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ЕЖЕМЕСЯЧНЫЙ НАУЧНЫЙ ЖУРНАЛ

Медицинские новости Грузии

საქართველოს სამედიცინო სიახლენი

GEORGIAN MEDICAL NEWS

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GMN: Georgian Medical News is peer-reviewed, published monthly journal committed to promoting the science and art of medicine and the betterment of public health, published by the GMN Editorial Board since 1994. GMN carries original scientific articles on medicine, biology and pharmacy, which are of experimental, theoretical and practical character; publishes original research, reviews, commentaries, editorials, essays, medical news, and correspondence in English and Russian.

GMN is indexed in MEDLINE, SCOPUS, PubMed and VINITI Russian Academy of Sciences. The full text content is available through EBSCO databases.

GMN: Медицинские новости Грузии - ежемесячный рецензируемый научный журнал, издаётся Редакционной коллегией с 1994 года на русском и английском языках в целях поддержки медицинской науки и улучшения здравоохранения. В журнале публикуются оригинальные научные статьи в области медицины, биологии и фармации, статьи обзорного характера, научные сообщения, новости медицины и здравоохранения. Журнал индексируется в MEDLINE, отражён в базе данных SCOPUS, PubMed и ВИНИТИ РАН. Полнотекстовые статьи журнала доступны через БД EBSCO.

GMN: Georgian Medical News – საქართველოს სამედიცინო სიახლენი – არის ყოველთვიური სამეცნიერო სამედიცინო რეცენზირებადი ჟურნალი, გამოიცემა 1994 წლიდან, წარმოადგენს სარედაქციო კოლეგიისა და აშშ-ის მეცნიერების, განათლების, ინდუსტრიის, ხელოვნებისა და ბუნებისმეტყველების საერთაშორისო აკადემიის ერთობლივ გამოცემას. GMN-ში რუსულ და ინგლისურ ენებზე ქვეყნდება ექსპერიმენტული, თეორიული და პრაქტიკული ხასიათის ორიგინალური სამეცნიერო სტატიები მედიცინის, ბიოლოგიისა და ფარმაციის სფეროში, მიმოხილვითი ხასიათის სტატიები.

ჟურნალი ინდექსირებულია MEDLINE-ის საერთაშორისო სისტემაში, ასახულია SCOPUS-ის, PubMed-ის და ВИНИТИ РАН-ის მონაცემთა ბაზებში. სტატიების სრული ტექსტი ხელმისაწვდომია EBSCO-ს მონაცემთა ბაზებიდან.

WEBSITE

www.geomednews.com

К СВЕДЕНИЮ АВТОРОВ!

При направлении статьи в редакцию необходимо соблюдать следующие правила:

1. Статья должна быть представлена в двух экземплярах, на русском или английском языках, напечатанная через **полтора интервала на одной стороне стандартного листа с шириной левого поля в три сантиметра**. Используемый компьютерный шрифт для текста на русском и английском языках - **Times New Roman** (**Кириллица**), для текста на грузинском языке следует использовать **AcadNusx.** Размер шрифта - **12**. К рукописи, напечатанной на компьютере, должен быть приложен CD со статьей.

2. Размер статьи должен быть не менее десяти и не более двадцати страниц машинописи, включая указатель литературы и резюме на английском, русском и грузинском языках.

3. В статье должны быть освещены актуальность данного материала, методы и результаты исследования и их обсуждение.

При представлении в печать научных экспериментальных работ авторы должны указывать вид и количество экспериментальных животных, применявшиеся методы обезболивания и усыпления (в ходе острых опытов).

4. К статье должны быть приложены краткое (на полстраницы) резюме на английском, русском и грузинском языках (включающее следующие разделы: цель исследования, материал и методы, результаты и заключение) и список ключевых слов (key words).

5. Таблицы необходимо представлять в печатной форме. Фотокопии не принимаются. **Все цифровые, итоговые и процентные данные в таблицах должны соответствовать таковым в тексте статьи**. Таблицы и графики должны быть озаглавлены.

