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Evaluation of Cinnamon as an Adjunct to Scaling and Root Planing In Treatment of Chronic Periodontitis Patients

Dr. Arun Vishnu C, 2. Dr. Padmakumar T. P., 3. Dr. Nandakumar K., 4. Dr. Devisree N., 5. Dr. Harikrishnan B

Post Graduate Student, Department Of Periodontology And Oral Implantology, Azeezia College F Dental Sciences And Research, Kollam

Mds, Prof. & Hod, Department Of Periodontology And Oral Implantology, Azeezia College F Dental Sciences And Research, Kollam

Dean, Department Of Periodontology And Oral Implantology, Azeezia College F Dental Sciences And Research, Kollam

Mds, Prof., Department Of Periodontology And Oral Implantology, Azeezia College F Dental Sciences And Research, Kollam

Mds, Reader, Department Of Periodontology And Oral Implantology, Azeezia College F Dental Sciences And Research, Kollam

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ABSTRACT:

Background: A number of in-vitro and in-vivo studies have reported that cinnamon extracts have anti-inflammatory, anti-microbial, anti-oxidant, anti-fungal, anti-diabetic, anti-carcinogenic and immunomodulatory effects. Cinnamon based products have long been used for controlling inflammation related condition in traditional medicine. To overcome the adverse effects caused by synthetic agents, cinnamon extract-based products are proposed as an alternative adjunct to treatment of gingival and periodontal diseases.

Aim: To assess the efficacy of Cinnamon based gel as an adjunct to scaling and root planing with scaling and root planning (SRP) in the treatment of Chronic Periodontitis.

Materials and methods: In this clinical study, forty-six participants with mild chronic periodontitis were included. Included participants underwent phase I therapy, after which they were allocated into 2 groups out of which one group received cinnamon gel as an adjunct to SRP. Modified sulcular Bleeding index (mSBI), Probing pocket depth (PPD) and Clinical attachment level (CAL) were recorded at baseline, 6th week, 12th week and 18th week follow-up. A saliva sample was collected and tested for IL1 β levels at baseline and 18th week follow-up.

Results: The results showed significant reduction in all clinical parameters like mean pocket probing depth (mPPD), mean clinical attachment levels (mCAL), mean sulcular bleeding index scores (mSBI) and IL-1β levels for both groups. All clinical parameters other than mean clinical attachment levels showed statistically significant improvement in intergroup comparison. On intergroup analysis, intrapocket application of cinnamon based gel in combination with SRP showed significantly more reduction in IL-1β levels.

Conclusion: Cinnamon as an adjunct to SRP showed significant reduction in all the clinical and diagnostic parameters as compared to SRP alone. Hence it is confirming the potential and additive effect of Cinnamon based gel along with SRP.

Keywords: Chronic Periodontitis, Scaling and Root Planning (SRP), Adjunct, Cinnamon, Cinnamaldehyde, Anti-microbial, Anti-inflammatory.

I. INTRODUCTION

Periodontitis is a chronic multifactorial inflammatory disease associated with dysbiotic plaque biofilms and characterized by progressive destruction of the tooth-supporting apparatus.[1] Its primary features include the loss of periodontal tissue support, manifested through clinical attachment loss (CAL) and radiographically assessed alveolar bone loss, presence of periodontal pocketing and gingival bleeding.[1] Periodontitis in various forms affect about 17.6 % of the world population with stage II and III being more common and grade B at about 60.5%.[2]

Periodontitis is a multifactorial disease of which the dental plaque can be considered to be the disease initiator.[3] The subgingival plaque harbours bacteria, producing proinflammatory products like lipopolysaccharides and peptidoglycans resulting in inflammation. A shift to more of gram -ve bacteria produce several kinds of other endotoxins and

tissue damaging enzymes.[4] This results in a host immune-inflammatory response in the periodontal tissues. The host immune-inflammatory response against bacterial plaque can thus be viewed as a "dual-edged sword," i.e. the response is protective by intent, yet in susceptible patients who exhibit an exaggerated inflammatory response to plaque, it ultimately is responsible for perpetuating destruction of periodontium.[5]

