Universidade Estadual de Campinas

Faculdade de Odontologia de Piracicaba

Mauro Pedrine Santamaria

Cirurgião-dentista

Tratamento cirúrgico-restaurador de recessão gengival associada à lesão cervical não-cariosa: resultados de diferentes abordagens e fatores locais contribuintes

Tese apresentada à Faculdade de Odontologia de Piracicaba da Universidade Estadual Campinas para obtenção do título de Doutor em Clínica Odontológica Área de Periodontia

Orientador: Prof. Dr. Enilson Antônio Sallum

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Travis

Resumo

Recessões gengivais estão frequentemente associadas às lesões cervicais não-cariosas. O tratamento dessa lesão combinada é um desafio. Trabalhos recentes têm apresentado resultados de tratamento conjunto de cirurgia periodontal e dentística restauradora para tratamento da lesão combinada. Porém nenhum trabalho demonstrou resultados de longo prazo desse tipo de abordagem, além de variações desse tratamento e dos fatores anatômicos locais que poderiam influenciar na resultado dessas terapias. Portanto, os objetivos do presente estudo foram: 1. Apresentar os resultados após 2 anos de tratamento de recessões gengivais associadas à lesões cervicais tratadas com retalho posicionado coronariamente (RPC) sozinho ou associado à restauração de ionômero de vidro modificado por resina (CIV). 2. Avaliar os resultados, após 6 meses de tratamento do enxerto de tecido conjuntivo (ETC) associado ou não à restauração de CIV para tratamento da lesão combinada. 3. Avaliar a possível influência das características anatômicas locais no recobrimento das lesões combinadas tratadas pelas técnicas do retalho posicionado coronariamente e pelo enxerto de tecido conjuntivo. Para o primeiro objetivo, foi realizado um estudo clínico controlado e randomizado que foram incluídos 16 indivíduos apresentando duas recessões gengivais bilaterais associadas à lesões cervicais em caninos ou pré-molares superiores. Os defeitos foram tratados com RPC sozinho ou associado à restauração de CIV. Os resultados não demonstraram diferença significante entre os grupos após 2 anos com relação à redução da recessão gengival, ganho no nível clínico de inserção e sangramento à sondagem. Para o segundo objetivo, foi realizado um estudo clinico controlado e randomizado que foram incluídos 40 indivíduos apresentando uma recessão gengival associada à lesão cervical em caninos ou pré-molares superiores. Os defeitos foram tratados com ETC sozinho ou associado à restauração de CIV. Os resultados não demonstraram diferença estatisticamente significante entre os grupos após 6 meses com relação à redução da recessão gengival, ganho no nível clínico de inserção, ganho de tecido queratinizado e sangramento à sondagem. No entanto, o grupo que recebeu ETC

e a restauração de CIV foi estatisticamente melhor na redução da hipersensibilidade dentinária. Para o terceiro objetivo, as características anatômicas locais dos indivíduos dos dois estudos clínicos prévios foram medidas e analisadas através de regressão linear multipla. Os resultados demonstraram correlação estatisticamente significante entre a profundidade da lesão cervical não-cariosa e o a redução na recessão gengival quando RPC foi utilizado de forma isolada. A altura da lesão combinada também apresentou correlação estatisticamente significante com a redução da recessão gengival para ambos os estudos. Além disso, a deiscência óssea apresentou correlação estatisticamente significante quando ETC foi utilizado. Dentro dos limites desse estudo, pode-se concluir que a restauração de ionômero de vidro modificado por resina parece não interferir no recobrimento da lesão combinada após 2 anos de avaliação, quando o retalho posicionado coronariamente foi utilizado e após 6 meses quando o enxerto de tecido conjuntivo foi utilizado. A profundidade da lesão cervical pode ter alguma influência quando RPC é utilizado e a deiscência óssea parece não interferir negativamente no recobrimento quando ETC foi utilizado

Palavras-chave: Recessão gengival/cirurgia; Restauração (Odontologia); abrasão dentária; Periodontia

Abstract

Gingival recessions are frequently associated with non-carious cervical lesion. Previous studies have shown results from a combined treatment (periodontal surgery plus restoration of the cervical lesion) to deal with the association of these two lesions. However, there is lack of information regarding the long term evaluation of the combined treatment. Moreover, no additional information regarding other surgical techniques and the influence of the local anatomical characteristics have not been evaluated. Thus, the objectives of this study were: 1. Evaluate the 2-year-follow-up outcome of the treatment of gingival recession associated with non-carious cervical lesions by coronally advanced flap alone (CAF), or in combination with a resin-modified glass ionomer restoration 2. Evaluate the 6-month-follow-up outcome of the treatment of gingival recession associated with cervical lesion by connective tissue graft alone (CTG), or in combination with a resin-modified glass ionomer restoration, and 3. Evaluate the possible influence of local anatomy on the amount of soft tissue coverage achieved and on the clinical attachment gain by the use of CAF and CTG, alone or in combination with resin-modified glass ionomer restoration to treat the combined defect. For the first objective, 16 patients with bilateral Miller Class I buccal gingival recessions, associated with non-carious cervical lesions were selected. The defects received either CAF alone or CAF plus a resin-modified glass ionomer restoration. The results showed that both groups showed statistically significant soft tissue coverage. The differences between groups were not statistically significant in reduction of gingival recession, gain in the clinical attachment level, and bleeding on probing after 2 years. For the second objective, 40 patients with Miller Class I buccal gingival recessions, associated with non-carious cervical lesions were enrolled. The defects were randomly assigned to receive either CTG alone or CTG plus a resin-modified glass ionomer restoration. The results showed that both groups showed statistically significant soft tissue coverage. The differences between groups were not statistically significant in gingival recession, gain in the clinical attachment level, and bleeding on probing, after 6 months.

However, the group CTG plus the restoration showed statistically significant reduction in dentin sensitivity when compared to CTG alone. For the third objective, the local anatomical characteristics from the patients enrolled in the 2 previous studies were correlated with the reduction of the gingival recession and the gain in the clinical attachment level using Stepwise Multivariate Linear Regression. The results showed that the cervical lesion depth was significantly correlated with reduction in gingival recession, when considering data from the CAF group. The cervical lesion height was statistically correlated with the reduction in gingival recession when the two groups were analyzed. Additionally, the bone level was statistically correlated with reduction in gingival recession when evaluating the CTG group. Within the limits of the present study it can be concluded that the presence of the resin-modified glass ionomer restoration may not interfere with the amount of coverage achieved either by CAF after 2 years or CTG after 6 months. The cervical lesion depth may have some influence on the final coverage achieved when CAF is applied and the bone level may not play any role when CTG is applied.

Key Words: Gingival recession/surgery; restoration dentistry; tooth abrasion; Periodontics

Prefácio

Esta tese está baseada nos seguintes artigos científicos

1. Santamaria MP, Feitosa DS, Nociti FH Jr, Casati MZ, Sallum AW, Sallum EA. Cervical restoration and the amount of soft tissue coverage achieved by coronally advanced flap. A 2-year-follow-up randomized controlled clinical trial. J Clin Periodontol 2009; 36: 434-441.

2. Santamaria MP, Ambrosano GMB, Casati MZ, Nociti FH Jr, Sallum AW, Sallum EA. Connective tissue graft plus resin-modified glass ionomer restoration for the treatment of gingival recession associated with non-carious cervical lesion. A randomized controlled clinical trial. J Clin Periodontol 2009; 36: 791-798

3. Santamaria MP, Ambrosano GMB, Casati MZ, Nociti FH Jr, Sallum AW, Sallum EA. The influence of local anatomy on the outcome of treatment of gingival recession associated with non-carious cervical lesion by different approaches. J Periodontol. Submetido

Sumário

1. Introdução Geral

O declínio da prevalência da doença cárie constatada nas últimas décadas contribuiu para o aumento da sobrevida dental. Dessa forma, nota-se que pelo fato dos dentes permanecerem por mais tempo na cavidade oral, estes ficam sujeitos à ação, por um período de tempo mais prolongado, a outros agentes deletérios como ao trauma de escovação e agentes ácidos, o que contribui para o aparecimento de outros problemas (Araújo Jr. & Arcari, 2003). A recessão gengival e as lesões cervicais não-cariosas são duas alterações em tecido mole e tecido duro respectivamente, que parecem aumentar com a idade (Löe *et al*.,1992; Bartlett *et al*, 2006.).

A lesão cervical não-cariosa é a perda da estrutura dental na região cervical a partir da superfície externa do elemento dental. É descrita na literatura com sendo conseqüência dos processos de erosão, abrasão e abfração.

- Erosão: é a perda de estrutura dental através da dissolução química do esmalte, dentina ou cemento não relacionados aos ácidos bacterianos ou à doença cárie (Eccles, 1982) Em grande parte das vezes, substâncias ácidas estão envolvidas. Esses ácidos podem ter origem intrínseca ou extrínseca. A fonte intrínseca de ácido é normalmente oriunda do estômago e está associada às desordens alimentares como a anorexia e a bulemia nervosa ou problemas de refluxo e regurgitação (Bartlet, 2006). Por ter pH em torno de 1 a 1,5, o ácido gástrico provoca a dissolução das estruturas mineralizadas do dente, uma vez que o pH crítico do esmalte é em torno de 5,5. Os ácidos de origem extrínseca são provenientes de componentes da dieta como bebidas refrigerantes gaseificadas, frutas cítricas *in natura* ou em forma de sucos.

- Abrasão: perda de estrutura dental devido a processos mecânicos anormais que não o contato dente a dente (Pindborg, 1970). A higiene oral realizada com escova dental, praticada de forma incorreta, traumática e com grande freqüência pode causar o desgaste de estruturas como o esmalte e o cemento. Outros objetos introduzidos na cavidade oral têm sido reportados como

responsáveis pela ocorrência da abrasão como a utilização de escovas interdentais, o hábito de fumar cachimbo e grampos de cabelo (Araújo Jr. & Arcari, 2003).

- Abfração: apesar de não haver consenso na literatura a respeito da real existência desse processo, a abfração é definida como a perda patológica de estrutura dental em decorrência da flexão produzida por forças oclusais excêntricas. Essa flexão dental promove a concentração de forças tencionais na região cervical, causando a ruptura das ligações químicas das estruturas cristalinas do esmalte, dentina e cemento, de forma que pequenas moléculas são capazes de penetrar nessas microrrachaduras, impedindo a sua reestruturação (Grippo, 1991; Litonjua, 2003).

Há atualmente um consenso na literatura de que a etiologia dessas lesões é multifatorial, sendo que na maioria das vezes, os fatores etiológicos como escovação dental praticada de forma traumática, ação de ácidos e sobrecarga oclusal agem simultaneamente (Litonjua, 2003).