6. Фотографии должны быть контрастными, фотокопии с рентгенограмм - в позитивном изображении. Рисунки, чертежи и диаграммы следует озаглавить, пронумеровать и вставить в соответствующее место текста **в tiff формате**.

В подписях к микрофотографиям следует указывать степень увеличения через окуляр или объектив и метод окраски или импрегнации срезов.

7. Фамилии отечественных авторов приводятся в оригинальной транскрипции.

8. При оформлении и направлении статей в журнал МНГ просим авторов соблюдать правила, изложенные в «Единых требованиях к рукописям, представляемым в биомедицинские журналы», принятых Международным комитетом редакторов медицинских журналов - http://www.spinesurgery.ru/files/publish.pdf и http://www.nlm.nih.gov/bsd/uniform_requirements.html
В конце каждой оригинальной статьи приводится библиографический список. В список литературы включаются все материалы, на которые имеются ссылки в тексте. Список составляется в алфавитном порядке и нумеруется. Литературный источник приводится на языке оригинала. В списке литературы сначала приводятся работы, написанные знаками грузинского алфавита, затем кириллицей и латиницей. Ссылки на цитируемые работы в тексте статьи даются в квадратных скобках в виде номера, соответствующего номеру данной работы в списке литературы. Большинство цитированных источников должны быть за последние 5-7 лет.

9. Для получения права на публикацию статья должна иметь от руководителя работы или учреждения визу и сопроводительное отношение, написанные или напечатанные на бланке и заверенные подписью и печатью.

10. В конце статьи должны быть подписи всех авторов, полностью приведены их фамилии, имена и отчества, указаны служебный и домашний номера телефонов и адреса или иные координаты. Количество авторов (соавторов) не должно превышать пяти человек.

11. Редакция оставляет за собой право сокращать и исправлять статьи. Корректура авторам не высылается, вся работа и сверка проводится по авторскому оригиналу.

12. Недопустимо направление в редакцию работ, представленных к печати в иных издательствах или опубликованных в других изданиях.

При нарушении указанных правил статьи не рассматриваются.

REQUIREMENTS

Please note, materials submitted to the Editorial Office Staff are supposed to meet the following requirements:

1. Articles must be provided with a double copy, in English or Russian languages and typed or compu-ter-printed on a single side of standard typing paper, with the left margin of **3** centimeters width, and **1.5** spacing between the lines, typeface - **Times New Roman** (**Cyrillic**), print size - **12** (referring to Georgian and Russian materials). With computer-printed texts please enclose a CD carrying the same file titled with Latin symbols.

2. Size of the article, including index and resume in English, Russian and Georgian languages must be at least 10 pages and not exceed the limit of 20 pages of typed or computer-printed text.

3. Submitted material must include a coverage of a topical subject, research methods, results, and review.

Authors of the scientific-research works must indicate the number of experimental biological species drawn in, list the employed methods of anesthetization and soporific means used during acute tests.

4. Articles must have a short (half page) abstract in English, Russian and Georgian (including the following sections: aim of study, material and methods, results and conclusions) and a list of key words.

5. Tables must be presented in an original typed or computer-printed form, instead of a photocopied version. **Numbers, totals, percentile data on the tables must coincide with those in the texts of the articles.** Tables and graphs must be headed.

6. Photographs are required to be contrasted and must be submitted with doubles. Please number each photograph with a pencil on its back, indicate author's name, title of the article (short version), and mark out its top and bottom parts. Drawings must be accurate, drafts and diagrams drawn in Indian ink (or black ink). Photocopies of the X-ray photographs must be presented in a positive image in **tiff format**.

Accurately numbered subtitles for each illustration must be listed on a separate sheet of paper. In the subtitles for the microphotographs please indicate the ocular and objective lens magnification power, method of coloring or impregnation of the microscopic sections (preparations).

7. Please indicate last names, first and middle initials of the native authors, present names and initials of the foreign authors in the transcription of the original language, enclose in parenthesis corresponding number under which the author is listed in the reference materials.