Periodontitis treatment includes mechanical and chemical biofilm control. Management of mild to moderate periodontitis cases can be done through non-surgical periodontal therapy which includes scaling and root planing and can be considered as the "gold standard".[6] Inspite of the excellent results achieved, mechanical therapy itself may not always reduce or eliminate the anaerobic infection at the base of the pocket, within the gingival tissues, and in both structures inaccessible to periodontal instruments.[7] To overcome this, systemic and local drug delivery of antimicrobials was initiated to enhance nonsurgical therapy by serving as an adjunct to scaling and root planing Adverse effects such as drug toxicity, acquired bacterial resistance, drug interaction, and patient's compliance limit the use of systemic antimicrobials.[8]To overcome these adverse effects several herbal/natural agents are being studied for use as an adjunct to scaling and root planing in treatment of chronic periodontitis.[9]

The attention of research has shifted to antimicrobial properties of traditional medicinal substances, like essential oils (EOs)/extracts. These have demonstrated effective antibacterial and antifungal properties. Oral hygiene products based on herbal extracts have gained popularity in recent times. One such extracts/EOs subjected to investigation in dentistry is cinnamon.[10]

The main constituent of cinnamon EOs/extracts is cinnamic aldehyde, other compounds which are present include cinnamic acid, hydroxyl cinnamaldehyde, cinnamyl alcohol, coumarin etc.[11] Cinnamon has shown to possess anti-microbial, anti-inflammatory, anti-oxidant, immuno-modulatory effects and several other medicinal properties and has been studied extensively for medical and dental use.[12] Cinnamon has also been proven to be effective against periodontal pathogens.[13]

Cinnamon is high in antioxidants such as polyphenols and glutathione. Mancini Filho et al. reported various antioxidant activities with the different extracts of cinnamon.[14] The volatile oils of cinnamon display widespread antioxidant assets at awareness ranging from 100 to 200 elements according to million Jayaprakashan et al.[15]. Cinnamon extract has also located to have a powerful loose radical scavenging effect.

The mechanisms underlying the antibacterial effects of natural derivatives of Cinnamomum plants are complex. Cinnamaldehyde, as well as eugenol, inhibited β-lactamase's production by the bacterium and destroyed its cell wall.[16] Phenolic compounds such as carvacrol can also cause destruction of the cell cytoplasmic membrane,[17] and terpenes interact with the bacterial membrane by modifying its permeability[18] and increasing the penetration of antibacterial agents. Essential oils of Cinnamomum contain a wide range of different groups of chemical compounds, suggesting that their antibacterial activity might have several mechanisms.

Various compounds contained in cinnamon showed anti-inflammatory effects by suppressing the expression of inducible nitric oxide synthesis (iNOS), cyclooxygenase-2 (COX-2), and nitric oxide (NO) production.

Cinnamon has following additional properties important in management of periodontal diseases like, they[19]

- Inhibit of NF-κB activity
- Reduce the activation of Src/spleen-tyrosine kinase
- Inhibit of TNF-α gene, IL-2, IL-4, and IFNγ
- Induct sirtuin expression
- Decrease IL-1β concentration
- Inhibit of 5-LPO, COX2 and iNOS enzymes

Which adds to the anti-inflammatory capacity exhibited by cinnamon compounds.

Cinnamon compound like cinnamaldehyde has added healing properties through the induction of cell proliferation and angiogenesis. This happens by activating the enzyme phosphatidylinositol-3-kinase (PI3K) and MAPKs. Cinnamaldehyde also stimulates the secretion of vascular endothelial growth factor (VEGF), facilitating angiogenesis.[20] Cinnamaldehyde's wound-healing mechanism involves stimulating new blood vessel formation, reducing cytokine levels, and promoting collagen type I synthesis.[21,22]

Interleukin (IL)-1, a pro-inflammatory cytokine has been identified as aperiodontal disease marker because of its function as not only an inflammatory mediator but also as a modulator ofextracellular matrix and bone. Although both isoforms of IL-1 (IL-1α and IL-1β) have similar biologic activities, IL-1β ismore potent in stimulating bone resorption and is the form thatoccurs more frequently in periodontitis.

