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Effect of Oxygenation during Wound Healing in Association with Root Coverage Procedures: A Pilot Clinical Trial

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Abstract

Background: Gingival recession occurs due to the migration of the gingiva in the apical direction, leading to compromised aesthetics and root hypersensitivity. Connective tissue graft (CTG) is still the gold standard when combined with coronally advanced flap (CAF) showing strong evidence with highest predictability. However, there are potential outcome errors associated with CAF with CTG despite having dual vascularity. The principle of oxygenation of a wound during initial stages of healing was found to enhance the vascularity of grafted site. Hence in this pilot study the effects of topical application of active oxygen oral gel post root coverage surgery was assessed.

Aim & Objectives: The aim of our study was to evaluate the effect of oxygenation therapy during wound healing after CAF with CTG using clinical parameters and with immunological marker Interleukin -1 beta (IL-1β).

Materials and methods: Individuals aged between 16 to 60 years in test group with Cairo's RT 2 recession, were included They were randomly assigned to test group with topical application of oxygen gel. GCF and clinical parameters were calculated at baseline (T0), One week(T1) and one month post-operatively (T2) to quantify GCF IL-1 β on pre & post active oxygen gel application.

Results: The quantitative levels of IL-1 β in test group at T0 (80.4 pg/ml) T1 (97.4 pg/ml) and at T2 (58.8 pg/ml) and ANOVA test yielded statistically significant difference in IL-1β level with topical application of oxygen gel which exhibited in IL-1 β count, which sustained for a period of one month (p= 0.03).

Conclusion: The study revealed that topical oxygen gel application has significant benefit in wound healing associated with root coverage procedures, Notably, this study observed a significant reduction in IL -1 β in the immediate post operative period favouring optimal healing outcome.

Keywords: Cavities, Gum Tissue, Malocclusion, Oxygenation Gel

Introduction

Gingival recession is indeed a common oral condition characterized by the exposure of the root surface of a tooth due to the migration of the gingiva in the apical direction. This migration can lead to several potential issues for the patient, including an increased risk of dental caries (tooth decay), erosion of the root surface, increase in tooth sensitivity, and compromised esthetics.[1,2.]

The etiological factors [3,4] contributing to gingival recession are diverse and can include:

Inadequate Restorations: Poorly restored dental restorations or fillings can contribute to gingival recession.

Malpositioned Teeth: Teeth that are not properly aligned can exert pressure on the surrounding gingival tissue, leading to recession.

Cavities: Untreated dental cavities can cause localized destruction of the tooth and surrounding gum tissue, potentially resulting in recession.

Periodontal Disease: Gum disease, such as gingivitis or periodontitis, is a significant cause of gingival recession. The inflammation and infection associated with these conditions can lead to tissue destruction and recession.

Labial Frenulum: In some cases, an inadequate insertion of the labial frenulum (the tissue connecting the lip to the gums) can contribute to gingival recession.

Thin Tissue Phenotype: Individuals with a thin tissue phenotype are more prone to gingival recession due to reduced tissue thickness and resilience.

The classification[10] of gingival recession has evolved over time to provide a more precise understanding of the condition. The new classification, based on the measurement of interdental clinical insertion, categorizes gingival recessions into three types:

Type 1 Recession (RT1): Gingival recession without loss of interproximal insertion.

Type 2 Recession (RT2): Gingival recession with loss of interproximal insertion, where the measurement of the cemento-enamel junction is less than or equal to the loss of buccal insertion.

Type 3 Recession (RT3): Gingival recession with loss of interproximal insertion, where the measurement of the cemento-enamel junction is greater than the loss of oral insertion.

This classification system helps clinicians in diagnosing and planning treatment for gingival recession by considering both the extent of recession and the degree of attachment loss[5]. Effective management of gingival recession often involves addressing the underlying causes, such as periodontal disease or malocclusion, and employing appropriate surgical techniques, such as gingival grafting, to restore tissue health and aesthetics.

Connective tissue graft (CTG) is still the gold standard when combined with coronally advanced flap (CAF) showing strong evidence with highest predictability[6]. However there are potential outcome errors associated with CAF with CTG despite having dual vascularity. The principle of oxygenation of a wound during initial stages of healing was found to enhance the vascularity of grafted site. Hence in this pilot study the effects of topical application of active oxygen oral gel post root coverage surgery is assessed.