A recessão gengival é caracterizada pelo posicionamento apical da margem gengival em relação á junção cemento esmalte (Academia Americana de Periodontia, 2001). Estudos longitudinais demonstraram que a recessão gengival é um achado comum tanto em pacientes com alto padrão de higiene oral como em pacientes com ausência de cuidados odontológicos (Serino et al., 1994).

As lesões cervicais não-cariosas e a recessão gengival são lesões que estão intimamente relacionadas (Toffenetti, 1998). A escovação dental praticada de forma traumática é fator etiológico tanto da recessão gengival como das lesões cervicais não-cariosas. Além disso, a exposição do cemento radicular decorrente da recessão do tecido marginal cria uma situação propícia para o início de uma lesão cervical não-cariosa (Toffenetti, 1998). Aproximadamente 50% de elementos dentais com recessão gengival apresentam perda da junção cemento esmalte em decorrência do aparecimento concomitante da lesão cervical não-cariosa (Sanges & Gjermo, 1976; Zucchelli *et al*., 2006).

A presença concomitante dessas duas lesões em um elemento dental cria uma lesão combinada que provoca um conflito quanto à terapêutica a ser utilizada. Caso o restabelecimento somente da lesão do órgão dental, com uma restauração adesiva, seja a terapia escolhida, a recessão gengival será mantida. Isso gera a manutenção do zênite gengival em uma posição apical dando um aspecto de dente alongado. Essa situação em dentes anteriores pode criar uma desarmonia estética. Ao passo que a resolução da recessão gengival associada à lesão dental somente com a cirurgia para recobrimento radicular, pode não ser o ideal. Isso se deve ao fato de que um grande número de lesões não-cariosas apresenta seu limite coronal acima de onde seria a junção cemento-esmalte, que foi perdida com a evolução da lesão não-cariosa, o que torna o completo recobrimento da lesão pelo tecido gengival imprevisível. Além disso, caso a lesão não-cariosa tenha uma profundidade no sentido vestíbulo-pulpar muito acentuada, isso dificultaria a adaptação do tecido gengival sobre a superfície dental afetada pela lesão.

Recentemente, tratamento integrado foi proposto para solucionar essa condição. Santamaria et al (2007) publicaram um relato de três casos nos quais recessões gengivais associadas à lesões cervicais não-cariosas foram tratadas com restauração de ionômero de vidro modificado por resina e retalho posicionado coronariamente (RPC) ou retalho posicionado coronariamente e enxerto de tecido conjuntivo (ETC). Todos os casos apresentaram recobrimento de aproximadamente 70% da extensão da lesão cervical e saúde gengival após o período de cicatrização. Em um estudo clínico randomizado controlado, Lucchesi et al. (2007) testaram diferentes tipos de materiais restauradores, ionômero de vidro modificado por resina e resina composta associado ao retalho posicionado coronariamente para tratamento da lesão combinada. Foram utilizados 3 grupos, nos quais dois foram incluídos elementos com lesão combinada que foram tratadas com resina composta ou ionômero de vidro modificado por resina e retalho posicionado coronariamente e um terceiro grupo onde os elementos dentais só apresentavam recessão gengival sem a presença da lesão cervical e

que foram tratados somente com o retalho posicionado coronariamente. Os autores observaram que a presença da restauração não influenciou na porcentagem de recobrimento radicular, independentemente do material utilizado, resina composta ou ionômero de vidro modificado por resina, e que a presença da restauração subgengival não alterava os parâmetros clínicos inflamatório. Em outro estudo, Santamaria et al. (2008) trataram a lesão combinada com retalho posicionado coronariamente com ou sem a presença da restauração de ionômero de vidro modificado por resina. Os resultados demonstraram a presença da restauração não interferia na porcentagem de recobrimento. Além disso, que o retalho posicionado coronariamente não conseguiu recobrir 100% da lesão combinada em nenhum dos casos, indicando que esse tipo de lesão poderia ter um prognóstico diferente em termos de recobrimento quando comparadas com recessões em raízes intactas. Também foi observado que o tratamento integrado (restauração da lesão cervical e cirurgia periodontal para recobrimento radicular) foi mais eficaz na redução da hipersensibilidade dentinária quando comparado ao retalho posicionado coronariamente empregado de forma isolada.

Em um estudo em cães, Santamaria et al. (no prelo) tiveram como objetivo avaliar a resposta dos tecidos periodontais frente a colocação da restauração de ionômero de vidro modificado por resina ao nível da crista óssea comparando esta condição com a ausência de restauração (somente a presença de um notch para identificação da posição original da crista óssea) . Esse estudo demonstrou que o grupo que recebeu a restauração apresentou reabsorção óssea compatível para a formação de uma camada de 1mm de tecido conjuntivo apicalmente posicionada ao término da restauração, que ficou em contato com a raiz do elemento dental. O epitélio juncional se estendeu até a porção apical da restauração, não havendo assim adaptação conjuntivo sobre o material restaurador. No entanto, após o período de cicatrização, os parâmetros clínicos de saúde periodontal foram similares ao grupo que não recebeu a restauração.

Apesar do tratamento integrado dessa lesão combinada apresentar resultados positivos nesses trabalhos, ainda faltam avaliações de longo prazo

desse tipo de tratamento e testar se outros materiais ou técnicas cirúrgicas são mais eficazes que os já estudados. Além disso, nenhum estudo foi feito sobre os possíveis fatores que influenciariam no recobrimento da lesão combinada.

2. Proposição Geral

Os objetivos desse estudo foram:

1. Avaliar clinicamente, o resultado após 2 anos do tratamento da lesão combinada (recessão gengival associada à lesão cervical não-cariosa) realizado com retalho posicionado coronariamente com ou sem a restauração de ionômero de vidro modificado por resina.

2. Comparar clinicamente o resultado após 6 meses do enxerto de tecido conjuntivo, associado ou não à restauração de ionômero de vidro modificado por resina no tratamento da lesão combinada após 6 meses de avaliação.

3. Avaliar a possível influência dos fatores anatômicos locais na redução da recessão gengival e no ganho no nível de inserção clínica quando o retalho posicionado coronariamente e o enxerto de tecido conjuntivo foram utilizados associados ou não à restauração de ionômero de vidro modificado por resina para o tratamento da lesão combinada.

3. Capítulos

3.1 Capítulo 1

Cervical restoration and the amount of soft tissue coverage achieved by coronally advanced flap. A 2-year-follow-up randomized controlled clinical trial.

Authors:
Mauro Pedrine Santamaria DDS, MS*
Daniela da Silva Feitosa DDS, MS*
Francisco Humberto Nociti Júnior DDS, MS, PhD*
Marcio Zaffalon Casati DDS, MS, PhD*
Antonio Wilson Sallum DDS, MS, PhD*
Enilson Antônio Sallum DDS, MS, PhD*

* Dept. of Prosthodontics and Periodontics, Division of Periodontics, Piracicaba Dental School, University of Campinas - UNICAMP, São Paulo, Brazil.

Corresponding Author:
ENILSON ANTONIO SALLUM
Department of Periodontics and Prosthodontics, Piracicaba Dental School
Av. Limeira, 901. Areião. Piracicaba. São Paulo. Brasil
Cep.13414-903 e-mail: easallum@fop.unicamp.br
Tel: +55 19 21065301
Fax: +55 19 21065301
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ABSTRACT

Background: The aim of this study was to evaluate the 2-year-follow-up success of the treatment of gingival recession associated with non-carious cervical lesions by a coronally advanced flap alone (CAF), or in combination with a resin-modified glass ionomer restoration (CAF+R).

Methods: Sixteen patients with bilateral Miller Class I buccal gingival recessions, associated with non-carious cervical lesions were selected. The defects received either CAF or CAF+R. Bleeding on probing (BOP), probing depth (PD), relative gingival recession (RGR), clinical attachment level (CAL), cervical lesion height (CLH) coverage were measured at the baseline and 6, 12 and 24 months after the treatment.

Results: Both groups showed statistically significant gains in clinical attachment level and soft tissue coverage. The differences between groups were not statistically significant in BOP, PD, RGR and CAL, after 2 years. The percentages of CLH covered were 51.57±17.2% for CAF+R and 53.87±12.6% for CAF ($P>0.05$). The estimated root coverage was 80.37±25.44% for CAF+R and 83.46±20.79% for CAF ($P>0.05$).

Conclusion: Within the limits of the present study it can be concluded that both procedures provide acceptable soft tissue coverage after 2 years, with no significant differences between the two approaches.

CLINICAL RELEVANCE

Scientific Rationale: Gingival recession is frequently associated with non-carious cervical lesion. Recent literature has reported short term successful treatment results when periodontal surgery is combined with glass ionomer restoration.

Principal Findings: The present study shows that the combination between coronally advanced flap for root coverage and cervical lesion restoration using glass ionomer can provide stable results after 2 years.

Practical Implications: The findings of the present study suggest that the combined approach may be considered as a treatment option for the type of lesion included in the study.

CONFLICT OF INTEREST AND SOURCE OF FUNDING STATEMENT

The authors report no conflicts of interest related to this study.

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INTRODUCTION

Due to the reduction of caries prevalence in several populations, teeth are functional for longer periods. This may expose the teeth to conditions other than caries and, as a consequence, different problems can appear. Gingival recession is an apical shift of the gingival margin with exposure of the root surface (Wennström 1996, Cairo et al 2008). This is a common finding in patients with a high standard of oral hygiene, as well as in periodontally untreated populations with poor oral hygiene, especially in elderly people (Löe et al 1992, Serino et al 1994).

The absence of the gingival tissue protecting the root surface may facilitate the occurrence of other problems, such as esthetic complaints, dentin sensitivity, root caries, and cervical wear (Goldstein et al, 2002). Sangnes & Gjermo reported that gingival recession and a wedge-shaped defect in the cervical area were often seen affecting the same tooth. Another report mentions that no signs of the cemento-enamel junction (CEJ) were observed in about 50% of the examined

teeth showing gingival recession, due to cervical abrasion (Zucchelli et al 2006). Despite this close association between gingival recession and non-carious cervical lesions, restorative procedures such as composite restoration are frequently selected as the single therapy to treat this condition (Terry et al 2003A). However, optimal functional and esthetic results may require the combined use of periodontal and restorative procedures (Terry et al 2003B).