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IL-1β is produced by wide variety of cells in periodontium including monocytes, macrophages, neutrophils, osteocytes, fibroblasts and keratinocytes. It is not only one of the key mediators of inflammatory process occurring in periodontitis but also influences other mediators synergistically like chemokines, prostaglandinE2, interleukin -6 which are involved in periodontal tissue damage. It induces neutrophil influx and activation, T-cell activation and cytokine production, B-cell activation and antibody production, osteoclast activation and bone resorption. Salivary IL-1β levels have been found tube raised in patients with chronic periodontitis, and reduced after phase I therapy, suggesting a close association between salivary IL-1β and periodontitis.[24]

So, to overcome the adverse effects caused by synthetic chemical agents' cinnamon can be employed in management of gingivitis and periodontitis. Hence, we have designed a clinical study to compare the efficacy of SRP with or without the application of cinnamon based gel based on clinical and biochemical parameters (salivary IL1 β levels).

II. MATERIALS AND METHODS

Gel preparation

The Gel system was prepared as the protocol followed by Ahmed et al 2019.[25]

Fresh cinnamon oil (Cinnamomum zeylanicum) was obtained from ICAR, Kozhikode, Kerala. The preparation of the gel system and testing was done at Central Laboratory for Instrumentation and Facilitation (CLIF), University of Kerala, Trivandrum, Kerala. Gel was prepared in two parts the cinnamon oil emulsion and a gelling system. The nano emulsion (CO-NE) was prepared first by taking Cinnamon oil and mixing it to the mixture of S_{mix} (surfactant: Tween 80 & co–surfactant: PEG-400) in a suitable ratio, followed by proper mixing and stirring on magnetic stirrer for complete homogenization at room temperature. The measured quantity of water added drop by drop with continuous mixing. Carbopol® 940 was selected as the thickening agent and Xanthan gum was selected to give mucoadhesive property to the gel. Carbopol (1.25%; w/w) was dispersed in water and after that keep aside for a time. In this way, polymer chains will swell fully and also hydrated completely. For the further improvement of this gel, PEG–400 added followed by triethanolamine vigorous stirring while a transparent gel was formed with alkaline nature. Xanthan gum was added and mixed till homogeneity was obtained. CO–NE was added to this prepared–gel base followed by continuous stirring until the CO–NE–Gel nano–formulation. pH was adjusted to attain 6.5-7.0 pH and stored in a plastic container, closed and labelled with the name of the product and stored at room temperature.

Study design

Forty-six subjects with chronic generalized periodontitis as per the AAP international workshop for classification of periodontal diseases, in the age group of 25-55 years with 4-6mm probing pocket depth was determined using William's Periodontal Probe and by assessing clinical parameters, reporting to the Department of Periodontics and Oral Implantology Azeezia College of Dental Sciences and Research, Meyannoor, Kollam, Kerala, India. The study protocol was approved by the institutional ethical committee (Reg. No. AEC/REV/2022/13). Patients of age group 25-55 years suffering from moderate chronic generalized periodontitis having at least four sites with pocket probing depth of 4-6 mm or more in one or both of arches were included in the study. Patients were excluded if they were allergic to cinnamon based products, suffering from known systemic diseases which could alter healing response of periodontium, who had received any periodontal treatment in three months before study, history of medication (antibiotics or anti-inflammatory drugs) in three months before study, using medicated toothpaste or anti-bacterial mouth rinse having acute periodontal conditions, wearing orthodontic or other removable appliances, current or previous smokers and pregnant or nursing women.

Subject Grouping

Patients so selected, wererandomly categorized into two parallel groups of 23 patients each-Group A [control group (n=23)] - Patients who were treated with scaling and root planing (SRP) alone. Group B [experimental group (n=23)] - Patients who were treated with scaling and root planning (SRP) followed by sub gingival application of cinnamon gel.