8. Please follow guidance offered to authors by The International Committee of Medical Journal Editors guidance in its Uniform Requirements for Manuscripts Submitted to Biomedical Journals publication available online at: http://www.nlm.nih.gov/bsd/uniform_requirements.html
http://www.icmje.org/urm_full.pdf
In GMN style for each work cited in the text, a bibliographic reference is given, and this is located at the end of the article under the title "References". All references cited in the text must be listed. The list of references should be arranged alphabetically and then numbered. References are numbered in the text [numbers in square brackets] and in the reference list and numbers are repeated throughout the text as needed. The bibliographic description is given in the language of publication (citations in Georgian script are followed by Cyrillic and Latin).

9. To obtain the rights of publication articles must be accompanied by a visa from the project instructor or the establishment, where the work has been performed, and a reference letter, both written or typed on a special signed form, certified by a stamp or a seal.

10. Articles must be signed by all of the authors at the end, and they must be provided with a list of full names, office and home phone numbers and addresses or other non-office locations where the authors could be reached. The number of the authors (co-authors) must not exceed the limit of 5 people.

11. Editorial Staff reserves the rights to cut down in size and correct the articles. Proof-sheets are not sent out to the authors. The entire editorial and collation work is performed according to the author's original text.

12. Sending in the works that have already been assigned to the press by other Editorial Staffs or have been printed by other publishers is not permissible.

Articles that Fail to Meet the Aforementioned Requirements are not Assigned to be Reviewed.

ავტორთა საყურადღებოდ!

რედაქციაში სტატიის წარმოდგენისას საჭიროა დავიცვათ შემდეგი წესები:

1. სტატია უნდა წარმოადგინოთ 2 ცალად, რუსულ ან ინგლისურ ენებზე,დაბეჭდილი სტანდარტული ფურცლის 1 გვერდზე, 3 სმ სიგანის მარცხენა ველისა და სტრიქონებს შორის 1,5 ინტერვალის დაცვით. გამოყენებული კომპიუტერული შრიფტი რუსულ და ინგლისურენოვან ტექსტებში - **Times New Roman (Кириллица)**, ხოლო ქართულენოვან ტექსტში საჭიროა გამოვიყენოთ **AcadNusx.** შრიფტის ზომა – 12. სტატიას თან უნდა ახლდეს CD სტატიით.

2. სტატიის მოცულობა არ უნდა შეადგენდეს 10 გვერდზე ნაკლებს და 20 გვერდზე მეტს ლიტერატურის სიის და რეზიუმეების (ინგლისურ, რუსულ და ქართულ ენებზე) ჩათვლით.

3. სტატიაში საჭიროა გაშუქდეს: საკითხის აქტუალობა; კვლევის მიზანი; საკვლევი მასალა და გამოყენებული მეთოდები; მიღებული შედეგები და მათი განსჯა. ექსპერიმენტული ხასიათის სტატიების წარმოდგენისას ავტორებმა უნდა მიუთითონ საექსპერიმენტო ცხოველების სახეობა და რაოდენობა; გაუტკივარებისა და დაძინების მეთოდები (მწვავე ცდების პირობებში).

4. სტატიას თან უნდა ახლდეს რეზიუმე ინგლისურ, რუსულ და ქართულ ენებზე არანაკლებ ნახევარი გვერდის მოცულობისა (სათაურის, ავტორების, დაწესებულების მითითებით და უნდა შეიცავდეს შემდეგ განყოფილებებს: მიზანი, მასალა და მეთოდები, შედეგები და დასკვნები; ტექსტუალური ნაწილი არ უნდა იყოს 15 სტრიქონზე ნაკლები) და საკვანძო სიტყვების ჩამონათვალი (key words).

5. ცხრილები საჭიროა წარმოადგინოთ ნაბეჭდი სახით. ყველა ციფრული, შემაჯამებელი და პროცენტული მონაცემები უნდა შეესაბამებოდეს ტექსტში მოყვანილს.

6. ფოტოსურათები უნდა იყოს კონტრასტული; სურათები, ნახაზები, დიაგრამები - დასათაურებული, დანომრილი და სათანადო ადგილას ჩასმული. რენტგენოგრამების ფოტოასლები წარმოადგინეთ პოზიტიური გამოსახულებით **tiff** ფორმატში. მიკროფოტოსურათების წარწერებში საჭიროა მიუთითოთ ოკულარის ან ობიექტივის საშუალებით გადიდების ხარისხი, ანათალების შეღებვის ან იმპრეგნაციის მეთოდი და აღნიშნოთ სურათის ზედა და ქვედა ნაწილები.