As previously shown, gingival recessions associated with non-carious cervical lesions can be successfully treated by glass ionomer restoration combined with the coronally advanced flap, with or without connective tissue graft (Santamaria et al 2007, Santamaria et al 2008). After the healing period, good esthetic outcome and gingival health with no signs of inflammation, such as redness and bleeding on probing, were observed despite the subgingival location of part of the restoration. These and other reports (Thanik & Bissada, 1999, Lucchesi et al 2007) showed successful outcomes when root coverage surgery was performed on the restored root surface. However, there is a lack of information about the long term results of this type of therapy. Therefore, the aim of the present study is to present the 2-year follow up results of a split-mouth randomized controlled clinical trial in which gingival recession, associated with non-carious cervical lesion, was treated by the coronally advanced flap combined or not with resin-glass ionomer restoration. The hypothesis that the sites treated with the associated approach (CAF+R) could present more recession over time was addressed.

MATERIALS AND METHODS

Prior to the beginning of the study, the consent form and the protocol of the study were approved by the Institutional Review Board of the State University of Campinas (CEP-UNICAMP 104/2005). Informed consent was signed by each subject after a thorough explanation of the nature, risks and benefits of the clinical investigation and associated procedures.

Study Population

Sixteen patients, 9 males and 7 females, aged 26 to 58 years (mean age 37.4 ± 8.8 years), were included. The subjects were selected from the group of patients referred for periodontal treatment to the Graduate Clinic of the Piracicaba Dental School, University of Campinas - UNICAMP. The patients were selected from May to December 2005, according to the following eligibility criteria:

1. Presence of bilateral Class I Miller gingival recession associated with non-carious cervical lesion 1-2mm deep in maxillary canines or premolars. The pair of recessions associated with the cervical wear in each patient must be comparable (same size).
2. Non-smokers.
3. Systemically and periodontally healthy.
4. No contraindication for periodontal surgery.
5. Had not taken medications known to interfere with periodontal tissue health and healing.
6. Probing depth < 3mm without bleeding on probing.
7. Tooth vitality, absence of restoration on cervical area, and absence of severe occlusal interferences in the area to be treated.
8. No previous periodontal surgery in the area.

The patients were referred for periodontal treatment based on their complaints (dentin sensitivity and/or esthetic concerns). Considering that a non-carious cervical lesion may be the consequence of a multifactorial process, including tooth structure loss caused by nonbacterial acids (erosion), traumatic tooth brushing (abrasion) and occlusal loading (abfraction), all patients were included in a pre-treatment program in order to eliminate the possible etiologic factors related to non-carious cervical lesion and gingival recession, as follows: Oral hygiene instructions with a non-traumatic brushing technique and a soft toothbrush were given. Patients were also encouraged to avoid excessive consumption of acidic beverages or acidic foods. When necessary, selective grinding was performed to remove oclusal interferences on the teeth included in the study. Scaling, root planing and crown polishing were performed as necessary.

Clinical assessments

After this initial therapy, the following parameters were recorded: 1) Full-mouth visible plaque index (Ainamo & Bay 1975) (FMPI) and presence or absence of visible plaque at the site included in the study (VPS); 2) full-mouth sulcus bleeding index (Mühlemann & Son, 1971) (FMBI) and presence or absence of bleeding on probing at the site included in the study (BOP); 3) probing depth (PD), assessed as the distance from the gingival margin to the apical end of the gingival sulcus; 4) relative gingival recession (RGR) measured as the distance from the gingival margin to the incisal border of the tooth; 5) relative clinical attachment level (CAL) as PD + RGR; 6) non-carious cervical lesion height (CLH), as the distance between the coronal and apical margins of the non-carious cervical lesion; 7) height of the non-carious cervical lesion located on the root surface (CLH-R): the cement-enamel junction (CEJ) was estimated by the method described by Zucchelli et al (2006) using digital photographs obtained with a camera positioned perpendicular to the buccal surface of the experimental teeth at a magnification ratio of 1:1. The distance from the estimated cemento-enamel junction to the incisal border of the tooth and RGR were measured using an image analysis software. CLH-R was calculated by subtracting the distance from the estimated cemento-enamel junction to the incisal border from RGR. This parameter allowed the calculation of the percentage of root coverage. The subtraction of the non-carious cervical lesion height on the root from the total cervical lesion height provided the amount of cervical lesion located on the crown (CLH-C); 8) keratinized tissue width (KTW), measured as the distance from the gingival margin to the mucogingival junction; 9) keratinized tissue thickness (KTT).

The probing depth was measured using a manual periodontal probe. The relative gingival recession, non-cervical lesion height and keratinized tissue width were measured using a pair of dividers and a digital caliper with 0.01-mm precision. The keratinized tissue thickness was measured using a pierced endodontic spreader, perpendicular to a mid-point location between the gingival margin and mucogingival junction and through the soft tissue with light pressure

until a hard surface was felt. The silicone stop was then placed in tight contact with the external soft tissue surface. After carefully removing the spreader, penetration depth was measured with a digital caliper. The probing depth, relative gingival recession, clinical attachment level, visible plaque at the site included in the study and bleeding on probing were measured at baseline and 6 months, 1 year, and 2 years after surgery. The keratinized tissue width and keratinized tissue thickness were obtained at baseline and at 2 years post-operatively. The restorations were also analyzed after two years in function. Presence or absence of retention of the restoration in the cavity, marginal adaptation and color match were observed.

Prior to the beginning of study, the examiner (MPS) measured the probing depth and relative gingival recession of all patients, two times, within 24 hours, with at least 1 hour between the examinations. The examiner was judged to be reproducible after fulfilling the pre-determined success criteria. The Kappa index was calculated to probing depth, resulting in 91% of reproducibility and the Intra-class correlation was calculated to relative gingival recession, resulting in 89% agreement. The examiner was not masked because it was possible to observe whether the glass ionomer restoration had been applied at the site.

Surgical procedures

All the surgical procedures were carried out by one operator (EAS). The sites were randomly assigned, by the flipping of a coin (FFS), to the control group or test group. A second coin flip was made to define the sequence of treatments to be performed. The control group received the coronally advanced flap (CAF group) and the test group was submitted to a coronally advanced flap plus a resin-modified glass ionomer restoration (CAF+R group). The pair of recessions and non-carious cervical lesions of each patient was treated in the same surgical session.

Briefly, after local anesthesia (Lidocaine with 1:100.000 Epinephrine), an intrasulcular incision was made at the buccal aspect of the involved tooth. Two horizontal incisions were made at right angles to the adjacent interdental papillae, 1-mm apically to the level of the coronal border of the non-carious cervical lesion,

without interfering with the gingival margin of neighboring teeth. Two oblique vertical incisions were extended beyond the mucogingival junction and a trapezoidal mucoperiosteal flap was raised up to the mucogingival junction. After this point, a split-thickness flap was extended apically, releasing the tension and favoring coronal positioning of the flap. In the CAF group, the root and non-carious cervical lesion were planed with a finishing bur (KG Sorensen 9803FF) and curettes until the tooth surface became smooth. In the CAF+R sites, a sterile rubber dam was placed to isolate the operative field and the complete restoration of the non-carious cervical lesion was performed with resin-modified glass ionomer cement (Vitremer - 3M ESPE), following the manufacturer's instructions. The restoration was performed in order to reestablish the entire defect caused by the cervical wear. Afterwards, the epithelium on the adjacent papillae was stripped away and the flap was coronally positioned and sutured (6.0 Polyglactin 910) to completely cover the non-carious cervical lesion in the CAF group and the restoration in the CAF+R group.

Post-operative care

Patients were instructed to take analgesics (500 mg sodium dipyrone every 6 hours for 2 days) and were instructed to discontinue toothbrushing around the surgical sites during the initial 30 days after surgery. During this period, plaque control was achieved with a 0.12% chlorhexidine solution rinse used twice a day. After this period, gentle toothbrushing with a soft-bristle toothbrush was allowed.

Sutures were removed after 7 days and the patients were enrolled in a periodontal maintenance program (professional plaque control and oral hygiene instruction) weekly during the first month, monthly during the first 6 months, and every four months until the end of the study period.

Statistical analysis

Descriptive statistics were expressed as means ± standand deviation (SD). The probing depth, relative gingival recession and relative clinical attachment level were examined by Friedman test to evaluate differences within groups, followed by post hoc non-parametric test for multiple comparisons and by Wilcoxon Signed

Rank to evaluate differences between groups. The cervical lesion height (CLH), height of the non-carious cervical lesion located on the root (CLH-R) and on the crown (CLH-C) surfaces were examined by Wilcoxon test to evaluate differences between groups. The visible plaque at the site included in the study (VPS) and the bleeding on probing at the site included in the study (BOP) were examined by McNemar test to evaluate differences within groups and by the Chi-square test to evaluate differences between groups. The keratinized tissue width (KTW) and the keratinized tissue thickness (KTT) were examined by Wilcoxon test to evaluate differences within and between groups. A significance level of 0.05 was adopted for all statistical comparisons.

Power calculation

The study power was calculated using the SAS 9.01 software (Release 9.1, 2003, SAS Institute Inc., Cary, NC, USA), considering the standard deviation of each group of the present study. A difference of 1.0 mm between CAF and CAF+R groups was considered as clinically significant. The power value was evaluated for relative gingival recession and relative clinical attachment level in the final period of evaluation. The minimum power value of 77% was achieved (for relative clinical attachment level parameter at 2 years).

RESULTS

A flow diagram of participants in the study is enclosed (Fig. 1). Table 1 shows the patients' characteristics at baseline. No adverse event was observed in any patient during the study.

Cervical lesion

The mean cervical lesion height (CLH) was 2.54±0.5 mm for the test group and 2.58±0.42mm for the control group (P>0.05). Using the method described by Zucchelli et al (2006) it was possible to estimate the place where the lost cement-enamel junction was located. Consequently, it was possible to identify the total amount of root (CLH-R) and crown (CLH-C) affected by the non-carious cervical lesion. CLH-R was 1.7±0.42 for the test group and 1.68±0.36 for the control group,

representing 67.19±11.81% and 65.68±7.52% of the total CLH, respectively. CLH-C was 0.84±0.32mm for test group and 0.9±0.21mm for control group. The differences observed between groups were not statistically significant for these parameters (P>0.05).

Gingival recession

All sites presented a reduction in the relative gingival recession, of 1.31±0.37 mm for the test group and 1.39±0.41 mm for the control (P>0.05). The coverage obtained at 6 months remained stable over time for both groups. These reductions in the relative gingival recession represent 51.57±17.2% CLH coverage for the test group and 53.87±12.6% for the control group. This difference was not statistically significant (P>0.05). No site in either group had achieved complete CLH coverage after 2 years of observation. The maximum CLH coverage was 78.18% for the CAF+R group and 76.66% for the CAF group

The percentage of root coverage at the end of the study period was calculated. The test group showed a mean root coverage of 80.37± 25.44% and the control group showed 83.46±20.79%. The difference between groups was not statistically significant (P>0.05). Table 1 shows the characteristics of the cervical lesion in each group and the total amount of coverage achieved. Figures 2 to 9 show the clinical aspect at the baseline and the post-operative periods of the control and test group.

