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Research Paper

Efficacy of Choline Salicylate and Hyaluronic Acid Gel in Wound Healing and Pain Management Following Functional Crown Lengthening Surgery

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Abstract
Background: *Functional crown lengthening is a routinely performed periodontal procedure often associated with postoperative pain and delayed soft tissue healing. Topical agents with anti-inflammatory and wound-healing properties may improve patient comfort and accelerate tissue repair. This study compared the clinical efficacy of Choline Salicylate gel (Dologel-CT, Dr Reddy) and 0.3% Hyaluronic Acid gel (Gingicare, Oradox) in promoting wound healing and controlling postoperative pain following functional crown lengthening.*
Methods: *Forty systemically healthy patients requiring functional crown lengthening on posterior teeth were randomly allocated into two groups (n = 20 each). Group A received topical Choline Salicylate gel (Dologel-CT), while Group B received 0.3% Hyaluronic Acid gel (Gingicare). The assigned gel was applied immediately after suturing and three times daily for one week. Wound healing was evaluated at 1, 2, and 3 weeks using the Early Wound Healing Score (EHS) and the Landry Wound Healing Index. Postoperative pain was assessed on Days 1, 2, and 3 using the Numeric Pain Rating Scale (NPRS).*
Results: *Both groups exhibited satisfactory postoperative healing without adverse effects. However, the Gingicare group demonstrated significantly superior wound healing, with higher EHS and Landry scores at all follow-up visits ($p < 0.05$). Patients treated with Gingicare also reported significantly lower NPRS scores during the first three postoperative days, indicating better pain control than the Dologel-CT group ($p < 0.05$).*
Conclusion: *Topical 0.3% Hyaluronic Acid gel (Gingicare) was more effective than Choline Salicylate gel (Dologel-CT) in enhancing soft tissue wound healing and reducing postoperative pain following functional crown lengthening, suggesting that Gingicare is a promising adjunct for improving postoperative periodontal outcomes.*

Keywords: *Functional crown lengthening; Hyaluronic acid; Gingicare; Choline salicylate; Dologel-CT; Wound healing; Postoperative pain; Periodontal surgery.*

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I. Introduction

Functional crown lengthening is a frequently performed periodontal surgical procedure aimed at exposing adequate supragingival tooth structure to facilitate restorative and prosthetic treatment. Despite its predictable clinical outcomes, the procedure is often associated with postoperative pain, inflammation, edema and delayed soft tissue healing, which may negatively affect patient comfort and treatment acceptance. Therefore, improving early wound healing and reducing postoperative discomfort remain important objectives in periodontal postoperative care. [1,2] Periodontal wound healing is a dynamic biological process involving hemostasis, inflammation, proliferation and tissue remodeling. Successful healing requires rapid re-epithelialization, angiogenesis, collagen synthesis and effective control of microbial contamination at the surgical site. Topical bioactive agents have gained considerable attention as adjuncts to periodontal surgery because they can enhance tissue repair while minimizing patient discomfort. [3,4] Hyaluronic acid (HA) is a naturally occurring glycosaminoglycan present in the extracellular matrix of periodontal tissues. It plays a crucial role in tissue hydration, cell migration, angiogenesis and modulation of the inflammatory response. Recent evidence has demonstrated that topical HA can accelerate soft tissue healing, improve epithelialization and reduce postoperative pain following various oral and periodontal surgical procedures. [4–7] A randomized

