A comparison of the efficacy of scaling and root planning with application of pomegranate chip, pomegranate gel, and scaling and root planing in sufferers with adult periodontitis – A prospective study

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Abstract:

Context: The use of herbal compounds is a comparatively safer alternative to synthetic compounds for periodontal therapy. Aim: This study aims to investigate effect of extracts from pomegranate in a chip and gel form on periodontitis following scaling and root planing in adult periodontitis patients. Settings and Design: An in vivo prospective study. Materials and Methods: Thirty patients of adult periodontitis with initial pocket depth ≥4 mm were enrolled into the research and divided randomly into three groups, (10 in every group). After baseline examination, scaling root planing of tooth was achieved. Then subgingival application of medicated chips in Group 1, gel in Group 2, and placebo in Group 3 was done. Plaque index, gingival index, probing pocket depth, and relative attachment ranges were recorded at baseline, 21 days and 45 days. Statistical Analysis Used: Analysis of variance test. Results: The study confirmed significant improvements of plaque index ratings in Group 1 at day 21. It showed significant improvements of gingival index scores, probing pocket depth, and clinical attachment at day 21 and 45. Gingival index rankings and probing pocket depth were extensively elevated altogether in three groups at day 21 and 45. Relative attachment degree was extensively raised in Group 1 and Group 2 at day 21 and day 45 and in Group 3 at day 45. The relative attachment degrees confirmed significance at day 21 between Group 1 and Group 2, and Group 1 and Group 3. Conclusion: Pomegranate extracts in chip and gel shape may offer additionally advantages to scaling and root planing for remedy of periodontal pockets.

Keywords: Chip, gel, gingiva, plaque, pomegranate

INTRODUCTION

Chronic periodontitis may be a serious bacterial infection leading to major damage to soft tissue, and thereafter, the bone that supports the teeth.1 Bacterial plaque has myriad microorganisms, which lead to mild or serious infections. Bacterial plaque usually is seen on the tooth surface and areas of tooth below the gums.2 Although mechanical plaque control methods have the potential to take care of an adequate level of oral hygiene, thanks to lack of accuracy of correct techniques, such methods are not properly employed by the patients. Therefore, plaque control with chemicals is used as an adjuvant method to routine or daily oral hygiene measures.3,4 They also have a role in periodontal therapy. Oral antibiotics, antiseptic mouthwashes, local drug delivery (LDD) of antiseptics and host modulating agents are used in this regard. The everlasting lookout for newer and safer adjunctive therapeutic agents remains ongoing.3,4 LDD of chemotherapeutic agents may be a well-documented and sometimes used method of chemical plaque control. The systemic use of drugs is associated with toxicity; LDD minimizes the issues related to systemic drug delivery. Two common issues eliminated by LDD are...
gastric disturbances and allergies. Systemic administration of antimicrobial also requires an adequate compliance by patients and is susceptible to the development of resistant bacteria.\[10\] LDD methods include subgingival irrigation, use of gels, and hollow fibers.\[5\] It has been reported that scaling and root planing when combined with delivery system like subgingival irrigation demonstrated reduction in microbes and improved clinical parameters.\[6\]

The use of synthetic compounds for LDD such as chlorhexidine digluconate and tetracycline causes various problems such as staining of tooth surface, alteration of taste, mucosal allergy. More recently, various herbal extracts are used for LDD as a comparatively safer alternative to synthetic compounds. Subgingival irrigation using herbal extract such as Mentha piperita (Menthol), commiphora myrrha, carvuum carinni, and turmeric have demonstrated significant improvement in gingival health.\[5\]

Punica granatum linn, mostly referred to as pomegranate may be a plant within the family punicaccae.\[3\] In brazil, fruit of this tree referred to as Roma, and commonly used for treatment of throat infections, cough and fever, thanks to its anti-inflammatory properties. The rind or pericarp of this fruit is understood to contain considerable amount of hydrolysable tannins, which are demonstrated to inhibit prostaglandin synthetase, have low acute toxicity, no mutagenic activity, and caused no skin irritation.\[7\] This will be utilized in gel also as in chip form. Recently introduced herbal chip containing extracts of pomegranate has been used as an adjunctive treatment in nonsurgical periodontal therapy.\[1,6\]

The objective of this present clinical study was to gauge the consequences and benefits of herbal chip and gel from extracts of pomegranate as a subgingival adjunct to scaling and root planing and their effect on clinical parameters such as plaque scores, gingival scores, pocket probing depth, and relative attachment level.