Probing depth (PD) and clinical attachment level (CAL)

The probing depth did not change significantly during the baseline to 2-year-follow-up. In the test group, this parameter did not significantly change between baseline and 2 years after surgery (1.25±0.44 mm for both periods) in the control group it was 1.31±0.47 mm at the baseline and 1.5±0.51 mm at the 2-year evaluation. The differences between and within groups were not statistically significant (p>0.05).

After 2 years, both groups produced statistically significant changes from baseline for clinical attachment level; 1.31±0.6 mm for the test group (P=0.0001)

and 1.2±0.72 mm for the control group (P=0.0001). The difference between the two groups was not statistically significant (P>0.05).

Keratinized tissue

No significant changes regarding the thickness (KTT) and the width (KTW) of the keratinized tissue were observed. Table 3 shows the mean and standard deviation of PD, CAL, RGR, KTT, and KTW of the test and control groups.

Bleeding on probing

Full mouth sulcus bleeding index (FMBI) remained low during the entire study period, being 16.5% at the baseline and 19.2% at the 2-year evaluation (P>0.05), demonstrating that the patients had performed acceptable oral hygiene. Additionally, low levels of full mouth visible plaque index (FMPI) were observed; 18.82% at the baseline and 21.3% at the 2-year evaluation. No bleeding on probing (BOP) was observed at any site included in the study in any evaluated period.

Restorations

After 2 years in function, the restorations were analyzed. All the restorations (16 out of 16), were retained at the sites and no restoration was lost. Seven of 16 restorations (43.75%), presented color change and their colors did not match the tooth color. When the color of the restoration changed, it became darker than the color of the tooth (Figure 10). Only 1 out of 16 presented marginal discrepancy.

DISCUSSION

The coronally advanced flap has shown predictable results in terms of root coverage for intact root Miller Class I gingival recessions (Allen & Miller 1989, Wennström & Zucchelli 1996, Pini-Prato et al 2000, Cairo et al 2008) However, the long-term success of the coronally advanced flap to treat gingival recession, associated with non-carious cervical lesion, combined or not with a cervical restoration has not been addressed in the literature. Thus, the goal of this split-mouth, randomized controlled clinical trial was to compare the 2-year-follow-up of gingival recession, associated with non-carious cervical lesion, treated by coronally

advanced flap plus glass ionomer restoration (Test - CAF+R group) and the coronally advanced flap alone (Control - CAF group).

The observed change in the relative gingival recession after 2 years was 1.31±0.37 mm and 1.39±0.41 mm for CAF+R and CAF, respectively ($p>0.05$). This change in the position of the gingival margin to a more coronal level provided a comparable percentage of cervical lesion height coverage (51.57±17.2% in the CAF+R group and 53.87±12.6% in the CAF group, $p>0.05$) and gain of clinical attachment level (1.2±0.72 mm in the CAF group and 1.31±0.6 mm in the CAF+R group, $p>0.05$) after the two treatment approaches. Therefore, it could be assumed that the presence of the restoration on the cervical area may not prevent soft tissue coverage by the coronally advanced flap. It is important to note that the cervical lesion height coverage reported in the present study should not be directly compared with other studies that included gingival recession on intact roots. This comparison is not possible because the non-carious cervical lesion simultaneously affects parts of the root and the crown of the tooth and, with its progression, the cemento-enamel junction generally disappears (Zucchelli et al 2006). This could explain why no site, neither in the CAF group nor in the CAF+R group, achieved complete CLH coverage and only the part of the non-carious cervical lesion located on the root could be predictably covered by soft tissue after a coronally positioned flap.

In order to explore the hypothesis that the uncovered part of the non-carious cervical lesion was mainly composed by the crown portion of the lesion, an estimation of the position of the CEJ by the method described by Zucchelli et al (2006) was performed and it was possible to estimate the part of the cervical lesion height located on the root (CLH-R). The CLH-R was 1.7±0.42mm (67.19% of the cervical lesion height) for the CAF+R group and 1.68±0.36 (65.68% of the cervical lesion height) for the CAF group. Based on these values, mean root coverage (CLH-R coverage) was calculated and reached 80.37± 25.44% for the CAF+R group and 83.46±20.79% for the CAF group ($p>0.05$). The mean values of root coverage observed in the present study are comparable to those reported in other

studies for this procedure (Harris & Harris 1994, Allen & Miller 1989, Wennström & Zucchelli 1996, Pini-Prato et al 2000). However, caution should be taken due to the subjective component of the method used to estimate the CEJ in the present study, which differs from the direct measurement obtained in studies with intact roots. This method does not allow precise determination of complete root coverage achieved by each procedure. Another consideration is that the present study included small Miller Class I gingival recessions. In spite of the small size of the recessions, they were considered sufficiently important by the patients. Therefore, this associated lesion is a common clinical finding that requires further investigation to establish a treatment protocol that could deal with the dentin sensitivity and esthetic complaints of the patients.

The first clinical trial aimed to evaluate the coverage achieved on restored roots was performed by Thanik & Bissada (1999). They concluded that similar coverage could be obtained regardless of the presence of the restoration. Later reports (Santamaria et al 2007, Santamaria et al 2008, and Lucchesi et al 2007) showed similar results. However, all these previous studies were short-term reports. Long-term studies are strongly recommended to show the stability of soft tissue coverage over time on restored roots achieved after periodontal surgery. The findings of the present 2-year follow up study corroborate previous findings (Santamaria et al. 2008) suggesting that gingival margin stability may be obtained after the coronally-advanced flap is performed on cervical lesions restored with resin-glass ionomer cement.

One important part to be evaluated when using the combined approach (periodontal surgery plus restoration) to treat gingival recession associated with non-carious cervical lesion is the gingival margin stability over time. The other part is the restoration. In the presented study, some interesting observations were made regarding the restoration. After the 2 years of observation, all the restorations were presented at the treated sited. This finding is in accordance with the literature, which shows a low rate loss of resin-glass ionomer cement when applied to Class V cavities after 2 years (Abdala & Alhadainy 1997) and after 5

years (Loguercio et al 2003). There are several factors that may have influenced this result. The utilization of a rubber dam to isolate the operative field might have maintained the cervical lesion cavity dry and decontaminated during the manufacture of the restoration. Additionally, all possible etiological factors related to the occurrence of the non-carious cervical lesion (e.g. occlusion, acids, and traumatic brushing) were controlled, which would have influenced this positive finding (Heymann et al, 1991).

Another observation is the color alteration of the restorative material used. In the present study, 7 of 16 (43.75%) of the restorations' color did not match the teeth's color after 2 years. This finding is also in accordance with the literature, which shows low color stability for the resin-glass ionomer over time (Gladys at al 1999). There are several factors that may influence resin-glass ionomer color, but alterations in surface texture are particularly important. Gladys et al (1999) observed a higher roughness surface of the resin-glass ionomer restoration using a scanning electron microscope, compared to other materials after 18 months of use. However the increased roughness surface may not have any negative impact on the gingival health. In the present study, no plaque accumulation and no bleeding on probing was observed at any site of the test group. Figure 10 shows one tooth allocated to the test group that presented color alteration of the restoration. Although some restorations presented color alteration, only one patient complained about it. For this patient, a thin external layer of the supragengival portion of the restoration was worn out using a round diamond bur and a composite resin layer was applied to correct the color alteration. The remaining patients considered that good esthetics was achieved after the procedures. However caution must be taken because the patients were simply asked about it and no visual analog scale or another method to measure the patient esthetic satisfaction was applied.

The presence of restoration margins close to the gingival margin or within the crevicular space has been suggested to cause gingival inflammation (Larato 1972). The results of the present study are not in agreement with this statement. As the amount of soft tissue coverage achieved in the CAF+R group was 51.57%,

the restorations present in this group remained approximately 50% covered by the soft tissue and, as a consequence, the apical margin of the restoration located subgingivally. However, no bleeding on probing or signs of gingival inflammation during the study period were observed. Dragoo's (1996 & 1997) and Alkan's (2006) studies demonstrated that the periodontal health was maintained when resin-modified glass ionomer was used for subgingival or transgingival restorations. The biocompatibility of the material added to the fact that the patients were followed-up every four months for prophylaxis, plaque control and oral hygiene instructions may help to explain the gingival health observed during the study. In addition, flap elevation allowed proper isolation of the operative field and a well finished filling could be achieved that might have facilitated plaque control.

Despite the fact that this is a 2-year follow up study, longer periods of observation are recommended to assess the rate of success and the possible complications of this combined approach. It should be recognize that the periodontal surgery associated with the restorative procedure required a longer clinical time compared to the isolated surgical procedure. In addition, the statistical analysis included a power value of 77% to detect a clinical significant difference of 1.0 mm between CAF and CAF+R in the RGR and CAL. Therefore, further studies with larger samples sizes are strongly recommended to confirm these results. Other studies testing other different restorative materials and surgical techniques should be performed to achieve the best combination to treat this particular combined lesion. The results of the present study suggest that the combination between coronally advanced flap for root coverage and cervical lesion restoration using glass ionomer can provide stable results after 2 years.

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Tables

Table 1. Patients characteristics at the baseline (N=16)

Age	26 to 58 (mean age 37.4 ± 8.8 years)
Gender	9 males and 7 females
	Canines: 4 (12.5%)
Teeth	1PM: 26 (81.25%)
	2PM: 2 (6.25%)
FMPI	16.5%
FMBI	18.82%

FMPI, full-mouth visible plaque index; FMBI, full-mouth sulcus bleeding index

Table 2. Mean values and standard deviation for CLH and CLH-R

	Test group	Control group	*P* value
CLH	2.54±0.5mm	2.58±0.42mm	0.93
CLH-R	1.7±0.42mm (67.19±11.81%)	1.68±0.36mm (65.68±7.52%)	0.8
CLH-C	0.84±0.32mm	0.9±0.21mm	0.67
CLH coverage	51.57±17.2%	53.87±12.6%	0.13
Root coverage	80.37± 25.44%	83.46±20.79%	0.8

CLH, non-carious cervical lesion height; CLH-R, non-carious cervical lesion height located on the root; CLH-C non-carious cervical lesion height located on the crown; *P* Values were calculated by Wilcoxon test to evaluate differences between groups.

