, it was seen that both the groups led to significant reduction in probing depth scores. In Curcumin group, reduction was observed from 6.58 ± 1.21 at baseline to 5.03 ± 0.25 at 1 month and to 4.37 ± 0.55 at 3 months (p=0.000), with significant reduction seen at 6 months being 3.23 ± 0.46

In SRP group, reduction was observed from 6.18 ± 1.21 at baseline to 5.15 ± 0.21 at 1 month and to 4.47 ± 1.10 at 3 months (p=0.000), with significant reduction seen at 6 months being 4.03 ± 0.95. Probing depth reductions were seen significantly in the Curcumin group than in the SRP group over the period of 6 months.

On intergroup comparison, it was analyzed that the baseline reading for all the three groups were insignificant, with significant reduction at 1 month and highly significant at 6 months.

On analyzing the Clinical attachment level [CAL], it was seen that all the groups led to significant reduction in CAL values. Highly significant mean decrease was observed in both the groups. On intergroup comparison, it was analyzed that the baseline reading for Curcumin group was 5.75 ± 0.47. Over a period of 1 month it was 5.28 ± 0.49 whereas after 3 months it was found to be 3.25 ± 0.43 and after 6 months it was 3.00 ± 0 00.

For SRP group, the CAL values at baseline were found to be 6.37 ± 1.34 at baseline. The readings after 1 month were found to be 5.43 ± 1.04 and over a period of 3 months it was 4.85 ± 1.00. The CAL value was reduced over the period of 6 months which was found to be 4.40 ± 1.12. CAL levels were significantly lower in the Curcumin group than the SRP group.

Analyzing the Sulcular bleeding, it was seen that both the groups led to significant reduction in scores (p<0.001). Highly significant mean decrease was observed in Curcumin group than the SRP group. On intergroup comparison, it was analyzed that the baseline reading for all the three groups were insignificant (p=0.290), with no significant reduction at 30 days (p=0.065) and highly significant at 6 months.

The sulcular bleeding scores for Curcumin group was found to be at baseline 2.50 ± 0.53. At the period of one month after the score was 1.78 ± 0.45. Over a period of 3 months the score was found to be 1.35 ± 0.57 and over 6 months it was found to be 0.65 ± 0.33.

For SRP group however the sulcular bleeding scores were at baseline 2.50 ± 0.53, over a period of 30 days it was found to be 1.92 ± 0.56. The score after 3 months were 1.37 ± 0.63 and over 6 months it was found to be 0.97± 0.581.

Figure 6: Probing depth at baseline

Figure 7: Turmeric gel application [test group]

Figure 8: Probing depth after 6 months of test group

Figure 9: Probing depth after 6 months of control group

7. Discussion

Periodontal disease is one of the most common diseases in the world affecting the mankind characterized by inflammatory lesions in periodontal connective tissues, de arrangement of periodontal fibers, alveolar bone loss, proliferation, ulceration and apical migration of functional epithelium. Many pathogenic bacteria residing subgingival, play an important role in helping the disease to occur. The importance of subgingival microflora is widely recognized. But its therapeutic handling presents difficulties. Scaling and root planing has definately proven to be of limited value in deep pockets and anatomical variations. The local or systemic use of antibacterial agents also give a promising therapeutic approach.

To augment the effects of scaling and root planing either systemic or topical antibiotics or local irrigations with a variety of antimicrobial agents have been used. The development of chemotherapeutic agents capable of inhibiting dental plaque formation has been and is the greatest interest to dental researchers and clinical dentists over the past decade. The suppression of periodontal pathogens is possible with the local application of anti-microbial agents, which also increases the clinical and microbial benefit of mechanical debridement but with their own complications and side effects like staining of teeth, taste alterations etc.

The development of chemotherapeutic agents which are efficient in inhibiting dental plaque formation has been of great interest to dental researchers and clinical dentists over the past decade. In the recent years, human pathogenic micro organisms have developed resistance to the indiscriminate and long term use of anti-microbial drugs commonly employed in the treatment of infectious diseases. Hence this limits the use of antimicrobial agents for oral care.