7. სამამულო ავტორების გვარები სტატიაში აღინიშნება ინიციალების თანდართვით, უცხოურისა – უცხოური ტრანსკრიპციით.

8. სტატიას თან უნდა ახლდეს ავტორის მიერ გამოყენებული სამამულო და უცხოური შრომების ბიბლიოგრაფიული სია (ბოლო 5-8 წლის სიღრმით). ანბანური წყობით წარმოდგენილ ბიბლიოგრაფიულ სიაში მიუთითეთ ჯერ სამამულო, შემდეგ უცხოელი ავტორები (გვარი, ინიციალები, სტატიის სათაური, ჟურნალის დასახელება, გამოცემის ადგილი, წელი, ჟურნალის №, პირველი და ბოლო გვერდები). მონოგრაფიის შემთხვევაში მიუთითეთ გამოცემის წელი, ადგილი და გვერდების საერთო რაოდენობა. ტექსტში კვადრატულ ფჩხილებში უნდა მიუთითოთ ავტორის შესაბამისი N ლიტერატურის სიის მიხედვით. მიზანშეწონილია, რომ ციტირებული წყაროების უმეტესი ნაწილი იყოს 5-6 წლის სიღრმის.

9. სტატიას თან უნდა ახლდეს: ა) დაწესებულების ან სამეცნიერო ხელმძღვანელის წარდგინება, დამოწმებული ხელმოწერითა და ბეჭდით; ბ) დარგის სპეციალისტის დამოწმებული რეცენზია, რომელშიც მითითებული იქნება საკითხის აქტუალობა, მასალის საკმაობა, მეთოდის სანდოობა, შედეგების სამეცნიერო-პრაქტიკული მნიშვნელობა.

10. სტატიის ბოლოს საჭიროა ყველა ავტორის ხელმოწერა, რომელთა რაოდენობა არ უნდა აღემატებოდეს 5-ს.

11. რედაქცია იტოვებს უფლებას შეასწოროს სტატია. ტექსტზე მუშაობა და შეჯერება ხდება საავტორო ორიგინალის მიხედვით.

12. დაუშვებელია რედაქციაში ისეთი სტატიის წარდგენა, რომელიც დასაბეჭდად წარდგენილი იყო სხვა რედაქციაში ან გამოქვეყნებული იყო სხვა გამოცემებში.

აღნიშნული წესების დარღვევის შემთხვევაში სტატიები არ განიხილება.

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Содержание:

THE IMPACT OF HYALURONIC ACID ON GINGIVITIS AND PERIODONTAL HEALTH

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Abstract.

Gingivitis is a reversible inflammatory condition of the gingival tissues, primarily initiated by microbial plaque accumulation. The present study aimed to assess the therapeutic efficacy of 1% hyaluronic acid (HA) gel as an adjuvant remedy to standard scaling and polishing procedures (SPP) in the management of gingivitis. Twenty systemically healthy adults diagnosed with gingivitis were randomly assigned into two parallel groups (n = 10 each). The test group received full-mouth SPP in combination with twice-daily topical application of 1% HA gel, while the control group underwent SPP alone. Clinical parameters, including the Gingival Index (GI), and biochemical markers, namely C-reactive protein (CRP) and lactate dehydrogenase (LDH), were evaluated at baseline and post-intervention. The adjunctive HA therapy group revealed significant improvements in all measured outcomes, with reductions in CRP levels (from 6.68 to 2.78 mg/L), LDH activity (from 177.1 to 88.0 U/L), and GI scores (from 1.7 to 0.2). These results suggest that adjunctive use of 1% HA gel may be effective, non-invasive therapeutic strategy for enhancing the clinical and biochemical resolution of gingival inflammation.

Key words. Hyaluronic acid, gingivitis, scaling and polishing, periodontal health, C-reactive protein, lactate dehydrogenase.