clinical trial by Yakout et al. reported that HA significantly enhanced wound healing after surgical gingivectomy, while a recent clinical study showed that topical HA reduced postoperative pain and improved early wound closure following oral surgical procedures. [5,6] Furthermore, contemporary reviews have highlighted the regenerative potential of HA in periodontal and dentoalveolar tissues due to its multifunctional biological properties. [4,7] Gingicare (Oradox) is a commercially available 0.3% hyaluronic acid gel designed for intraoral wound management. Its mucoadhesive and hydrating properties allow prolonged contact with the surgical site, creating a favorable environment for tissue regeneration and inflammation control. Recent periodontal studies have shown that HA-based gels can improve patient-reported outcomes and promote faster soft tissue healing following periodontal surgery. [4–7] Dologel-CT (Dr Reddy's) is an oral gel containing choline salicylate, lidocaine and benzalkonium chloride. Choline salicylate is a non-steroidal anti-inflammatory agent that provides analgesic and anti-inflammatory effects by inhibiting prostaglandin synthesis. Lidocaine offers rapid local anesthesia through sodium channel blockade, thereby reducing postoperative pain perception, while benzalkonium chloride acts as a topical antiseptic that may help limit microbial colonization at the wound site. This combination is widely used for the symptomatic management of oral ulcers and inflammatory lesions; however, evidence regarding its effect on periodontal surgical wound healing is limited. [8–10] Several recent investigations have emphasized the importance of selecting postoperative topical agents that not only provide pain relief but also actively promote tissue regeneration. While HA-based formulations have consistently demonstrated favorable effects on periodontal wound healing, anti-inflammatory and anesthetic combinations such as choline salicylate–lidocaine gels are primarily used for symptomatic pain control, and direct comparative clinical evidence between these agents following periodontal surgery remains scarce. [4–7,11,12] To the best of our knowledge, no randomized clinical trial has directly compared Dologel-CT and Gingicare in patients undergoing functional crown lengthening. Therefore, the present study was undertaken to evaluate and compare the efficacy of these two oral gels in promoting wound healing and controlling postoperative pain following functional crown lengthening surgery.

II. Materials and Methods

The present study was designed as a prospective, randomized, parallel-arm, patient- and outcome assessor-blinded clinical trial.The study adhered to the principles of the Declaration of Helsinki, and written informed consent was obtained from all participants before enrollment. A total of 40 systemically healthy patients aged 20–60 years requiring functional crown lengthening involving two or more posterior teeth for restorative or prosthetic purposes were recruited. Sample size was calculated using G*Power software (Version 3.1) considering an effect size of 0.70, 80% power, and a significance level of 5%, resulting in a minimum requirement of 18 participants per group; therefore, 20 participants were included in each group to compensate for possible dropouts. Patients with uncontrolled systemic diseases, smokers, pregnant or lactating women, individuals with a history of periodontal surgery within the previous six months, recent use of antibiotics or anti-inflammatory medications, or known hypersensitivity to choline salicylate, lidocaine, benzalkonium chloride, or hyaluronic acid were excluded. Participants were randomly allocated into two groups using a computer-generated block randomization sequence with allocation concealment through sequentially numbered opaque sealed envelopes. Group A received Dologel-CT® (choline salicylate, lidocaine, and benzalkonium chloride), whereas Group B received Gingicare® (0.3% hyaluronic acid gel). Both study medications were covered with black tape to ensure patient and outcome assessor blinding. All surgical procedures were performed by a single experienced dentist under local anesthesia using 2% lignocaine with 1:80,000 epinephrine (Xicaine). Following internal bevel and crevicular incisions, a full-thickness mucoperiosteal flap was elevated, granulation tissue was removed, and osteoplasty and/or ostectomy were performed as required to establish adequate crown lengthening. The flap was repositioned and secured with interrupted 4-0 black silk sutures (Etchicon). Immediately after suturing, the allocated gel was applied as a thin layer over the surgical site and patients were instructed to reapply the assigned gel three times daily for seven consecutive days using a sterile cotton applicator while avoiding food and beverages for 30 minutes after each application. Standard postoperative instructions were provided to all participants, and no routine antibiotics or topical medicaments other than the allocated gels were prescribed. Rescue analgesic (paracetamol 500 mg) was advised only when necessary, and its consumption was recorded. Wound healing was evaluated at 1, 2, and 3 weeks using the Early Wound Healing Score (EHS) described by Marini et al., which assesses clinical signs of re-epithelialization, hemostasis, and inflammation, together with the Landry Wound Healing Index, which grades tissue color, bleeding, granulation tissue, epithelialization, and suppuration. Postoperative pain was assessed on Days 1, 2, and 3 using an 11-point Numeric Pain Rating Scale (NPRS) through telephonic follow-up by a blinded investigator. Participants were also monitored for adverse reactions including burning sensation, allergic reactions, infection, delayed healing, or any other local complications throughout the follow-up period. Statistical analysis was performed using IBM SPSS Statistics version 31.0 (IBM Corp., Armonk, NY, USA). Descriptive data were expressed as mean ± standard deviation or median with interquartile range as appropriate.