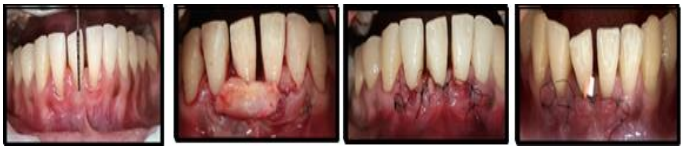
Materials and Method

A single blind randomized controlled, prospective clinical study was conducted for three months with 10 participants assigned to test and control group using block randomisation method. Patients with Cairo's RT 2 recession were considered in the study. Both males and females in the age group of 25-50 years who attended the outpatient department of Periodontics, were included in the study. The Institutional Ethical clearance was obtained and it was monitored in accordance with Declaration of Helsinki and Good Clinical Practice (ICH-GCP) guidelines. Smokers and alcoholics, pregnant and lactating women, patients treated with antibiotics in the past 6 months, participants allergic to lactose and fermented milk products and to other drugs, patients with systemic illness and HIV infection/AIDS were excluded from the study. Prior to initiating the study, the patients were informed of the purpose and design of the study and were requested to sign an informed consent.

After the connective tissue graft (CTG) was harvested on the recipient site, for the test group an oxygenation gel was applied at the recipient site for seven days after the surgery. Gingival crevicular fluid (GCF) samples were collected from all participants at three different time points: T0 (before the surgery), T1 (after 7 days of surgery), and T3 (after one month of surgery). This study design allows for the assessment of the effects of the oxygenation gel on the healing process and GCF Interleukin 1-β levels over time.

GCF Interleukin 1-β levels was assessed by paper point method (Quantitative Assay using ELISA). GCF sample was collected by gently inserting sterile paper point into gingival sulcus for 20 sec and placed in Eppendorf tube containing Phosphate Buffer Solution and stored at -80 degree until needed.

All the samples were subjected to analysis of IL 1 beta. Diaclone Human IL-1 β ELISA Kit was used for analysis of GCF Interleukin 1-β levels.



Recession Coverage procedure for Test and Control Group

Oxygenation gel application for Test Group

IL-1β Kit

GCF Solution embedded in well

Spectrophotometer

Results

The study design allows for the assessment of the effects of the oxygenation gel on the healing process and GCF Interleukin 1-β levels over time. Analysing GCF samples

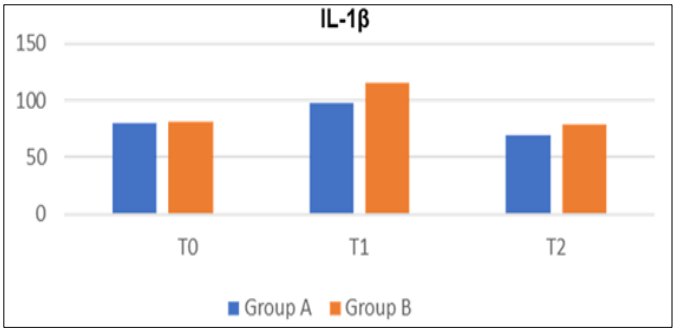
at these time points can provide valuable insights into the inflammatory response, tissue healing, and potential effects of the oxygenation gel by quantify GCF IL-1 β on pre & post active oxygen gel application.

The patients included the study comprised of 06 male and 04 female patients aged between 28-60 year. The study included two groups, where group A subjects were treated with oxygenation gel application after root coverage procedure and the group B, subjects treated with root coverage procedure only and The GCF samples were taken for both the groups at baseline, 1 week and 1 month The statistical analysis was carried out using ANNOVA.

The quantitative levels of GCF Interleukin 1-β levels Group A at T_0 T_1 and at T_2 was 80.4pg/ml, 97.4pg/ml & 58.8pg/ml respectively and in Group B it was found to be 81.2pg/ml ($T_{0)}$, 115.2pg/ml(T_1) and 78.5pg/ml (T_3). ANOVA test yielded statistically significant results in the root coverage procedure with oxygenation gel application. (p= 0.03).

	Group A	Group B
T_0	80.4 pg/ml	81.2 pg/ml
T_1	97.4 pg/ml	115.2 pg/ml
T_2	58.8 pg/ml	78.5 pg/ml

Quantitative analysis of IL-1β Level at baseline, 1 week and after 1 month



Discussion

Gingival recession can lead to both physical discomfort and aesthetic concerns for patients. Root coverage procedures aim to address these issues by increasing the keratinized gingiva band[6], which helps protect the underlying tissues, improving aesthetics and functionality. Additionally, eliminating dentin hypersensitivity[2] provides relief from discomfort associated with exposed dentin surfaces, enhancing patient comfort. Moreover, by minimizing the accumulation of plaque[7,8] root coverage procedures contribute to the prevention of periodontal diseases and support overall oral health. Therefore, an effective root coverage approach should encompass these objectives to ensure comprehensive care for patients with gingival recession.

Wound healing is a complex process, which it has oxygen as a prerequisite in almost every step. Topical therapies that release O_2 molecules are great allies in reparative processes, favouring increased cell metabolism, collagen synthesis, antibacterial activity, release of growth factors and angiogenesis[9].