Table 3. Clinical results (mean± SD; n = 16 patients).

		Baseline	6 months	1 year	2 years
PD	CAF+R	1.25±0.44	1±0.36	1.12±0.5	1.25±0.44
	CAF	1.31±0.47	1.37±0.5	1.5±0.51	1.5±0.51
CAL	CAF+R	11.73±1.15	10.14±0.95*	10.30±1.26*	10.42±1.0*
	CAF	11.56±0.72	10.21±0.83*	10.37±0.95*	10.36±0.97*
RGR	CAF+R	10.48±1.09	9.14±1.0*	9.17±0.99*	9.17±1.0*
	CAF	10.25±0.81	8.84±0.77*	8.87±0.81*	8.86±0.8*
KTT	CAF+R	1.16±0.13	-	-	1.07±0.2
	CAF	1.12±0.16	-	-	1.04±0.33
KTW	CAF+R	3.16±0.85	-	-	3.11±0.91
	CAF	3.24±0.4	-	-	3.25±0.56

* Statistically significant difference within groups ($p<0.05$) by Friedman test.

† Statistically significant difference between groups ($p<0.05$) by Wilcoxon test.

CAF+R, coronally advanced flap plus resin-modified glass ionomer restoration group; CAF, coronally advanced flap group; PD, probing depth; CAL, clinical attachment level; RGR, relative gingival recession; KTT, keratinized tissue thickness; KTW, , keratinized tissue width.

Figures

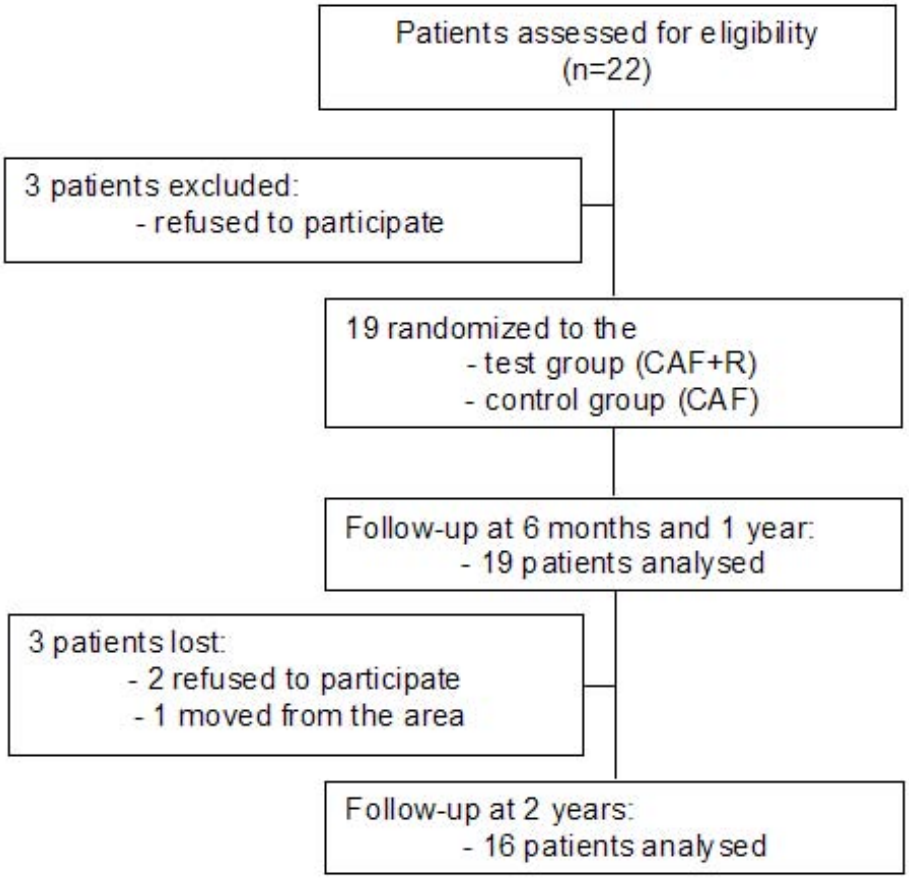

Figure 1. Flowchart for the study patients. CAF, coronally advanced flap group; CAF+R, coronally advanced flap plus restoration group.

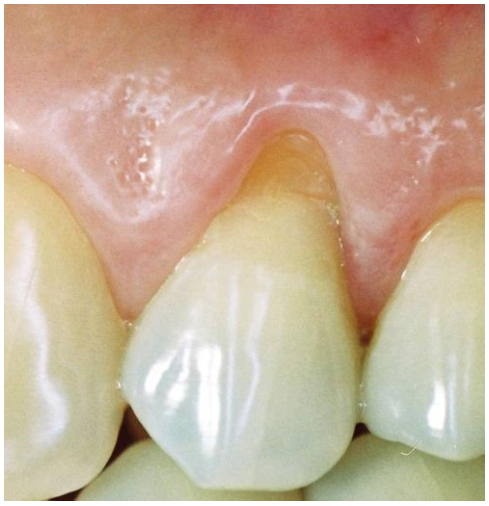

Fig 2. Preoperative view of the CAF site.
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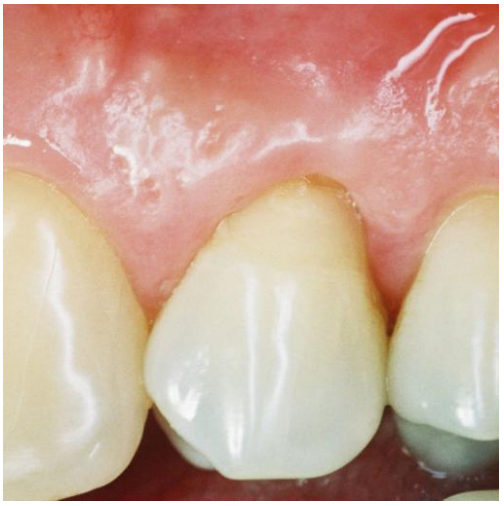

Fig 3. CAF site after 6 months of the treatment.

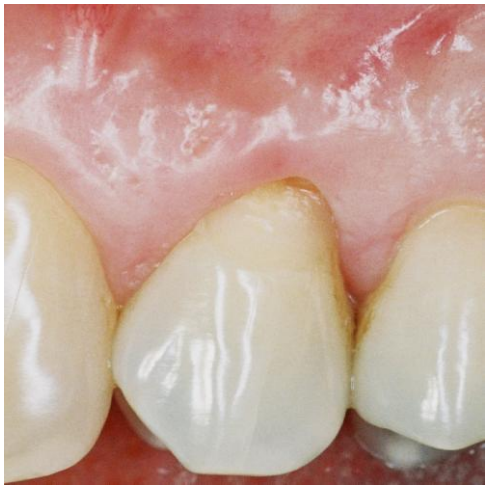

Fig 4. CAF site after 1 year of the treatment

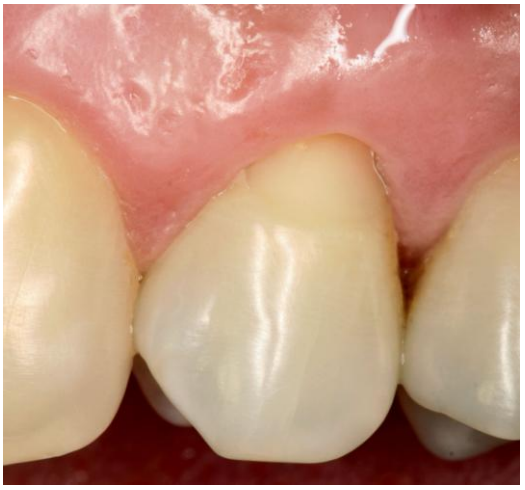

Fig 5. CAF site after 2 years of the treatment.

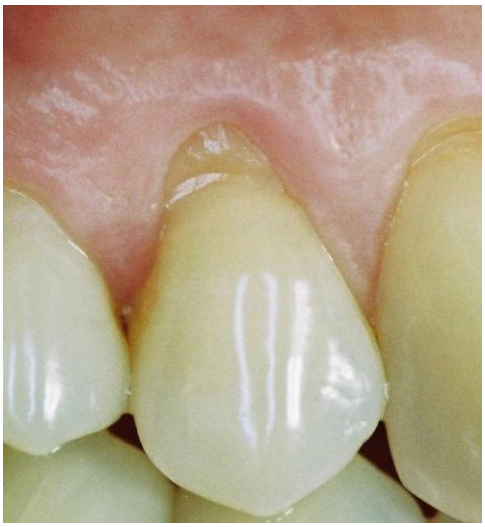

Fig 6. Preoperative view of the CAF+R site.

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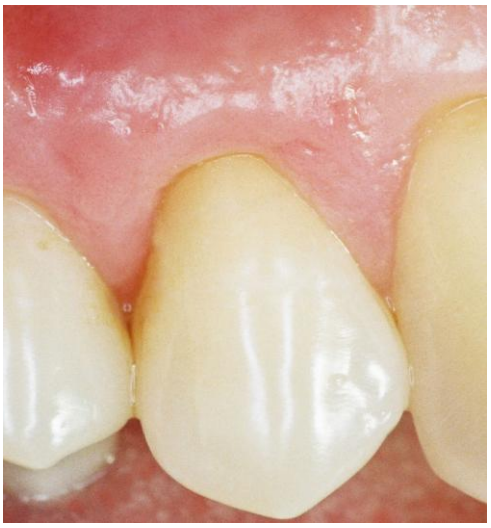

Fig 7. CAF+R site after 6 months of the treatment.

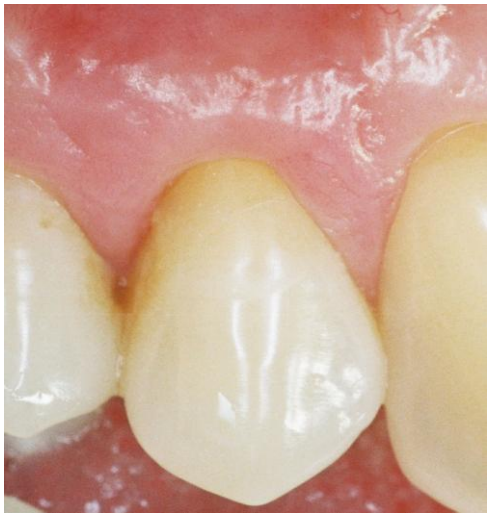

Fig 8. CAF+R site after 1 year of the treatment

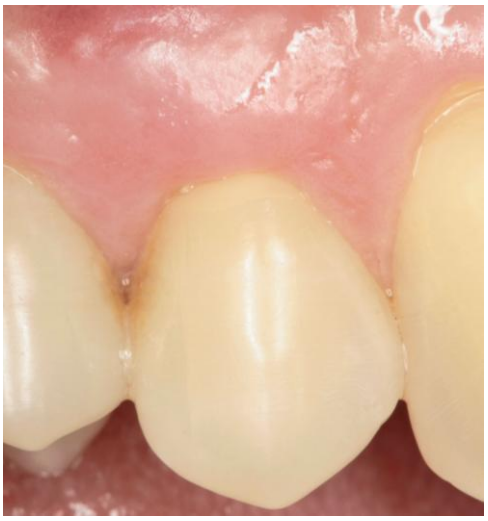

Fig 9. CAF+R site after 2 years of the treatment.