Hence scientists looked for antimicrobial substances of other sources like plant origin. During the last thirty years, the activity of extracts from plants against bacteria have been studied in a more intensified way. [19, 20, 21, 22]

These results can be thanked for its anti-inflammatory property and wound healing property of Curcumin (turmeric) by virtue of which it lowers the inflammatory mediators generated by arachiodonic acid pathway and leads to shrinkage by reducing inflammatory swelling and vascular engorgement of connective tissue. It also promotes migration of various cells including fibroblasts in wound bed and thus causes the reduction of vascularization by bringing about fibrosis of connective tissue. Curcumin causes the migration of epithelial cells to wounded sites by helping the localization of TGF-β1 thus helping re-epithelization. [23]

Trend for reduction in pocket depth and gain in Relative attachment levels by curcumin is given for the ability of curcumin in raising regeneration after traumatic injury as demonstrated by **Sidhu et al.** in an *in vivo* experiment on rats and guinea pigs. It has been seen that curcumin treated wounds had increased TGF-β1 which enhances wound healing. **Swarnakar et al.** studied the effect of Curcumin by controling the expression and activity of MMP 9 and 2 helps in prevention and healing of Indomethacin-induced Gastric Ulcer. This is similar to the results obtained by the previous studies done by Santos et al., Faveri et al [24]

Healing response after root debridement stands upon the degree of the inflammation which is pre existing and trauma caused to sulcular epithelium. In our study meticulous debridement was done with area-specific curettes to avoid trauma to soft tissues. Better results obtained by Curcumin gel can be thanked for its anti-inflammatory, antioxidant properties in resolving the signs of inflammation at an earlier stage as compared to other groups. Curcumin also assists in healing of wounds as quoted by **Swarnakar et al** in her study**. Sajithal et al.** detailed that curcumin acts in the same way as aspirin and aspirin like anti-inflammatory drug in lowering inflammatory mediators of arachidonic acid metabolism. Curcumin has an crucial asset over aspirin, as it selectively stoped synthesis of prostaglandin, thromboxane while not changing synthesis of prostacyclin. PPD and CAL values when analyzed between the test and control group showed difference at 30th day from baseline.. This is in the same page as seen with the results of the study conducted by **Mizrak et al. and Paolantonio et al.** where the considerable difference was observed at 15 day and 30 day.

Turmeric also commonly known as “haldi,” possesses anti-inflammatory, antioxidant, and antimicrobial properties also with anti mutagenic and anticoagulant activities. It also speedens wound healing. Due to these reasons, it was felt that publicity of turmeric in dental terrain may prove beneficial. [25, 26, 27, 28]

For the taste and comfort, the experimental material was found to be acceptable by all the subjects in our study without discomfort. It was biological accepted, as evidenced by no burning sensation, dryness/soreness, ulcer formation or staining of teeth. It is clear from the results of the present study that the experimental local drug along with SRP is effective in removing the local irritants, reducing gingival inflammation, lowers pocket depth and also helps in gain in clinical attachment. It also regulates the localized infection and forbids new lesion formation.

The local drug-delivery system used in the present study is very simple and can be used with ease. Its suitability for use with a syringe allows easy insertion into the pocket depth. It

is also biologically accepted by subjects without any side effects. The clinical results of curcumin proved to be a more effective treatment modality than SRP alone, as demonstrated by the clinical parameters.

8. Conclusion

1) In patients with chronic periodontitis, scaling and root planing with adjunctive subgingival administration of 2% curcumin gel has a significantly affect than Scaling and root planing.
2) Treatment with 2 % curcumin gel as local drug delivery also showed significant improved in probing depth.
3) In areas treated with scaling root planing and along with curcumin gel showed, significant reduction in bleeding on probing.
4) Local delivery of curcumin gel leads to significant gains in clinical attachment levels at 1 and 3 months compared to Scaling and root planing.

The curative property of this local drug delivery system was biologically accepted without any side effects. Moreover, it was simple to use and required less chair side time. So, it appears as a viable and an inexpensive option for common man and can be incorporated as a treatment modality in day to day life.

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