When oxygenation gel components come into contact with moist surfaces such as mucosa, saliva, and blood, they initiate a decomposition reaction, releasing oxygen in the form of hydrogen peroxide into the surrounding medium. At low concentrations, this active oxygen exhibits antibacterial properties and can promote angiogenesis, increased collagen synthesis, cellular metabolism, and the release of growth factors. These effects contribute to improving the overall oxygen transport capacity, facilitating tissue repair[10].

Studies, such as the one by Imano et al. (2019), have demonstrated the potential of oxygenation gel in aiding the healing and formation of keratinized tissue. In procedures like free connective tissue grafting, satisfactory healing outcomes were observed, likely due to the gel's angiogenic stimulus and antibacterial effects.

The immune response to wound healing involves the release of various cytokines, including inflammatory cytokines like IL-1β, regulatory cytokines like IL-10, and chemokines like IL-8.[11] Assessing the effects of oxygenation gel on the healing process and levels of GCF interleukin-1β (IL-1β) over time provides valuable insights into the inflammatory response, tissue healing, and potential impacts of the gel. Quantifying GCF IL-1β levels before and after active oxygen gel application offers a means to evaluate its efficacy in modulating inflammation and supporting tissue repair processes.

Overall, the use of oxygenation gel in wound healing holds promise for enhancing the reparative process and improving outcomes in root coverage procedures.

Conclusion

The study revealed that topical oxygen gel application has significant benefit in wound healing associated with root coverage procedures, Notably, this study observed a significant reduction in IL -1 β in the immediate post operative period favoring optimal healing outcome. New clinical trials and must be carried out to observe the effects of oxygen therapy on the technique of free connective tissue grafting.

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Quantitative analysis of IL 1 βlevel at Baseline, One week and One month

1. Group A(pg/ml)

S. No	T0	T1	T2
B1	82.4	96.4	58.2
B2	78.7	98.8	60.2
B3	80.6	97.2	58.4
B4	81.1	97.6	59.2

B5	79.2	97.2	58
Mean	80.4	97.4	58.8

2. Group B(pg/ml)

S. No	T0	T1	T2
C1	82.6	116.4	79.4
C2	79.5	114,6	78.3
C3	81.4	115.4	78.2
C4	82.4	115.1	78.8
C5	80.1	114.5	77.6
Mean	81.2	115.2	78.5

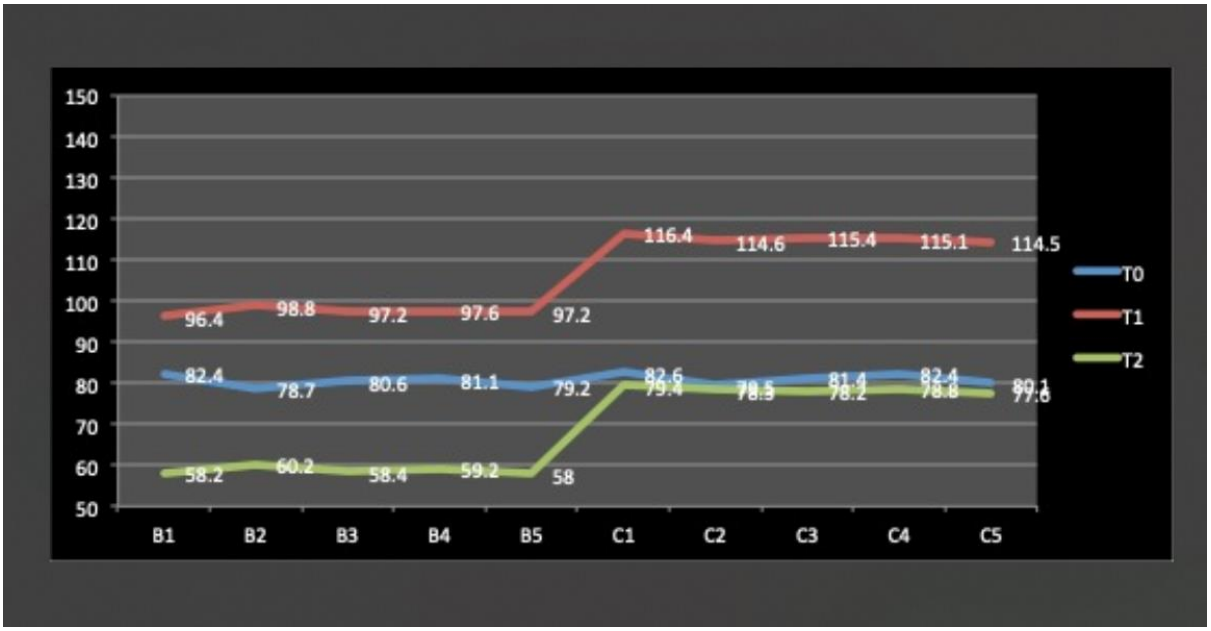

Figure 1