**MATERIALS AND METHODS**

A total of 30 patients affected by chronic periodontitis who reported to the outpatient department of periodontology at our institution were recruited for this randomized controlled clinical test. The sample size was decided by employing a suitable open source software N-Master version 2.0. Inclusion criteria for the study were patients with chronic periodontitis with a minimum of three sites having a probing depth ≥4 mm, age bracket between 35 and 50 years, and having an American Society of Anaesthesiologists Grade I physical status. Exclusion criteria were patients taking anti-inflammatory medication, any systemic antibiotics use within the past 3 months, periodontal therapy within the past 6 months, tobacco users, eight or less natural teeth in mouth, pregnant and lactating women, and teeth with hopeless prognosis. Due and needful approval was obtained from the institutional ethical committee, and every one of the patients gave written consent for participation within the study. The patients were allocated randomly into three groups of 10 each [Figure 1] using open source Random Allocation Software version 2.0.(developed by M. Saghaei, MD., Department of Anesthesia, Isfahan University of Medical Sciences, Isfahan, Iran). Group 1 received scaling and root planing plus placement of pomegranate chips at selected sites [Figure 2]. Group 2 received scaling and root planing plus placement of pomegranate gel at selected sites [Figure 3]. Group 3 received scaling and root planing alone.

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**Figure 1:** CONSORT diagram of randomization; n = number of study participants

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The clinical parameters noted were Turesky-Gilmore and Glickman modification of Quigley Hein Plaque index, Loe and Silness Gingival Index, Pocket Probing depth in millimeter from a marked point of reference to the bottom of pocket, measured with UNC 15 probe employing a customized occlusal acrylic stents.\[8-10]\ The parameters were recorded at baseline, 21 days and 45 days altogether the three groups. One independent examiner who was blinded to the study recorded all indices.

**Chip preparation**

Hydrolyzed collagen was dispersed in water and the solution was heated to 85°C–90°C. Mixture was stirred, then mixed with the extract of Punica pericarp. The mixture was poured evenly on to stainless steel mold plates and allowed to chill down at temperature. It was then dried in a refrigerator. With an innovative chip cutting machine, the sheets were uniformly sliced into 4 mm × 5 mm rectangular chip with one rounded end, resembling a ‘U’ shape. Chips were packaged in blister packs and submitted for sterilization by gamma irradiation.\[6,11]\  

**Gel preparation**

Fresh pomegranates were obtained via grocery stores. Their barks and juice were separated. The barks were dried at high temperature for 5 days, and then they were powdered. An infusion was prepared with this powdered material at a ratio of 100 g powder to 1000 ml water, cooled at temperature and filtered. Thereafter, a total of fifty grams of carboxymethylcellulose was added to 1 l of the mix, and it was kept boiling until its complete dissolution to get the ten percent gel concentration. The pomegranate extract concentration utilized in this work was prepared by hydrolyzing collagen in water and the solution was heated to 85°C–90°C. Mixture was stirred, then mixed with the extract of Punica pericarp. The mixture was poured evenly on to stainless steel mold plates and allowed to chill down at temperature. It was then dried in a refrigerator. With an innovative chip cutting machine, the sheets were uniformly sliced into 4 mm × 5 mm rectangular chip with one rounded end, resembling a ‘U’ shape. Chips were packaged in blister packs and submitted for sterilization by gamma irradiation.\[6,11]\  

**Statistical analysis**

The statistical analysis was done using SPSS (Statistical Package for Social Sciences) Version 15.0 statistical Analysis Software. (IBM, Chicago, United States of America). The analysis of variance (ANOVA) test was undertaken to compare the intra-group and inter-group variances. The ANOVA provided “F” ratio, where a better “F” value depicted a better inter-group difference. A \( P \leq 0.05 \) was considered statistically significant.