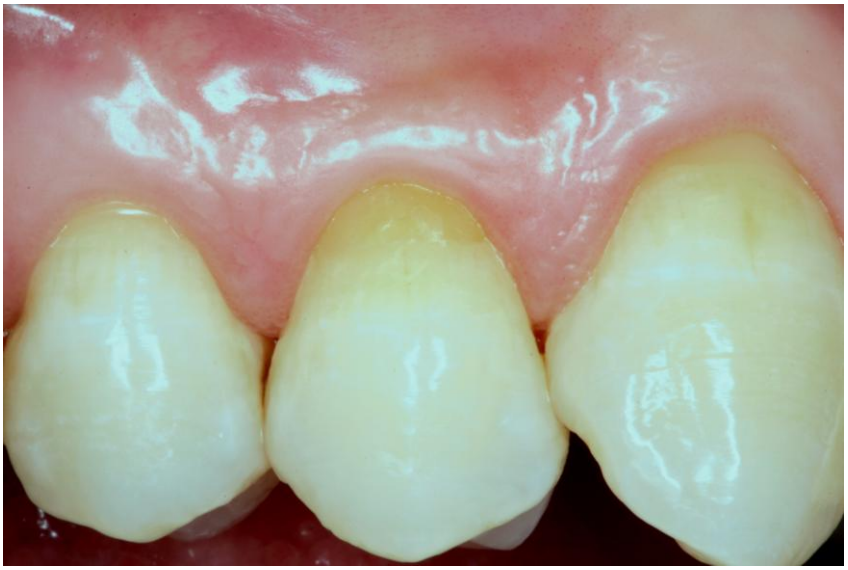

Figure 10. CAF+R site after 2 years of the treatment presenting alteration of the restoration color.

3.2 Capítulo 2

Connective tissue graft plus resin-modified glass ionomer restoration for the treatment of gingival recession associated with non-carious cervical lesion. A randomized controlled clinical trial.

Authors:

Mauro Pedrine Santamaria – DDS, MS*.

Gláucia Maria Bovi Ambrosano – MS, PhD Professor**.

Marcio Zaffalon Casati - DDS, MS, PhD, Assistant Professor*.

Francisco Humberto Nociti Júnior - DDS, MS, PhD, Professor*.

Antônio Wilson Sallum - DDS, MS, PhD, Professor*.

Enilson Antônio Sallum - DDS, MS, PhD, Professor*.

* Dept. of Prosthodontics and Periodontics, Division of Periodontics, Piracicaba Dental School, University of Campinas - UNICAMP, São Paulo, Brazil.

** Dept of Social Dentistry, Division of Biostatistics Piracicaba Dental School, University of Campinas - UNICAMP, São Paulo, Brazil.

Corresponding Author:

ENILSON ANTONIO SALLUM

Department of Periodontics and Prosthodontics, Piracicaba Dental School

Av. Limeira, 901. Areião. Piracicaba. São Paulo. Brazil

Cep.13414-903 e-mail: easallum@fop.unicamp.br

Tel: +55 19 21065301

Fax: +55 19 21065301

(e-mail can be published)

Tables: 4

Figures: 11

Short title: Connective tissue graft on restored root surface.

Key words: Gingival recession/surgery; surgical flap; cementoenamel junction; glass ionomer cement; tooth abrasion.

ABSTRACT

Background: The aim of this clinical study was to evaluate the treatment of gingival recession, associated with non-carious cervical lesions by a connective tissue graft alone (CTG), or in combination with a resin-modified glass ionomer restoration (CTG+R).

Methods: Forty patients presenting Miller Class I buccal gingival recessions, associated with non-carious cervical lesions were selected. The defects were randomly assigned to receive either CTG or CTG+R. Bleeding on probing (BOP), probing depth (PD), relative gingival recession (RGR), clinical attachment level (CAL), and cervical lesion height (CLH) coverage were measured at baseline and 45 days, 2, 3, and 6 months after treatment.

Results: Both groups showed statistically significant gains in clinical attachment level and soft tissue coverage. The differences between groups were not statistically significant in BOP, PD, RGR and CAL, after 6 months. The percentages of CLH covered were 74.88±8.66% for CTG and 70.76±9.81% for CTG+R ($P>0.05$). The estimated root coverage was 91.91±17.76% for CTG and 88.64±11.9% for CTG+R ($P>0.05$).

Conclusion: Within the limits of the present study, it can be concluded that both procedures provide comparable soft tissue coverage. The presence of the glass ionomer restoration may not prevent the root coverage achieved by connective tissue graft.

CLINICAL RELEVANCE

Scientific Rationale: Gingival recession is frequently associated with non-carious cervical lesion. The literature lacks controlled studies evaluating the use of connective tissue grafts and restorations to treat this condition.

Principal Findings: The present study shows that connective tissue graft alone, or in combination with glass ionomer restoration, may provide comparable

soft tissue coverage in the treatment of gingival recession associated cervical lesion.

Practical Implications: The present results suggest that the combined approach may be considered as a treatment option for the type of lesion included in the study. Long-term observations are necessary to confirm the stability of the achieved results.

CONFLICT OF INTEREST AND SOURCE OF FUNDING STATEMENT

The authors report no conflicts of interest related to this study.

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INTRODUCTION

During the past few decades, the periodontal literature has presented a great number of clinical trials aimed to evaluate different surgical approaches for root coverage. It has been recognized that buccal gingival recession, presenting no loss of interproximal periodontal attachment and bone (Miller Class I and II), can be predictably covered by a variety of surgical procedures (Roccuzzo 2002, Cairo et al 2008). The main outcomes of these studies were to evaluate the complete root coverage and percentage of root coverage achieved by the procedures. For this, the cemento-enamel junction (CEJ) was used as the reference point.

It has also been recognized that gingival recession is frequently associated with cervical wear. Sangnes and Gjermo (1976) reported that gingival recession and a wedge-shaped defect in the cervical area were often seen affecting the same tooth. In another report (Zucchelli et al 2006), no signs of the cemento-enamel junction were observed in about 50% of the examined teeth showing

gingival recession, due to cervical abrasion. The presence of a non-carious cervical lesion, associated with gingival recession, can cause some confusion regarding the identification of the CEJ location, which is often mistaken with the coronal border of the cervical lesion.

With the loss of the CEJ, caused by the progression of the non-carious cervical lesion, it could be inferred that the cervical lesion simultaneously affects parts of the root and crown of the tooth. Therefore, it may be speculated that the most coronal zone of the non-carious cervical lesion is mainly formed by the exposed dentin of the dental anatomic crown. This condition makes the complete coverage of the associated lesion (gingival recession plus non-carious cervical) an unpredictable goal. There is a trend towards leaving the coronal border of the lesion still exposed after the surgical procedures, however, even in the presence of complete root coverage (gingival margin at the level or pre-existing CEJ) the patient can still present dentin sensitivity, associated with the portion of the non-carious cervical lesion that is exposed above the gingival margin (located in the anatomic crown).

Recently, it has been shown that gingival recessions, associated with non-carious cervical lesions, can be successfully treated by glass ionomer restoration (Santamaria et al, 2007, 2008, 2009) or composite resin (Lucchesi et al, 2007) combined with coronally advanced flap. After the healing period, part of the restoration was covered by the soft tissue. Good esthetic outcome and gingival health with no signs of inflammation, such as redness and bleeding on probing were observed. Even though soft tissue coverage was obtained in these cases, the coronal zone of the restorations in the group treated by a coronally advanced flap plus restoration, or the coronal zone of the non-restored cervical lesion in the group treated only by coronally advanced flap, remained uncovered, probably due to the fact that the crown portion of the lesion could not be completely covered. However, there is a lack of information derived from randomized controlled clinical trials about the ability of other surgical procedures to treat gingival recession, associated with non-carious cervical lesion. Therefore, the aim of the present

study was to compare the outcome of connective tissue graft alone or in combination with a resin-modified glass ionomer restoration in the treatment of gingival recessions associated with non-carious cervical lesions.

MATERIALS AND METHODS

Prior to the beginning of the study, the consent form and the protocol of the study were approved by the Institutional Review Board of the University of Campinas (CEP-UNICAMP 104/2005). Informed consent was signed by each subject after thorough explanation of the nature, risks and benefits of the clinical investigation and associated procedures.

Study Population

Forty patients, 21 males and 19 females, aged 19 to 71 years (mean age 36.25 ± 22.8 years) were included. The subjects were selected from the group of patients referred for periodontal treatment to the Graduate Clinic of the Piracicaba Dental School, University of Campinas, to participate in this study. The patients were selected from March of 2006 to February of 2007, according to the following eligibility criteria:

1. Presence of one Class I Miller gingival recession, associated with non-carious cervical lesion 1-2mm deep in maxillary canines or premolars.
2. Non-smokers.
3. Systemically and periodontally healthy.
4. No contraindication for periodontal surgery.
5. No use of medications known to interfere with periodontal tissue health and healing.
6. Probing depth < 3mm without bleeding on probing.
7. Tooth vitality, absence of restoration on cervical area, and absence of severe occlusal interferences in the area to be treated.
8. No previous periodontal surgery in the area.

The patients were referred for periodontal treatment based on their complaints (dentin sensitivity and/or esthetic concerns). Since a non-carious cervical lesion may be the consequence of a multifactorial process, including tooth structure loss caused by nonbacterial acids (erosion), traumatic tooth brushing (abrasion) and occlusal loading (abfraction) (Bartlett & Shah 2006; Litonjua et al 2003) all patients were included in a pre-treatment program in order to eliminate the possible etiologic factors related to non-carious cervical lesion and gingival recession. Oral hygiene instructions with a non-traumatic brushing technique and a soft toothbrush were given. Patients were also encouraged to avoid excessive consumption of acidic beverages or acidic foods. When necessary, selective grinding was performed to remove oclusal interferences on the teeth included in the study. Scaling, root planing and crown polishing were performed as necessary.