Introduction.

Gingivitis is a prevalent and reversible inflammatory condition of the gingival tissues, clinically characterized by erythema, edema, and bleeding upon probing. Although it is initially confined to the gingiva, if left unmanaged, gingivitis can progress to periodontitis—a chronic, destructive inflammatory disease resulting in the irreversible loss of periodontal underlying structures, comprising alveolar bone and connective tissue linning [1]. The primary etiological factor in gingivitis is the accumulation of bacterial plaque biofilm at the gingival margin, underscoring the necessity of mechanical debridement for effective management [2].

Scaling and polishing procedures (SPP) remain the cornerstone of nonsurgical periodontal therapy. These mechanical interventions aim to eliminate supra- and subgingival plaque and calculus, thereby reducing microbial burden and halting disease progression [3]. Despite their effectiveness, complete resolution of inflammation and optimal healing is not always achieved with mechanical debridement alone, particularly in anatomically complex areas or in patients with suboptimal host responses. Consequently, there is growing interest in exploring adjunctive therapeutic agents that can enhance the outcomes of conventional treatment modalities [4].

Hyaluronic acid (HA) has emerged as a promising adjunct in periodontal therapy. It is a high-molecular-weight, non-sulfated glycosaminoglycan that constitutes a major component of the extracellular matrix in connective tissues, including the periodontium [5]. HA exhibits a wide range of biological activities that are highly relevant to periodontal health. It possesses anti-inflammatory properties through the modulation of cytokine production and leukocyte infiltration [6], exerts bacteriostatic effects by inhibiting bacterial adhesion and proliferation [7], and promotes wound healing and tissue regeneration by stimulating fibroblast activity and collagen synthesis [8]. These attributes suggest that HA could support accelerated resolution of inflammation and improved clinical outcomes when used adjunctively in the management of gingival diseases.

In addition to clinical indices, systemic biomarkers such as C-reactive protein (CRP) and lactate dehydrogenase (LDH) offer valuable insights into inflammatory status and tissue damage, respectively. CRP, an acute-phase protein synthesized by the liver, serves as a sensitive marker of systemic inflammation and therapeutic efficacy [9]. LDH, a cytoplasmic enzyme present in various tissues, is released during cellular injury and is often employed to assess the extent of tissue damage [10-13]. Monitoring these biomarkers may provide a comprehensive understanding of the biological impact of adjunctive therapies beyond clinical resolution alone [14].

The addition of HA0.2% to daily brushing schedule or to dental floss were resulted in improved clinical periodontal parameters compared to baseline [15,16]. Despite the increasing interest in HA-based interventions, high-quality clinical evidence supporting its adjunctive use in gingivitis remains limited. The present study was thus designed to assess the clinical and biochemical efficacy of a 1% HA gel applied topically in conjunction with full-mouth SPP in adult patients with gingivitis. We hypothesized that the adjunctive use of HA would result in greater reductions in clinical signs of inflammation and systemic biomarkers of tissue damage when compared to mechanical debridement alone.

Materials and Methods.

Study design: This investigation was performed as a randomized, controlled, parallel-group clinical trial aimed at evaluating the adjunctive effects of 1% hyaluronic acid (HA) gel (PerioKIN, Spain) in the non-surgical management of gingivitis. The study was conducted in accordance with the criteria listed in the Declaration of Helsinki and applied for ethical approval from the institutional ethics committee. Informed consent was obtained from all participants.

Patients: A total of 20 systemically healthy patients aged between 18 and 30 years, diagnosed with gingivitis, were enrolled. Participants were randomly assigned to the treatment group (n = 10), which received HA gel alongside normal care, or the control group (n = 10), which received normal care alone.

Inclusion criteria:

1. Diagnosis of gingivitis characterized by bleeding on probing (BOP) in ≥10% of sites, with associated gingival erythema and edema.
2. Presence of at least 20 natural teeth.
3. Good general systemic health with no conditions affecting periodontal status.
4. No periodontal therapy in the preceding six months.
5. No known hypersensitivity to HA.
6. Non-smokers or individuals who had ceased smoking for at least 12 months prior to enrollment.
7. Willingness to comply with study protocols and attend all scheduled follow-up visits.