**RESULTS**

The mean age of the study sample was 42.7 years, with 12 males and 18 females. All the patients completed the study properly and none were lost to follow-up. Among the three groups, statistically significant reduction was seen in plaque index scores in Group 1 from baseline to day 21 \( (P = 0.029) \), in Group 2 from baseline to day 45 \( (P = 0.014) \) and in Group 3 from baseline to day 21 \( (P = 0.025) \) and baseline to day 45 \( (P = 0.002) \) [Table 1 and Figure 4]. All the three groups led to a statistically significant reduction in gingival index scores from baseline to day 21 and baseline to day 45. In Group 1, both the \( P \) values were <0.001, in Group 2 the \( P \) values were 0.006 and <0.001, and in day 3 both the \( P \) values were <0.001 [Table 1 and Figure 5]. All the three groups led to a statistically significant reduction in probing pocket depth from baseline to day 21 and baseline to day 45. In Group 1, the \( P \) values were 0.001, and <0.001, in Group 2 both the \( P \) values were <0.001, and in Group 3 the \( P \) values were 0.013 and <0.001 [Table 1 and Figure 6]. Among the three groups, statistically significant reduction was seen in relative attachment levels in Group 1 from baseline to day 21 \( (P = 0.028) \) and baseline to day 45 \( (P < 0.001) \), in Group 2 from baseline to day 21 \( (P = 0.002) \) and baseline to day 45 \( (P < 0.001) \), and in Group 3 from baseline to day 45 \( (P = 0.028) \) [Table 1 and Figure 7].

Intergroup comparison revealed that the values at all the time intervals for all the three groups were not statistically significant for plaque index scores, gingival index scores and probing pocket depth. In case of the relative attachment levels, a significant finding was seen at baseline between Group 1 and Group 2 \( (P = 0.028) \), and Group 1 and Group 3 \( (P \leq 0.001) \). Statistical significance was seen at day 21 between Group 1 and Group 2 \( (P = 0.002) \), and Group 1 and Group 3 \( (P \leq 0.001) \). Similarly, significance was also seen at day 45 between Group 1 and Group 3 \( (P \leq 0.001) \) [Table 1] statistically.

**DISCUSSION**

Herbs have more than a few bioactive aspects which possess widespread medicinal properties with least unwarranted effects.\[19]\ Synthetic antimicrobials and antibiotics are recognized to motivate

![Figure 2: Placement of Punica granatum chip at surgical site](image1)

![Figure 3: Placement of Punica granatum gel at surgical site](image2)
Pomegranate flavonoids have a proven antibacterial motion in vitro in opposition to Streptococcus sanguis, which is acknowledged to be the preliminary colonizer in dental plaque formation.\textsuperscript{[4,12]} Pomegranate extract additionally suppresses the antimicrobial resistance, as evident by emergence of distinguished infections. It is probable due to the inappropriate or massive overuse of antimicrobials.\textsuperscript{[4,13]} Natural phytochemicals have demonstrated to be a true selection to counteract such artificial agents.\textsuperscript{[4,13]}

Table 1: Intra and Inter group comparison of measured parameters with statistical significance