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Clinical Parameters

The following clinicalmeasurements were recorded for all patients in the study: Sulcus Bleeding Index (BI) (Muhlemann H.R. and Son S, 1971),[26]Probing pocket depth (PPD) recorded using UNC-15 periodontal probe and clinical attachment level (CAL)recorded using UNC-15 probe and custom-made acrylic stent.

Saliva Collection and assay

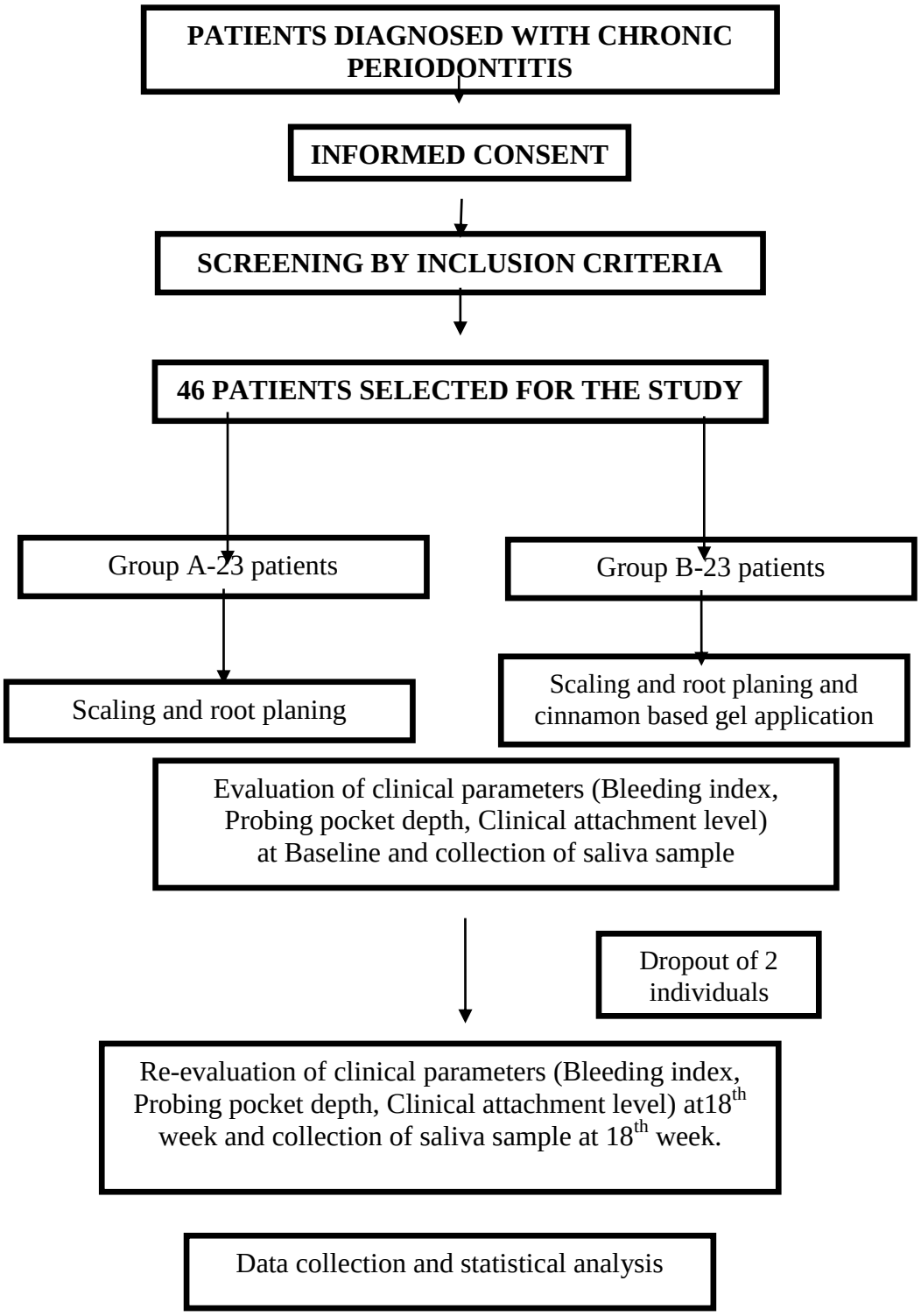
Unstimulated whole saliva was collected from all patients into sterile plastic containers by passive drool method. Procedure was carried out until sufficient sample (3- 5ml) was collected. At the conclusion, all the remaining saliva was collected and spit out into the container. Collected samples were centrifuged, and then transported to the laboratory for further analysis. Interleukin-1β was analysed in samples using human interleukin-1β ELISA kit. The total amounts of Interleukin 1β in the samples were analysed by sandwich enzyme-linked immunosorbent assay using commercially available kits (sensitivity – 15.6 to 1000 pg/ml) from the manufacturer ELK Biotechnology and the dealer CLEMENTIA BIOTECH, New Delhi.