Exclusion Criteria:

1. Diagnosis of periodontitis (probing depth ≥4 mm and clinical attachment loss ≥3 mm at multiple sites).
2. Use of systemic antibiotics or anti-inflammatory medications within three months prior to baseline.
3. Pregnancy or lactation.
4. Immunocompromised status.
5. Current orthodontic treatment.
6. Presence of other oral inflammatory conditions (e.g., oral lichen planus, mucositis).

Intervention Protocol.

Baseline Assessment:

All participants underwent a full-mouth periodontal examination at baseline. The following clinical parameters were recorded:

Assessed using the modified Löe and Silness Index (0 = normal gingiva **Gingival Index (GI):**; 1 = mild inflammation; 2 = moderate inflammation; 3 = severe inflammation) [14].

Scaling and Polishing: All participants received a single session of full-mouth scaling and polishing performed by the same experienced dental hygienist. Oral hygiene instructions, including proper toothbrushing and interdental cleaning techniques, were reinforced for all patients.

Hyaluronic Acid Gel Application (Treatment Group Only): Immediately following scaling and polishing, participants in the treatment group received a topical application of 1% HA gel (twice daily). The gel was applied to the gingival sulcus and marginal gingiva of all teeth using a blunt-ended syringe or cotton swab, ensuring consistent coverage. Patients were instructed not to rinse, eat, or drink for at least 30 minutes post-application.

Outcome Measures and Follow-up: Participants were re-evaluated along two months after the intervention. The following clinical and biochemical parameters were measured:

1. **GI:** To assess gingival inflammation.
2. **Serum CRP:** Using kit supplied by Biolabo (France), based on manufacturer instructions the serum samples were used for measurement based on Nephlometry Immunoassay Method.
3. **Serum LDH:** Using kit supplied by Hipro Biotechnology (USA), based on manufacturer instructions the serum samples were used for measurement of LDH based on colorimetric enzymatic analysis.

Statistical Analysis: Results were analyzed using SPSS-IBM (V26.0 USA). data expressed as mean ± standard deviation (SD). Paired t-test was used to assess within-group changes. A p-value < 0.05 was considered statistically significant.

Results.

All 20 participants completed the study with no reported adverse events. Significant improvements were observed in the treatment group compared to control group across all clinical and biochemical parameters (Figure 1).

LDH levels in the treatment group showed a significant decrease in LDH (177.3 ± 43.2 U/L to 68.5 ± 54.1 U/L, $p < 0.001$), while the control group showed a non-significant increase in LDH (137.3 ± 33.5 U/L to 145.2 ± 57.8 U/L, $p = 0.12$) (Figure 2).

CRP in treatment group showed a significant decrease in CRP (6.7 ± 3.8 mg/L to 2.6 ± 2.4 mg/L, $p = 0.002$). Control group also showed a significant decrease in CRP (4.6 ± 1.8 mg/L to 2.7 ± 2.6 mg/L, $p = 0.03$) (Figure 3).

GI scores in HA-treated group revealed a significant decrease in GI scores (1.9 to 0.2, $p = 0.001$). The control group also revealed significant improvement in GI scores (1.6 to 0.7, $p = 0.04$) (Figure 4).

Relative percentage change in mean LDH, CRP, and GI scores for the HA-treated group (n=10) and the control group (n=10) after the intervention period compared to baseline. Positive values denote reduction/improvement, while negative values denote an increase. treatment group showed a 61.3% reduction in LDH, a 61.2% reduction in CRP, and an 89.5% reduction in GI scores. Control group showed a 5.7% increase in LDH, a 41.3% reduction in CRP, and a 56.3% reduction in GI scores.

Discussion.