Clinical assessments

After this initial therapy, the following parameters were recorded: 1) full-mouth visible plaque index (Ainamo & Bay 1975) (FMPI) and presence or absence of visible plaque accumulation at the site included in the study (PI); 2) full-mouth sulcus bleeding index (Mühlemann & Son, 1971) (FMBI) and presence or absence of bleeding on probing at the site included in the study (BOP); 3) probing depth (PD), assessed as the distance from the gingival margin to the apical end of the gingival sulcus; 4) relative gingival recession (RGR), measured as the distance from the gingival margin to the incisal border of the tooth; 5) relative clinical attachment level (CAL) as PD + RGR; 6) non-carious cervical lesion height (CLH), measured as the distance between the coronal and apical margins of the non-carious cervical lesion; 7) height of the non-carious cervical lesion located on the root surface (CLH-R): the cement-enamel junction (CEJ) was estimated by the method described by Zucchelli et al (2006) using digital photographs obtained with a camera positioned perpendicular to the buccal surface of the experimental teeth at a magnification ratio of 1:1. The distance from the estimated cemento-enamel junction to the incisal border of the tooth and RGR were measured using an image analysis software. CLH-R was calculated by subtracting the distance from the

estimated cemento-enamel junction to the incisal border from RGR. This parameter allowed the calculation of the percentage of root coverage. The subtraction of the non-carious cervical lesion height on the root from the total cervical lesion height provided the amount of cervical lesion located on the crown (CLH-C); 8) keratinized tissue width (KTW), measured as the distance from the gingival margin to the mucogingival junction; 9) keratinized tissue thickness (KTT); 10) dentin sensitivity (DS), which was determined by asking patients about the presence or absence of cervical sensitivity in the sites included in the study before and after treatment. No thermal stimulus was applied to assess this parameter and the patients simply answered if they felt any discomfort in the area.

The probing depth was measured using a manual periodontal probe. The relative gingival recession, non-cervical lesion height and keratinized tissue width were measured using a pair of dividers and a digital caliper with 0.01-mm precision. The keratinized tissue thickness was measured using a pierced endodontic spreader, perpendicular to a mid-point location between the gingival margin and mucogingival junction and through the soft tissue with light pressure until a hard surface was felt. The silicone stop was then placed in tight contact with the external soft tissue surface. After carefully removing the spreader, penetration depth was measured with a digital caliper. The probing depth, relative gingival recession, clinical attachment level, visible plaque at the site included in the study and bleeding on probing were measured at baseline and 45 days, 2, 3, and 6 months after surgery. The keratinized tissue width and keratinized tissue thickness were obtained at baseline and at 6 months post-operatively.

Prior to the beginning of study, the examiner (MPS) measured the probing depth and relative gingival recession of all patients, two times, within 24 hours, with at least 1 hour between the examinations. The examiner was judged to be reproducible after fulfilling the pre-determined success criteria. The Kappa index was calculated to probing depth, resulting in 91% of reproducibility and the Intra-class correlation was calculated relative to gingival recession, resulting in 89% of agreement. The masking of the examiner was not practical, since it was possible to

observe whether the glass ionomer restoration was applied at the site. Thus, it was impossible to hide which treatment each site received.

Surgical procedures

All the surgical procedures were carried out by one operator (EAS). The sites were randomly assigned by flipping a coin (FFS) to control group or test group immediately before surgery. The control group received connective tissue graft (CTG group) and the test group was submitted to connective tissue graft plus a resin-modified glass ionomer restoration (CTG+R group).

Briefly, after local anesthesia (Lidocaine with 1:100.000 Epinephrine DFL, Rio de Janeiro, RJ,Brazil), an intrasulcular incision was made at the buccal aspect of the involved tooth. Two horizontal incisions were made at right angles to the adjacent interdental papillae, 1-mm apically to the level of the coronal border of the non-carious cervical lesion, without interfering with the gingival margin of neighboring teeth. Two oblique vertical incisions were extended beyond the mucogingival junction and a trapezoidal mucoperiosteal flap was raised up to the mucogingival junction. After this point, a split-thickness flap was extended apically, releasing the tension and favoring coronal positioning of the flap. In the CTG group, the root and non-carious cervical lesion were planed with a finishing bur (KG Sorensen 9803FF - São Paulo, Brazil) and curettes until the tooth surface became smooth. In the CTG+R sites, a sterile rubber dam was placed to isolate the operative field and the non-carious cervical lesion restoration was performed with resin-modified glass ionomer cement (Vitremer - 3M ESPE - St. Paul, MN, USA), following the manufacturer's instructions. The restoration was performed in order to reestablish the entire defect caused by the cervical wear. The entire length of the non-carious cervical lesion was restored and the original contour of the tooth was restored. Afterwards, the epithelium on the adjacent papillae was stripped away and the connective tissue graft harvested from the palate using a scalpel with parallel blades (1.5 mm distant from each other) was placed in such a way to cover all the non-carious lesion (CTG control group) or the restoration (CTG+R test group). Then the flap was coronally positioned and sutured

(6.0 Polygalactin 910 Ethicon INC - São José dos Campos, Brazil) to completely cover the graft.

Post-operative care

Patients were instructed to take analgesics (500 mg sodium dipyrone every 6 hours for 2 days) and were instructed to discontinue toothbrushing around the surgical sites during the initial 30 days after surgery. During this period, plaque control was achieved with a 0.12% chlorhexidine solution rinse used twice a day. After this period, gentle toothbrushing with soft-bristle toothbrush was allowed.

Sutures were removed after 7 days and the patients were enrolled in a periodontal maintenance program (professional plaque control and oral hygiene instruction) weekly during the first month, monthly during the 6 months.

Statistical analysis

Descriptive statistics were expressed as mean ± standand deviation (SD). The probing depth, relative gingival recession and relative clinical attachment level were examined by Friedman test to evaluate differences within groups, followed by post hoc non-parametric test for multiple comparisons and by Mann-Whitney test to evaluate differences between groups. The cervical lesion height (CLH), height of the non-carious cervical lesion located on the root (CLH-R) and on the crown (CLH-C) surfaces were examined by Mann-Whitney test to evaluate differences between groups. The dentin sensitivity (DS), the visible plaque at the site included in the study (VPS) and the bleeding on probing at the site included in the study (BOP) were examined by the Chi-square test. The keratinized tissue width (KTW) and the keratinized tissue thickness (KTT) were examined by Mann-Whitney test to evaluate differences within and between groups. A significance level of 0.05 was adopted for all statistical comparisons.

Power calculation

The study power was calculated using the SAS 9.01 software (Release 9.1, 2003, SAS Institute Inc., Cary, NC, USA). This analysis indicated that with 16 subjects in each group, the study would have >80% power to detect a 1mm difference (1.0 mm between CTG and CTG+R groups was considered as clinically

significant) in relative gingival recession and clinical attachment level between the two groups. After the completion of the study, considering SD of each group of the present study, the power values were confirmed to be >80% to detect a 1mm difference in relative gingival recession and clinical attachment level between the two groups. A difference of 1.0 mm between CTG and CTG+R groups was considered as clinically significant.

RESULTS

Healing was uneventful for all patients and none were excluded from the study (40 patients 1 defect in each patient – total of 40 defects treated). Full-mouth PI and FMBOP were maintained below 20%, indicating a good standard of supragingival plaque control during the study period. The sites included in the study did not show bleeding on probing or visible plaque during the entire study period. A flow diagram of participants in the study is depicted (Fig. 1). Table 1 shows the patients' characteristics at baseline. No adverse event was observed in any patient during the study.

Cervical lesion

The mean cervical lesion height (CLH) was 3.22±0.52 mm for the CTG group and 3.27±0.68 mm for the CTG+R (P>0.05). Using the method described by Zucchelli et al (2006), it was possible to estimate the place where the lost cement-enamel junction was located. Consequently, it was possible to identify the total amount of root (CLH-R) and crown (CLH-C) affected by the non-carious cervical lesion. CLH-R was 2.45±0.53 for the CTG group and 2.36±0.71 for the CTG+R group, representing 74.88±8.66% and 70.76±9.81% of the total cervical lesion height, respectively. CLH-C was 0.77±0.26mm for CTG group and 0.91±0.23mm for CTG+R group. The differences observed between groups were not statistically significant for these parameters (P>0.05).

Gingival recession

The two groups presented statistically significant reductions in the relative gingival recession; 2.53±0.78 mm for the CTG group and 2.31±0.74 mm for the

CTG+R group (P<0.05). These reductions in the relative gingival recession represent 77.59±20.15% of the cervical lesion height (CLH) covered by CTG and 70.0±13.85% by CTG+R. This difference between groups was not statistically significant (P>0.05) for this parameter. Three sites in the CTG group and four sites in the CTG+R group had achieved complete CLH coverage after 6 months of observation.

The percentage of root coverage at the end of the study period was calculated. The CTG group showed a mean root coverage of 91.91± 17.76% and the CTG+R group showed a mean root coverage of 88.64±11.9%. The difference between groups was not statistically significant (P>0.05). Table 2 shows the characteristics of the cervical lesion in each group and the total amount of coverage achieved and figures 2 to 10 show the preoperative view and the 6-month postoperative outcome.

Probing depth (PD) and clinical attachment level (CAL)

The two groups presented statistically significant increases in the probing depth from the baseline until 6-month-follow-up. In the CTG group, this parameter changed from 1.15±0.48 mm to 2.1±0.55 mm (P<0.05) and the CTG+R group changed from 1.1±0.44 mm to 2.15±0.67 mm (P<0.05). The difference between groups was not statistically significant (P>0.05).

After 6 months, both groups produced statistically significant changes from baseline for clinical attachment level; 1.58±0.74 mm for the CTG group (P<0.05) and 1.26±0.9 mm for the CTG+R group (P<0.05). The difference between groups was not statistically significant (P>0.05) (Table 3).

Keratinized tissue

The two groups produced statistically significant changes regarding the thickness (KTT) and the width (KTW) of the keratinized tissue. The keratinized thickness gain was 1.03±0.43 mm for the CTG group and 1.1±0.32 mm for the CTG+R group, while the keratinized width gain was 0.67±33 mm and 0.8±0.4 mm, respectively. There was no statistically significant difference between groups

neither in KTT nor KTW. Table 4 shows the mean and standard deviation of PD, CAL, RGR, KTT, and KTW of test and control groups.