| Parameter and group (n=10) | Day | P (significant when $P \leq 0.05$) |
|---------------------------|-----|----------------------------------|
|                           | Baseline | Day 21 | Day 45 | Baseline to day 21 | Baseline to day 45 | Day 21 to 45 |
| Plaque Index score        | Group-1 (chip) | 2.00±0.47 | 1.30±0.48 | 1.40±0.70 | 0.029 | 0.072 | 1.000 |
|                           | Group-2 (gel)   | 1.70±0.48 | 1.30±0.48 | 1.10±0.32 | 0.148 | 0.014 | 0.938 |
|                           | Group-3 (control) | 2.00±0.47 | 1.40±0.52 | 1.20±0.42 | 0.025 | 0.002 | 1.000 |
| Gingival Index score      | Group-1 (chip) | 1.80±0.42 | 0.90±0.32 | 0.70±0.48 | <0.001 | <0.001 | 0.865 |
|                           | Group-2 (gel)   | 1.60±0.52 | 0.90±0.32 | 0.60±0.52 | 0.006 | <0.001 | 0.467 |
|                           | Group-3 (control) | 1.90±0.32 | 1.10±0.32 | 0.90±0.32 | <0.001 | <0.001 | 0.506 |
| Probing pocket depth in millimetres | Group-1 (chip) | 5.40±0.52 | 4.20±0.79 | 3.40±0.70 | 0.001 | <0.001 | 0.041 |
|                           | Group-2 (gel)   | 5.00±0.00 | 3.90±0.32 | 3.70±0.48 | <0.001 | <0.001 | 0.573 |
|                           | Group-3 (control) | 5.20±0.42 | 4.40±0.52 | 3.90±0.74 | 0.013 | <0.001 | 0.186 |
| Relative attachment Level in millimeters | Group-1 (chip) | 10.70±0.82 | 9.50±1.08 | 8.70±0.95 | 0.028 | <0.001 | 0.217 |
|                           | Group-2 (gel)   | 10.00±0.47 | 8.90±0.57 | 8.70±0.82 | 0.002 | <0.001 | 1.000 |
|                           | Group-3 (control) | 9.50±0.97 | 8.60±1.27 | 8.10±1.10 | 0.250 | 0.028 | 0.980 |

| Parameter and group (n=10) | Intergroup comparison | P (significant when $P \leq 0.05$) |
|---------------------------|------------------------|--------------------------------------------------|
|                           | Group-1 and Group-2    | Group-1 and Group-3    | Group-2 and Group-3    |
| Plaque index score        | Baseline | 0.509 | 1.000 | 0.509 |
|                           | Day 21   | 1.000 | 1.000 | 1.000 |
|                           | Day 45   | 0.587 | 0.587 | 1.000 |
| Gingival index score      | Baseline | 0.909 | 1.000 | 0.381 |
|                           | Day 21   | 1.000 | 0.506 | 0.506 |
|                           | Day 45   | 1.000 | 1.000 | 0.436 |
| Probing pocket depth in millimetres | Baseline | 0.084 | 0.766 | 0.766 |
|                           | Day 21   | 0.759 | 1.000 | 0.186 |
|                           | Day 45   | 0.933 | 0.290 | 1.000 |
| Relative attachment level in millimeters | Baseline | 0.028 | <0.001 | 0.217 |
|                           | Day 21   | 0.002 | <0.001 | 1.000 |
|                           | Day 45   | 0.250 | 0.028 | 0.980 |

$P$ – Probability of obtaining results

Figure 4: Graphical representation of mean values of Plaque Index

Figure 5: Graphical representation of mean values of Gingival Index
capacity of microorganisms to adhere to the tooth. It might also be an effective alternate for the prevention of the formation of dental plaque.\[14\] Pomegranate mouthwash has antibacterial efficacy in opposition to Aggregatibacter actinomycetemcomitans, Porphyromonas gingivalis and Prevotella intermedia, which are the most unnecessary periodontal pathogens.\[17\] P. granatum has proven antimicrobial aspects in an opposing manner to Eikenella corrodens, which is a secondary colonizer in the biofilm formation on the teeth floor. This opposing of Eikenella corrodens, is drastically greater than chlorhexidine.\[18\] Pomegranate mouthwash used on two instances every day for 15 days, in studies, have resulted in an environment friendly reduction of gingival and bleeding on probing ratings when in contrast to chlorhexidine.\[19\]

Pomegranate and its components have been fed upon for centuries, with least damaging effects.\[14,7\] Studies of pomegranate parts in animals at concentrations and stages, typically used in people and normal medication, did not point out any poisonous effects.\[14,20\] Pomegranate juice, oil, or powdered extracts can be fed upon by healthy humans, with no excessive risk. No destructive results on renal or liver characteristics have been discovered in human beings on the administration of up to 1420 mg/day of pomegranate fruit extract tablets.\[14,21\] Pomegranate can be safely used as a tremendous adjunct to the traditional periodontal remedy as an anti-plaque agent due to its antibacterial properties.\[11,21\]