This randomized controlled clinical trial provides compelling evidence supporting the adjuvant remedies use of 1% hyaluronic acid (HA) gel in the non-surgical management of

Figure 1. *A representative images for the patients enrolled in the present study before and after the use of hyaluronic acid (HA).*

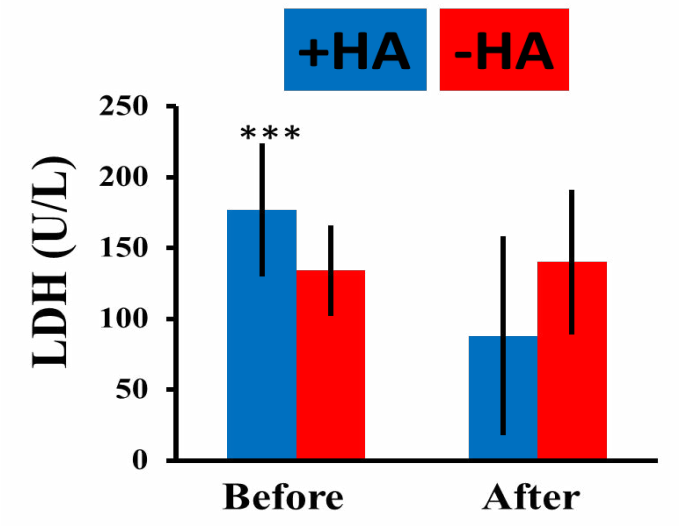

Figure 2. *The levels of serum LDH enzyme in hyaluronic acid-treated versus control group. The histogram bar represent mean and standard deviation. *** indicate significant differences at p value less than 0.001 as compared to baseline using paired t-test. HA=hyaluronic acid, LDH=lactate dehydrogenase.*

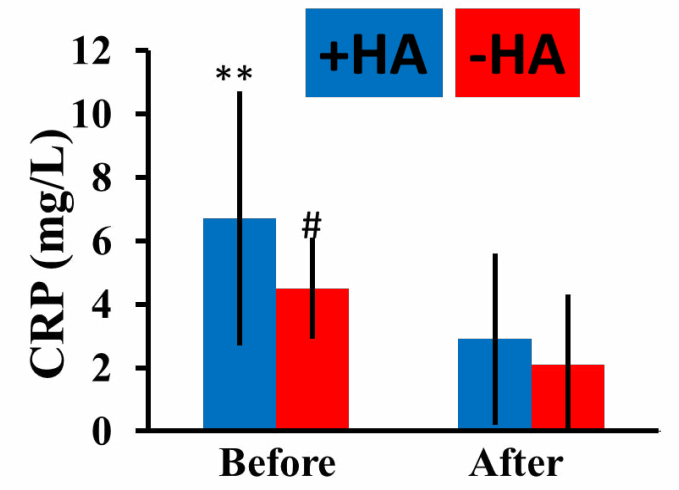

Figure 3. *The levels of serum CRP in hyaluronic acid-treated versus control group. The histogram bar represent mean and standard deviation. ** indicate significant differences at p value less than 0.002 as compared to baseline using paired t-test, # indicate significant differences at p value less than 0.03 as compared to baseline using paired t-test. HA=hyaluronic acid, CRP=c-reactive protein.*

gingivitis. The findings demonstrate that the application of HA following conventional scaling and polishing (SPP) results in significantly greater reductions in gingival inflammation and more pronounced improvements in clinical gingival parameters compared to SPP alone over a two-month period [15,16].

Hyaluronic acid, a naturally occurring glycosaminoglycan found in connective tissues—including the gingiva—plays a multifaceted role in maintaining oral health due to its intrinsic anti-inflammatory, antimicrobial, and wound-healing properties. Its presence in periodontal tissues contributes to hydration, structural integrity, and cellular signalling crucial for tissue regeneration and inflammation resolution [17,18].