Assay: Interleukin-1β was analysed in samples using human interleukin-1β ELISA kit. C ELISA plate was coated with 100 µL/well of capture antibody in coating buffer. The plate was sealed and incubated overnight at 4°C. Wells were aspirated and washed 3 times with >250µL/well wash buffer. Plate was blotted on absorbent paper to remove any residual buffer. Wells were blocked with 200 µL/well of 1X Assay Diluent & incubated at room temperature for 1hour.Wells were aspirated and washed once with Wash Buffer. Using 1X Assay Diluent, standards were diluted to prepare the top concentration of the standard. 100 µL/well of top standard concentration was added to the appropriate wells. 2-fold serial dilutions of the top standards were performed to make the standard curve for a total of 8 points. 100 µL/well of the sample was added to the appropriate wells. The plate was sealed and incubated overnight at 4°Cfor maximal sensitivity. Wells were aspirated/ washed with wash buffer. This was repeated for a total of 3-5 washes.100 µL/well of detection antibody was diluted in 1X Assay Diluent. The plates were sealed and incubated at room temperature for 1 hour. Wells were aspirated/ washed as in step 2. This was repeated for a total of 3-5 washes. 100 µL/well of Avidin-HRP was diluted in 1X Assay Diluent. The plates were sealed and incubated at room temperature for 30 minutes. Wells were aspirated/ washed as in step 2. This was repeated for a total of 5-7 washes. Wells were soaked in Wash Buffer for 1 to 2 minutes prior to aspiration. 100 µL/well of Substrate Solution was added to each well. Plate was incubated at room temperature for 15 minutes. 50 µL of Stop Solution was added to each well. Plate was read on microplate reader.

Study method

Patients were explained about the purpose and method of the study and their informed consent was taken. Complete medical and dental history of patients was taken and clinical examination of patients was carried out. At baseline visit bleeding score, probing pocket depth, clinical attachment level and salivary interleukin-1β were recorded. Complete oral prophylaxis was carried out for both control group and experimental group. For experimental group cinnamon gel was applied sub-gingivally after scaling and root planing. Oral hygiene instructions were given. Recall visits were scheduled after 18 weeks of periodontal therapy for measuring clinical parameters. A second saliva sample was collected at 18th week and biochemical parameter was recorded. Data thus collected was put to statistical analysis.

FIG 1: FLOWCHART SHOWING STUDY PARTICIPANTS



III. STATISTICAL ANALYSIS

The statistical analysis was performed using Statistical Package for Social Sciences (SPSS) 20.0. Calculation for power (80%) of the study was performed before the commencement of the study. All quantitative variables are expressed

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in mean and standard deviation. Qualitative variables are expressed in percentages. The intragroup comparison between time groups were performed using paired t test. The intergroup comparisons were performed using Unpaired t test. Probability value ($p<0.05$) was considered statistically significant. The data was also represented as tables and graphs for easy understanding.