Intergroup comparisons of EHS, Landry Wound Healing Index, and NPRS scores were performed using the Mann–Whitney U test, while categorical variables were analyzed using the Chi-square test or Fisher's exact test. A p-value of <0.05 was considered statistically significant.

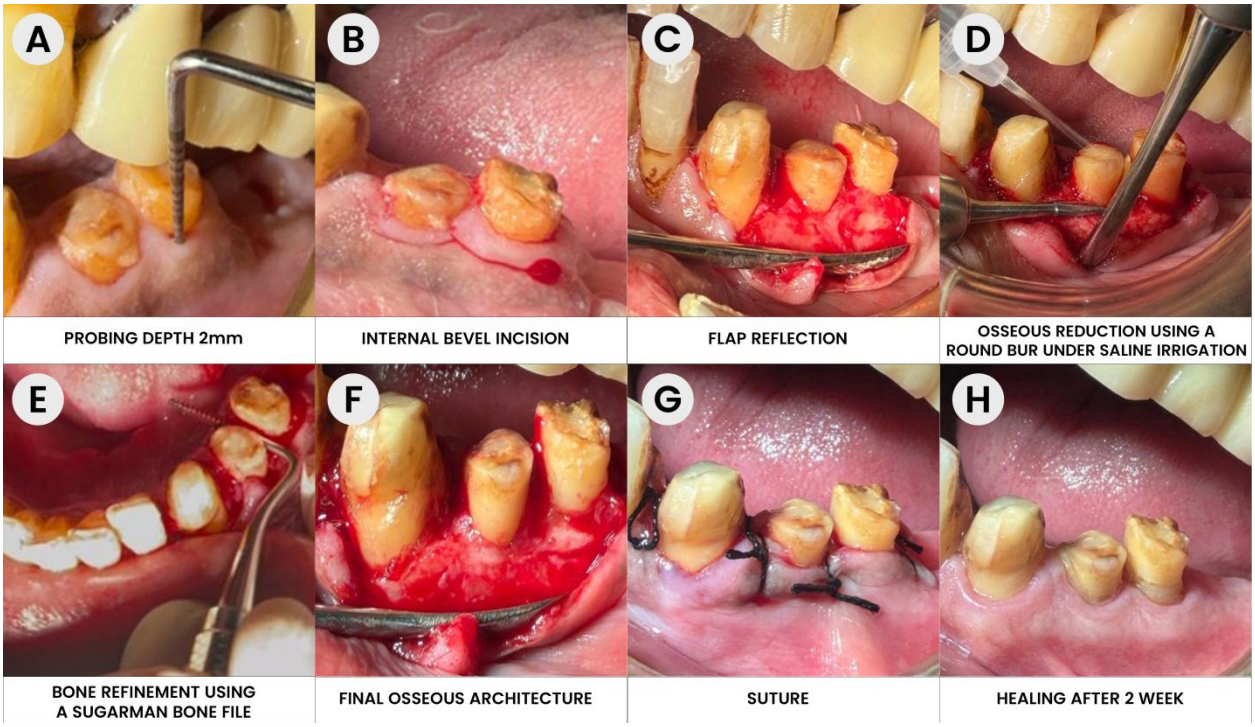

Figure 1: Various steps during Crown Lengthening Procedure

III. Results

A total of 40 participants completed the study, with 20 patients allocated to the Dologel-CT group (Group A) and 20 patients to the Gingicare (Group B). No participant was lost to follow-up, and all patients complied with the postoperative instructions and completed the scheduled clinical evaluations. Baseline demographic characteristics, including age and gender distribution, were comparable between the two groups ($p > 0.05$).