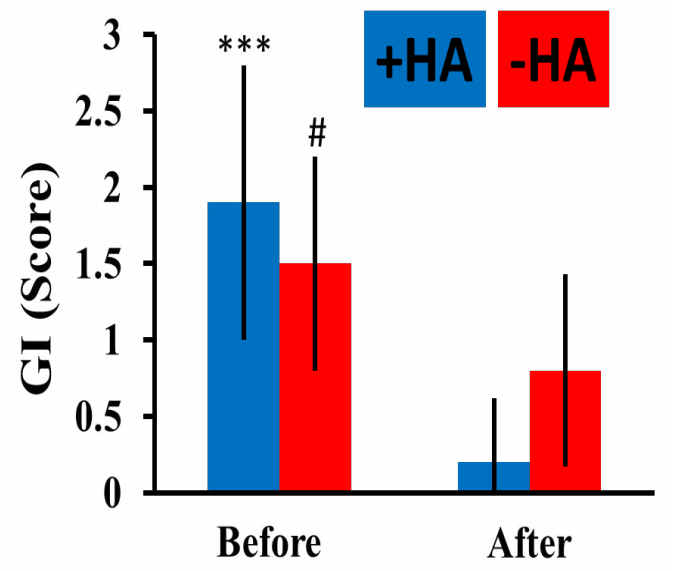

Figure 4. *The scores of gingival index in hyaluronic acid-treated versus control group. The histogram bar represent mean and standard deviation. *** indicate significant differences at p value less than 0.001 as compared to baseline using paired t-test, # indicate significant differences at p value less than 0.04 as compared to baseline using paired t-test. HA=hyaluronic acid, GI=gingival index.*

The observed improvements in gingival health in the HA-treated group are consistent with the bioactive properties of HA. HA promotes gingival healing by stimulating fibroblast proliferation, enhancing collagen synthesis, and accelerating re-epithelialization. Its anti-inflammatory effects are mediated through its interaction with CD44 receptors on immune cells, which leads to suppression of pro-inflammatory cytokines, thereby reducing leukocyte migration [19-21]. Furthermore, HA's viscoelasticity and moisture-retention capacity support the formation of a hydrated extracellular matrix conducive to tissue remodelling and repair. This not only improves the clinical appearance of the gingiva but also enhances functional healing, particularly in inflammatory conditions such as gingivitis [22-24].

The therapeutic application of HA in periodontal therapy has also demonstrated favorable modulation of biochemical markers such as LDH and CRP. Elevated LDH levels are indicative of cellular damage and metabolic stress in periodontal tissues, while CRP is a systemic marker of inflammation commonly elevated in patients with chronic gingival and periodontal disease. The present findings align with previous studies indicating that topical or subgingival application of HA gel can significantly reduce LDH and CRP levels, reflecting both local tissue healing and a potential attenuation of systemic inflammatory burden [25,26].

The adjunctive use of 1% HA gel offers several clinical advantages in the management of gingivitis by; Enhanced Wound Healing: Through stimulation of fibroblast activity and collagen deposition, HA accelerates the regenerative processes essential for gingival tissue repair [27,28]. Reduction of Inflammation: HA downregulates key inflammatory pathways, thereby mitigating tissue destruction and promoting symptom

resolution [29,30]. Improved Biochemical Profiles: Decreases in LDH and CRP suggest a reduction in both localized tissue damage and systemic inflammation, respectively. Supportive Antimicrobial Function: HA exhibits moderate antibacterial effects, contributing to a reduced microbial burden and healthier oral biofilm dynamics [31-34].

Despite the promising outcomes, certain limitations must be acknowledged. Firstly, the sample size was limited (n=10 per group), which restricts the generalizability of the findings and underscores the need for larger, multicenter trials. Secondly, the follow-up duration of two months may not capture the long-term effects of HA on periodontal health, particularly with respect to recurrence of inflammation or sustained biomarker modulation. Additionally, while examiner blinding was maintained, complete blinding of participants and the operator applying the gel was not feasible, potentially introducing performance or detection bias. The study also utilized a single application of HA gel; thus, future research should evaluate the effects of multiple applications, varying frequencies, and different molecular weights or formulations of HA for optimizing clinical outcomes.

Conclusion.

This study reinforces the therapeutic value of HA as an adjunct in non-surgical periodontal therapy. By reducing inflammation, enhancing tissue regeneration, and modulating relevant biochemical markers, HA may serve as a promising adjunct agent in the management of gingivitis. Further studies with larger populations, longer follow-ups, and detailed analyses of HA formulations are warranted to refine its clinical application and broaden its integration into periodontal protocols.

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