IV. RESULTS

The flow chart of study participants is depicted in figure1. The study population consisted of 44 patients in the age group of 25-55 years old suffering from chronic periodontitis. 2 patients were lost to follow-up. All the parameters taken in group A and group B are summarized in table 1 and table 2. A statistically significant reduction was observed in all clinical and biochemical parameters in intragroup comparison. A statistically significant reduction in mean sulcular bleeding index was noticed at baseline and 18th week and also on intergroup comparison a statistically significant difference was noted in the 18th week. A statistically significant reduction in mean probing pocket depths was noted at baseline and 18th week in both groups, at 18th week a significant difference was seen between groups after application of cinnamon based gel. Similar improvements were noted in case of clinical attachment levels although in intergroup comparison at 18th week results were not statistically significant. A statistically significant reduction in the salivary interleukin 1β with scaling androot planing alone and scaling and root planing with cinnamon gel application at baseline and 18th week and on intergroup comparison statistical significance was noted at 18th week follow-up. None of the participants reported of any adverse events following application of cinnamon based gel.

Clinical parameters and biochemical parameters in group A

Periods of observation	Parameters			
	Sulcular bleeding index	Probing pocket depth (mm)	Clinical attachment levels (mm)	IL-1β(pg/mL)
Baseline	2.61±0.76	5.27±0.68	5.68±0.81	533.78±138.54
18th week	0.73±0.32	3.81±0.64	4.31±1.06	467.55±129.92
p-value	<0.01*	<0.01*	<0.01*	<0.01*

Clinical parameters and biochemical parameters in group B

Periods of observation	Parameters			
	Sulcular bleeding index	Probing pocket depth (mm)	Clinical attachment levels (mm)	IL-1β(pg/mL)
Baseline	2.73±0.50	5.36±0.56	5.86±1.05	594.19±127.08
18th week	0.44±0.31	3.36±0.77	4.04±1.39	390.83±117.80
p-value	<0.01*	<0.01*	<0.01*	<0.01*

Comparison between clinical parameters and biochemical parameters in group Aand group B

Parameters	Time interval	Mean group A	Mean Group B	p Value
Sulcus bleeding index	Baseline 18th week	2.61±0.76 0.73±0.32	2.73±0.50 0.44±0.31	0.555 0.003*
Probing pocket depth	Baseline 18th week	5.27±0.68 3.81±0.64	5.36±0.56 3.36±0.77	0.642 0.045*
Clinical attachment levels	Baseline 18th week	5.68±0.81 4.31±1.06	5.86±1.05 4.04±1.39	0.536 0.480
Interleukin -1β	Baseline 18th week	533.78±138.54 467.55±129.92	594.19±127.08 390.83±117.80	0.139 0.046*

V. DISCUSSION

The aim of the present study was to assess the effectiveness of cinnamon based gel as a local drug agent in the treatment of chronic periodontitis. The study population consisted of 44 patients grouped into 2 groups. Group A received scaling and root planing alone and Group B received Scaling and root planing and intrapocket application of cinnamon based gel. The clinical parameters analysed were sulcular bleeding index, probing pocket depth and clinical attachment level at baseline, 6th week, 12th week and 18th week. A saliva sample was collected at baseline and 18th week and IL-1β levels were analysed.

In the present study effectiveness of 2.5% cinnamon-based gel as adjunct to nonsurgical periodontal therapy in treatment of chronic periodontitis was analysed, which demonstrated an improvement in clinical parameters and diagnostic parameters from baseline to 18 weeks' time interval when compared to SRP alone. This beneficial improvement can be due to the advantage of using a local/subgingival delivery of the drug system that includes greater drug concentrations at the desired site into the gingival sulcus, surpassing its systemic metabolism when administered systemically.

There was a significant difference in the clinical level of gingival inflammation and bleeding parameters and long-term outcome of probing pocket depth levels which corelated with the reduction of salivary levels of IL-1β. The group which used cinnamon based gel as an adjunct to SRP showed a greater reduction in clinical and laboratory parameters. It can be said that cinnamon based gel is an effective agent in controlling chronic periodontitis when used as an adjunct to SRP. In the present study cinnamon-based gel was used sub gingivally and no local or systemic complications were noticed.

The reduction in clinical parameters and biochemical parameters in the present study may be corelated with results given by Haffajee et al 1997[27]and Citterio et al 2022[28].were similar reduction in clinical parameters like bleeding on probing, pocket probing depth and gingival redness was seen.