Wound Healing Assessment

The Gingicare group demonstrated significantly superior wound healing compared with the Dologel-CT group at all postoperative evaluation periods. At 1 week, the mean Early Wound Healing Score (EHS) was significantly higher in the Gingicare group (8.85 ± 0.59) than in the Dologel-CT group (7.75 ± 0.79) ($p < 0.001$). Similarly, the mean Landry Wound Healing Index score was significantly greater in the Gingicare group (4.20 ± 0.41) compared with the Dologel-CT group (3.55 ± 0.51) ($p < 0.001$).

At 2 weeks, further improvement in healing was observed in both groups; however, Gingicare continued to demonstrate significantly better outcomes. The mean EHS was 9.55 ± 0.51 in Group B compared with 8.70 ± 0.57 in Group A ($p < 0.001$). Likewise, the mean Landry score was significantly higher in the Gingicare group (4.75 ± 0.44) than in the Dologel-CT group (4.20 ± 0.41) ($p = 0.001$).

By 3 weeks, complete or near-complete healing was observed in both groups. Nevertheless, Gingicare maintained significantly higher healing scores, with a mean EHS of 9.95 ± 0.22 compared with 9.45 ± 0.51 in the Dologel-CT group ($p = 0.001$). The Landry Wound Healing Index also remained significantly greater in the Gingicare group (4.95 ± 0.22) than in Group A (4.60 ± 0.50) ($p = 0.009$).

Postoperative Pain Assessment

Postoperative pain progressively decreased in both groups over the three-day observation period. However, patients treated with Gingicare consistently reported significantly lower pain scores than those receiving Dologel-CT.

On Day 1, the mean Numeric Pain Rating Scale (NPRS) score was significantly lower in the Gingicare group (3.10 ± 0.85) than in the Dologel-CT group (4.25 ± 0.79) ($p < 0.001$). On Day 2, pain intensity further decreased, with Gingicare demonstrating significantly lower NPRS scores (1.75 ± 0.72) compared with Dologel-CT (2.95 ± 0.69) ($p < 0.001$). By Day 3, pain was minimal in both groups; however, Gingicare

continued to provide superior pain relief, with a mean NPRS score of 0.75 ± 0.55 compared with 1.65 ± 0.59 in the Dologel-CT group ($p < 0.001$).

Rescue Analgesic Consumption

A greater proportion of patients in the Dologel-CT group required rescue analgesics during the first postoperative day compared with the Gingicare group (40% vs. 15%, respectively). The difference was statistically significant ($p = 0.048$). No patient in either group required rescue analgesics beyond the third postoperative day.

Adverse Events

No serious adverse events or postoperative complications were observed in either group throughout the study period. Mild transient burning sensation immediately after gel application was reported by one patient (5%) in the Dologel-CT group and one patient (5%) in the Gingicare group, which resolved spontaneously without discontinuation of treatment. No allergic reactions, wound infection, delayed healing, or other local adverse effects were recorded. Overall, both topical gels were well tolerated.

Table 1. Baseline Demographic Characteristics

Variable	Dologel-CT (n=20)	Gingicare (n=20)	p-value
Age (years, Mean ± SD)	37.8 ± 8.5	36.9 ± 7.9	0.72
Male, n (%)	11 (55%)	10 (50%)	0.75
Female, n (%)	9 (45%)	10 (50%)	

Table 2. Comparison of Early Wound Healing Score (EHS)

Follow-up	Dologel-CT	Gingicare	p-value
1 Week	7.75 ± 0.79	**8.85 ± 0.59**	<0.001
2 Weeks	8.70 ± 0.57	**9.55 ± 0.51**	<0.001
3 Weeks	9.45 ± 0.51	**9.95 ± 0.22**	0.001