Periodontology entails a range of therapy processes. Scaling and root planning are the foremost effective and utilized procedures. However, the use of neighborhood natural adjunctive therapeutic sources, alongside with scaling and root planning, has proven to be effective with favorable consequences as in contrast to scaling and root planning alone. A few researches have been undertaken which have studied the impact of P. granatum extracts in remedy of periodontal pathology.\[3,11,15-17,19\] In the existing study, statistical reduction in plaque ratings was viewed in Group 1 at 21 days, Group 2 at 45 days, and in Group 3 at 21 and 45 days. However, in Group 1, statistical significance at baseline to day 45 was no longer seen. This is in accordance with the end-result of the study performed by Sastravaha et al.\[11\] This can be attributed to scaling and root planning accompanied with the aid of antibacterial impact of pomegranate, which incorporates hydrolysable tannins that contain structure complexes of excessive molecular weight with soluble proteins. They will increase bacterial lysis and intrude in the bacterial adherence mechanism on teeth. They also possess a substantivity property.

In Group 2, although a suggestive plaque index reduction was discovered from baseline to day 21, this distinction was no longer found to be statistically relevant. Between baseline and day 45, the change in Plaque Index was statistically significant. These findings were in accordance with the end result acquired in research carried out by Somu et al. who confirmed a tremendous reduction from baseline to 21 days and Salgado et al.\[12,3\] On intergroup comparison, it was analyzed that the readings at all the three time intervals for all the three corporations have been insignificant at baseline, day 21 and day 45, respectively.

Highly statistical reduction was located in all the three groups in Gingival Index rankings at day 21 and day 45. This is in accordance in the research achieved by Sastravaha et al. and Sastravaha et al.\[11,22\] This decrease in the ratings can be attributed to scaling and root planing accompanied through anti-inflammatory impact of pomegranate as it has immunoregulatory impact over macrophages and T and B lymphocytes subsets and their substantivity.\[11,22\] On intergroup comparison, it was analyzed that the baseline score for all the three groups have been statistically insignificant at all the time intervals. None of the in-between comparisons yielded a statistical difference.

In probing pocket depth scores, statistical decrease was found in all groups at day 21 and day 45. This is in accordance in the research accomplished by Sastravaha et al. and Sastravaha et al.\[11,22\] The higher probing depth reduction may the end result of the astringent property of the tannin containing Punica extract in the chip. The astringent property is commonly accompanied with a contraction of the tissues.\[21,22\] On intergroup comparison, it was analyzed that the baseline value for all the three groups have been statistically insignificant, with no statistically substantial reduction at 21 days and special statistically reduction at 45 days. This is in accordance with the research executed through Sastravaha et al.\[11\]
A distinctive statistical reduction was seen in all the groups in relative attachment degree rankings at day 21 and in Group 1 and Group 2 at day 45. This is in accordance with the research by Sastravaha et al.[11] and Sastravaha et al.[21] On intergroup comparison, it was analyzed that the baseline score for all the three groups have been statistically valuable, with implied distinction between Groups 1 and three. This is in accordance with the research executed by Sastravaha et al.[11]

It seems from the above data that the gel may be of higher value than the chip in reduction of plaque index and might also be equally of high value in reduction of gingival index, probing pocket depth and relative attachment level. Chip seems to be distinctly of high value in enhancing the relative attachment when in contrast to control. Chip additionally seems to be higher than gel in the former degrees of treatment; however, gel seems to be comparable to manage relative attachment level. Limitations of the present research were a shorter length of follow-up, and a smaller population size.

**SUMMARY AND CONCLUSION**

LDD with the use of *P. granatum* chip is easy and noninvasive technique. The *P. granatum* chip remedy can also decorate the advantages of scaling and root planing in the remedy of periodontal pockets. The chip alongside with scaling and root planing seems to be finer than gel and scaling and root planing alone. The current research used a short time period scientific trial, which confirmed that *P. granatum* chip is substantially higher in value for restoring periodontal fitness as in contrast to *P. granatum* gel and scaling and root planing alone. Future endeavors in this direction are wished to perceive the actual advantages of pomegranate chip and gel.

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**Conflicts of interest**

There are no conflicts of interest.

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