The Sulcular bleeding index (Muhlemann HR & Son S 1971) was compared between both groups. The baseline scores were 2.61 ± 0.76 for group A and 2.73 ± 0.50 for group B. The inter group comparison showed that the scores were statistically significant at 18th week (p=0.003). At 18th week the group A score reduced to 0.44 ± 0.31 compared to group B with a score of 0.73 ± 0.32 which shows a statistically significant reduction (p=0.003). The intragroup comparison of scores at baseline and 18th week follow up showed a statistically significant reduction (p=<0.01) in both groups. However, the results were much more significant in group 2 compared to group 1.

This effect may be attributed to the potent anti-inflammatory effect of cinnamon extracts, which inhibits prostaglandin biosynthesis, nitric oxide production and cyclooxygenase-2 (COX-2) enzyme.[29] In addition, eugenol is one of the most components of cinnamon, could also inhibit 5-lipoxygenase enzyme in polymorphonuclear leukocytes and it can inhibit inducible nitric oxide synthesis (iNOS), and nitric oxide (NO) production.[29] Gunawardena et al[30] showed the potent anti-inflammatory property of cinnamon extracts like hydroxy cinnamaldehyde which has the strongest inhibitory effect on NO production among the cinnamaldehyde derivatives through inhibition of NF-kappa B activation. Cinnamon also has shown effectiveness against all periodontal pathogens due to presence of several antimicrobial components like cinnamaldehyde, flavonoids, alkaloids, saponins, tannins, quinones, terpenoids[31] and possess anti-inflammatory effect on periodontal pathogen induced cytokine production and inactivation of NF-Kβ signalling pathway[32]. Furthermore, cinnamaldehyde promoted the osteogenic differentiation of HPDLCs with an increase in alkaline phosphatase expression and activity, formation of more mineralization nodules, and increased the expression of bone sialoprotein and osteopontin.[32]

Periodontal pocket probing depth were also evaluated and there was an improvement in both the groups. The mPPD reduced from 5.2 mm to 3.8 mm in group 1 and 5.3 mm to 3.3 mm in group 2. The intragroup comparison showed a statistically significant reduction in both of the groups (p=<0.01). The inter group comparison showed that the difference was statistically non-significant at baseline (p=0.642) but was statistically significant at 18th week of recall (p=0.045).

This result indicates the added effect of cinnamon extract on periodontal healing and the potent anti-inflammatory effects.[33] The reduction mPPD was also seen in use of cinnamon based product in chronic periodontitis.[34] Cinnamon extracts have also shown to have added tissue healing properties.[35] It has shown to accelerate wound healing, especially increase epithelialization. Cinnamon extracts also shown to accelerate wound healing by inducing angiogenesis in the wound area.[36] This involves activation of certain signalling pathways and thus activating growth factors like FGF-2, TGF beta, VEGF etc. Cinnamon extracts have also shown to increase type I collagen synthesis[37] and shortened the inflammatory phase, increased fibroblast distribution, collagen deposition, and accelerated the cellular proliferation, reepithelialisation and keratin synthesis.[38]

The mCAL showed a statistically significant reduction in both groups in intragroup comparison (p=<0.001). The mCAL reduced from 5.6 mm to 4.3 mm in group 1 and 5.8 mm to 4.0 mm in group 2. The intergroup comparison showed a statistically insignificant result at Baseline and 18th week (p=0.480).

The difference in mPPD and mCAL levels may be due to the fact that baseline PPD and CAL may be recorded when the tissues are inflamed and the probe tip may penetrate apically through the junctional epithelium into the connective tissue when gingiva is inflamed. The resolution of the inflammatory state will subsequently result in a reorganization of connective tissue and as a result the probe tip will stop coronal to its original location.[39] Thus, there might be a difference when correlating the mPPD and mCAL at different time points. Also, as the gingiva shrinks and inflammation reduces PPD might be seen to decrease but no significant gain in clinical attachment levels is noted.