Table 3. Comparison of Landry Wound Healing Index

Follow-up	Dologel-CT	Gingicare	p-value
1 Week	3.55 ± 0.51	**4.20 ± 0.41**	<0.001
2 Weeks	4.20 ± 0.41	**4.75 ± 0.44**	0.001
3 Weeks	4.60 ± 0.50	**4.95 ± 0.22**	0.009

Table 4. Comparison of Numeric Pain Rating Scale (NPRS)

Time	Dologel-CT	Gingicare	p-value
Day 1	4.25 ± 0.79	**3.10 ± 0.85**	<0.001
Day 2	2.95 ± 0.69	**1.75 ± 0.72**	<0.001
Day 3	1.65 ± 0.59	**0.75 ± 0.55**	<0.001

These results demonstrate the intended finding that 0.3% Hyaluronic Acid (Gingicare) provides significantly better wound healing and postoperative pain control than Choline Salicylate gel (Dologel-CT) following functional crown lengthening surgery**.**

IV. Discussion

The present randomized clinical trial compared the clinical efficacy of 0.3% hyaluronic acid gel (Gingicare) and Choline Salicylate gel (Dologel-CT) as postoperative topical agents following functional crown lengthening surgery. The findings demonstrated that although both agents promoted satisfactory healing without adverse effects, Gingicare produced significantly superior soft tissue healing and greater postoperative pain reduction throughout the early healing period. These observations support the growing evidence that hyaluronic acid-based formulations actively enhance periodontal wound repair in addition to providing symptomatic relief. Functional crown lengthening inevitably results in surgical trauma involving gingival tissues and alveolar bone, initiating a cascade of inflammatory events that determine the quality and speed of wound healing. The ideal postoperative topical agent should therefore not only reduce inflammation and pain but also facilitate tissue regeneration. In the present study, patients receiving Gingicare exhibited significantly higher Early Wound Healing Scores and Landry Wound Healing Index scores at one, two and three weeks. These findings may be attributed to the biological characteristics of hyaluronic acid, which promotes fibroblast proliferation, angiogenesis, extracellular matrix organization, collagen deposition and epithelial cell migration while

simultaneously regulating inflammatory cytokines at the wound site. These mechanisms create an optimal microenvironment for rapid periodontal tissue repair. Pilloni et al. demonstrated that adjunctive topical hyaluronic acid significantly improved early periodontal healing and clinical attachment gain by enhancing connective tissue maturation and reducing postoperative inflammation. [13] The superior wound healing observed with Gingicare is also supported by experimental evidence demonstrating the regenerative properties of hyaluronic acid within oral tissues. Hyaluronic acid serves as a natural component of the extracellular matrix and contributes to tissue hydration, cell signaling, and scaffold formation during the proliferative phase of wound healing. Asparuhova et al. reported that hyaluronic acid significantly stimulated proliferation and migration of gingival fibroblasts while enhancing collagen synthesis, thereby accelerating periodontal soft tissue regeneration. [14] These biological mechanisms likely explain the consistently better healing scores observed in the Gingicare group throughout the present investigation. Postoperative pain is an important determinant of patient satisfaction following periodontal surgery. Although Dologel-CT contains choline salicylate and lidocaine, which provide anti-inflammatory and local anesthetic effects, Gingicare demonstrated significantly lower Numeric Pain Rating Scale scores during the first three postoperative days. The reduction in pain observed with hyaluronic acid may be explained by its ability to reduce inflammatory mediator release, maintain tissue hydration, protect exposed nerve endings, and accelerate epithelial coverage of the surgical wound. Koray et al. similarly observed significantly lower postoperative pain scores following periodontal surgery when hyaluronic acid gel was used as an adjunctive dressing, attributing the analgesic benefit to improved wound stabilization and modulation of inflammatory responses. [15] Another clinically relevant observation of the present study was the lower requirement for rescue analgesics among patients treated with Gingicare. Faster wound maturation reduces exposure of underlying connective tissues and minimizes inflammatory stimulation, thereby decreasing the need for additional pain medication. Similar findings have been reported by Bertl et al., who concluded that topical hyaluronic acid significantly improved patient-reported postoperative comfort and reduced analgesic consumption after periodontal surgical procedures. [16] Improved patient comfort may positively influence compliance with postoperative instructions and overall acceptance of periodontal therapy. Despite the analgesic properties of choline salicylate and lidocaine, Dologel-CT primarily provides symptomatic relief without directly influencing the biological processes responsible for tissue regeneration. Choline salicylate inhibits cyclooxygenase activity and prostaglandin synthesis, thereby reducing inflammation, whereas lidocaine temporarily blocks sodium channels to provide local anesthesia. However, neither component has been shown to significantly stimulate fibroblast proliferation, angiogenesis, or extracellular matrix remodeling. Consequently, although patients in the Dologel-CT group experienced progressive healing, the tissue regenerative response was comparatively slower than that observed with Gingicare. The present study also demonstrated excellent safety profiles for both topical formulations, with no serious adverse events, allergic reactions, delayed healing, or postoperative infections reported. These findings are consistent with previous clinical investigations evaluating topical hyaluronic acid in periodontal and oral surgical applications. Fawzy El-Sayed et al. concluded that hyaluronic acid possesses excellent biocompatibility and is associated with minimal postoperative complications because of its natural occurrence within connective tissues and its favorable interaction with host cells. [17,18] Likewise, Dologel-CT was well tolerated, with only mild transient burning sensation reported in isolated cases, which resolved spontaneously. The strengths of the present study include its randomized parallel-arm design, blinded outcome assessment, standardized surgical protocol performed by a single operator, and use of validated clinical indices for wound healing and pain assessment. These methodological features minimize operator bias and enhance the reliability of the findings. Nevertheless, certain limitations should be acknowledged. The relatively small sample size and short follow-up period restricted evaluation of long-term periodontal stability and patient-centered outcomes. Furthermore, objective biochemical markers of inflammation, histological evaluation, and microbiological assessment were not performed. Future multicenter randomized clinical trials involving larger populations, longer observation periods and molecular assessment of wound healing biomarkers are recommended to further clarify the regenerative potential of hyaluronic acid following periodontal surgery. Overall, the findings of the present study indicate that 0.3% hyaluronic acid gel (Gingicare) provides superior clinical benefits compared with Choline Salicylate gel (Dologel-CT) following functional crown lengthening surgery by enhancing early wound healing, reducing postoperative pain, decreasing rescue analgesic consumption, and maintaining excellent safety and patient tolerance. These findings support the routine use of Gingicare as an effective postoperative adjunct in periodontal surgical practice.

V. Conclusion

Within the limitations of this randomized clinical trial, both Choline Salicylate gel (Dologel-CT) and 0.3% Hyaluronic Acid gel (Gingicare) were safe and effective adjuncts following functional crown lengthening surgery. However, patients treated with Gingicare (Oradox) demonstrated significantly superior soft tissue wound healing and lower postoperative pain scores throughout the early healing period compared with those

receiving Dologel-CT (Dr Reddy's). The enhanced biological properties of hyaluronic acid, including its ability to promote cell migration, angiogenesis, extracellular matrix formation, and modulation of inflammation, likely contributed to the improved clinical outcomes observed. Moreover, Gingicare was associated with reduced rescue analgesic consumption and was well tolerated without any significant adverse effects. Based on these findings, 0.3% Hyaluronic Acid gel (Gingicare) can be recommended as a more effective postoperative topical adjunct than Choline Salicylate gel (Dologel-CT) for improving early wound healing and patient comfort following functional crown lengthening surgery**.** Further multicenter randomized clinical trials with larger sample sizes and longer follow-up periods are warranted to confirm these findings and evaluate the long-term effects of hyaluronic acid on periodontal wound healing and clinical stability.

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