The diagnostic test evaluated salivary IL-1β levels at baseline and 18th week. Both groups showed a reduction in mean IL-1β levels at 18th week of recall compared to baseline (p=<0.01). The IL-1β levels reduced from 533.78 ± 138.54 pg/ml at baseline to 467.55 ± 129.92 pg/ml in group 1 and 594.19 ± 127.08 pg/ml at baseline to 390.86 ± 117.80 pg/ml at 18th week in group 2. The intergroup comparison showed a statistically significant reduction of IL-1β levels at 18th week of recall (p= 0.046).

Toll-like receptors, like TLR2 and TLR4, can sense both Pathogen-associated and Damage-associated molecular pattern (PAMP, DAMPs) and once activated, they trigger the secretion of pro-inflammatory cytokines such as IL-1β and tumor necrosis factor (TNF-α), the generation of reactive oxygen and nitrogen species (ROS, RNS) and the release of DAMPs.[40] Study by Schink et al [41] showed cinnamon extract compounds like trans-cinnamaldehyde might possess synergistic effects when combined with p-cymene, cinnamyl alcohol and cinnamic acid and they affect TLR2 and TLR4 signalling thus reducing expression of several proinflammatory cytokines like IL-1β, IL6, Il8 and TNF alpha. The results of study done by Chao et al[42]showed that cinnamon extracts especially cinnamaldehyde inhibited secretion of IL1 beta and TNF alpha and demonstrated the antioxidant and anti-inflammatory properties of cinnamon extracts.

A drawback noticed was the shorter duration (18 weeks) of the study which reflected in the IL-1β levels which was significantly higher than controls (healthy individuals).

This result can be correlated with study by Kinney et al[43] which shows that change in IL-1 β is gradual and requires longer time to reach lower levels. Thus, longer duration studies should be conducted to confirm the long-term changes in IL-1β levels post treatment.

All these results in the present study suggests that the intrapocket application of cinnamon based gel along with SRP shows clinical effectiveness in treatment of mild to moderate chronic periodontitis. The gel system was a sustained release formula which slowly released the drug for about 24.8 hrs. The gel was easy to place using a 2.5 ml syringe with a blunt angles tip. This allowed for repeated application of the gel during recall visits. The added advantage of the gel system was the mucoadhesive property which avoided the use of periodontal packs and improved patient compliance. The gel was easy to apply and remained in the pocket for longer time. No adverse reactions were noticed during the study.

VI. CONCLUSION

Within the limitations of the study, it can be concluded that application of cinnamon based gel has an added benefit over scaling and root planning alone in the treatment of chronic periodontitis. Cinnamon gel provides an effective and easy to apply adjunct to SRP to achieve significantly better clinical results. Further research and longitudinal studies with larger sample size and expanded biomarker panels can cement cinnamon as a treatment option in patients suffering from chronic periodontitis.

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Conflict of interest statement
There was no conflict of interest to be stated

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ANNEXURE

Grover V, Malhotra R, Sachdeva S. Cytokines: the signaling molecules of periodontium,

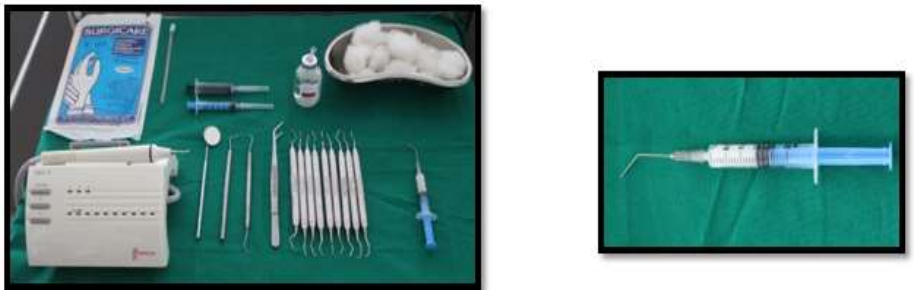

FIG 2:Armamentarium for the procedure

FIG 3:Armamentarium for saliva sample collection

FIG 4:ELISA KIT