Bleeding on probing

Full-mouth sulcus bleeding index (FMBI) remained low during the entire study period. FMBI was 18% for CTG and 14% for CTG+R at the baseline and 16.7% and 16% at 6-month evaluation, respectively ($P>0.05$). Additionally, low levels of full mouth visible plaque index (FMPI) were observed during the entire study period; mean of 19.4% for CTG and 18.5% for CTG+R. No bleeding on probing (BOP) was observed at any site included in the study in any evaluated period.

Dentin sensitivity

Within the study sample, 60% of the subjects (12 patients) from the CTG group and 70% of the subjects (14 patients) from the CTG+R group reported dentin sensitivity (DS) at baseline. After 6 months, the CTG group presented 35% (7 patients) of sites exhibiting this symptom and the CTG+R group showed 5% (1 patient). The reduction in the percentage of sites with dentin sensitivity was statistically significant for both groups ($P<0.05$), and a statistically significant difference for this parameter was observed between groups ($P<0.05$). Figure 11 shows the reduction in DS.

DISCUSSION

Since gingival recession is frequently associated with cervical wear, some previous clinical trials have evaluated the ability of the coronally advanced flap to cover this combined lesion (Santamaria et al, 2008). The comparison between restored and non-restored sites has been previously performed (Santamaria et al 2008, and Lucchesi et al 2007). However, there is a need for clinical trials evaluating different approaches to deal with this common condition. In the present study, the connective-tissue graft was used to treat gingival recession, associated with non-carious cervical lesion alone or combined with a glass ionomer restoration of the cervical wear. Therefore, the present study evaluated the ability

of the connective tissue graft to cover the combined defect (CTG group) and determined whether the glass ionomer restoration interferes with the amount of coverage achieved by the connective tissue graft (CTG+R group).

The observed changes in the relative gingival recession after 6 months were 2.53±0.78 mm and 2.31±0.74 mm for CTG and CTG+R, respectively ($P>0.05$). These changes in the position of the gingival margin to a more coronal level provided a comparable percentage of cervical lesion height coverage (77.59±20.15% in the CTG group and 70.0±13.85% in the CTG+R group, $P>0.05$) and gain of clinical attachment level (1.57±0.74 in the CTG group and 1.26±0.9 in the CTG+R group, $P>0.05$) after the two treatment approaches. Therefore, it can be assumed that the presence of the restoration on the cervical area may not prevent the amount of soft tissue coverage that can be achieved by connective tissue graft flap in this situation, considering the period of observation of 6 months.

The values of CLH coverage reported in the present study are related to the total height of the cervical lesion (crown and root zones). Therefore, cervical lesion height coverage reported in the present study should not be directly compared with other studies that included gingival recession on intact roots. This comparison is not possible because the non-carious cervical lesion simultaneously affects parts of the root and crown of the tooth and with its progression, the cementoenamel junction generally disappears. A new line is established, coronally to the original cementoenamel junction, representing the incisal border of the non-carious cervical lesion and is often mistaken for the cementoenamel junction (Zucchelli et al 2006). Only the part of the non-carious cervical lesion located on the root could be predictably covered by soft tissue after the surgical procedure. This is probably the reason why no total CLH coverage could be previously observed with the coronally advanced flap (Santamaria et al 2008). However, in the present study, a total of 7 sites (3 in CTG group and 4 in the CTG+R group) presented complete CLH coverage. One possible explanation for this result could be that the presence of the connective tissue graft beneath the flap might have prevented the collapsing flap inside the dead space created by the cervical lesion. The presence of the

connective tissue under the flap might have given an adequate support to the flap and, as a consequence, provided a better stability (Mele et al 2008). Successful cases in which the gingival margin was moved coronally, beyond the cementenamel junction, using the connective tissue graft were shown by McNeely (McNeelly 2005), not only for the CTG group but also for CTG+R group since the restorations were carried out avoiding a convex surface. This is probably the reason why both groups of the present study showed slightly better averages of CLH coverage, when compared to the groups of the previous study (Santamaria et al 2008). However, additional studies are necessary to test this hypothesis.

In order to explore the hypothesis that the most coronal zone of the non-carious cervical lesion was mainly composed by the crown portion of the lesion, an estimation of the position of the CEJ by the method described by Zucchelli was performed (Zucchelli et al 2006). According to this method, a scalloped line which represents the cementoenamel junction lost is constructed following the patient biotype and connecting the ideal dimension of the adjacent papilla. Therefore, it was possible to estimate the part of the cervical lesion height located on the root (CLH-R). The CLH-R was 2.45±0.53mm (74.88±8.66% of the cervical lesion height) for the CTG group and 2.36±0.71mm (70.76±9.81% of the cervical lesion height) for the CTG+R group. Based on these values, mean root coverage (CLH-R coverage) was calculated, reaching 91.91± 17.76% for the CTG group and 88.64%±11.9 for the CTG+R group ($P>0.05$). The mean values of root coverage observed in the present study are comparable to the ones reported in other studies for this procedure (Harris & Harris 1994, Allen & Miller 1989, Pini-Prato et al 2000, Wennström & Zucchelli 1996, Cortellini et al 2009). However, caution should be taken due to the subjective component of the method used to estimate the CEJ in the present study, which differs from the direct measurement obtained in studies with intact roots.

An interesting finding of the present study is related to bleeding on probing. In spite of the subgingival location of the apical margin of the restoration, as a consequence of the coverage achieved after the surgical procedures; no site in

either the CTG+R group or in the CTG group showed bleeding on probing. This result is in accordance with other studies (Santamaria et al 2007, 2008, 2009; Lucchesi et al 2007). Conversely, these data do not agree with studies that demonstrated that the presence of restoration margins close to the gingival margin or within the crevicular space may cause gingival inflammation (Larato 1972). Dragoo's (Dragoo 1996, Dragoo 1997) and Alkan's (Alkan 2006) studies showed that periodontal health was maintained when resin-modified glass ionomer was used for subgingival or transgingival restorations. Therefore, the selection of the resin-modified glass ionomer to be used in the present study was based on the results of these previous studies. The suggested biocompatibility of the material, added to the fact that the patients were followed-up monthly for prophylaxis, plaque control and oral hygiene instructions may help to explain the gingival health observed during the study. In addition, flap elevation allowed proper isolation of the operative field and a well finished filling could be achieved which might have facilitated plaque control.

In the present study, the patients were asked about the presence of dentin hypersensitivity (DS) before and after treatment, without application of any thermal or tactile stimuli to detect the sensitivity. The success of the therapy should be based on patient's evaluation of this symptom (Cairo et al 2008, Roccuzzo et al 2002). The results revealed a statistically significant reduction in dentin sensitivity between baseline and the subsequent observation periods for the CTG+R group, whereas these within-group differences were not observed for the CTG group. The comparison between the groups revealed a statistically significant difference, with better outcomes for the CTG+R group in all postoperative periods. This may be related to the fact that most of the cervical lesions did not achieve complete coverage with gingival tissue. Thus, part of the cervical lesion was still exposed to the oral environment in the CTG group. Conversely, cervical lesions in the CTG+R group were restored, sealing the exposed dentinal tubules and reducing the chances of symptoms. Again, the subjective nature of dentin sensitivity evaluation in the present study should be pointed out. A decision was made during the

planning of the study to limit this evaluation to a simple question, without the use of a scale. If the patient reported any sensitivity, regardless of the intensity, it was considered positive for the analysis.

The probing depth (PD) showed a statistically significant change between baseline and postoperative periods in the two groups. They showed an increase of about 1mm in the PD after the treatments. Although the increase was statistically significant, the clinical importance of this alteration could be questioned since both groups presented shallow PD after 6 months; 2.1±0.55 mm for the CTG group and 2.15±0.67 mm for the CTG+R group. The differences between groups were not statistically significant at any period of revaluation.

Within the limits of this short-term study, it can be concluded that the presence of resin-modified glass ionomer restoration may not interfere with the percentage of soft tissue coverage, when connective tissue graft is performed for the treatment of Miller Class I gingival recessions, associated with non-carious cervical lesions. The combined treatment showed better results in the reduction of dentin sensitivity. However, these conclusions should be interpreted with caution, based on the following considerations: The periodontal surgery associated with the restorative procedure required a longer clinical time, compared to the isolated surgical procedure. Additionally, no assessment of patient satisfaction using a standardized approach was done in the present study. The statistical analysis of the present study included a power value > 80% to detect a clinically significant difference of 1.0 mm between CTG and CTG+R in the RGR and CAL. Although this is an acceptable value, further studies with larger samples are strongly recommended to confirm these results. Longitudinal observation is also necessary to evaluate the stability of the results and to establish the long-term success of this combined approach. Other restorative materials and surgical techniques should be tested to achieve the best combination to treat this particular combined lesion.

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Tables

Table 1. Patients characteristics at the baseline (N=40)

	CTG	CTG+R
Age	23 to 55 (mean age 31.8 ± 12.2 years)	19 to 71 (mean age 39.4 ± 20.4 years)
Gender	10 males and 10 females	11 males and 9 female
	Canines: 8 (40%)	Canines: 10 (50%)
Teeth	1PM: 9 (45%)	1PM: 6 (30%)
	2PM: 3 (15%)	2PM: 4 (20%)
FMPI	19.4%	18.5
FMBI	18%	14%

FMPI, full-mouth visible plaque index; FMBI, full-mouth sulcus bleeding index

Table 2. Mean values and standard deviation for CTG and CTG+R after 6 months

	CTG	CTG+R	*P* value
CLH	3.22±0.52 mm	3.27±0.68 mm	0.81
CLH-R	2.45±0.53mm . (74.88±8.66%)	2.36±0.71mm (70.76±9.81%)	0.43
CLH-C	0.77±0.26mm	0.91±0.23mm	0.67
CLH coverage	77.59±20.15%	70.0±13.85%	0.2
Root coverage	91.91± 17.76%	88.64±11.9%.	0.74

CLH, non-carious cervical lesion height; CLH-R, non-carious cervical lesion height located on the root; CLH-C non-carious cervical lesion height located on the crown; *P* Values were calculated by Mann-Whitney test to evaluate differences between groups.

Table 3. Mean gain in CAL and RGR at 6 month (mm).

	CTG	CTG+R	*P* Value
CAL gain	1.58±0.74	1.26±0.9	0.16
RGR reduction	2.53±0.78	2.31±0.74	0.41

CTG, connective tissue graft group; CTG+R, connective tissue graft plus resin-modified glass ionomer restoration group; CAL, clinical attachment level; RGR, relative gingival recession; *p* Value were calculated by Mann-Whitney test to evaluate differences within groups

Table 4. Clinical results in mm (mean± SD; n = 40 patients).

		Baseline	45 days	2 months	3 months	6 months
PD	CTG+R	1.1±0.44	1.9±0.64*	2±0.56*	2±0.56*	2.15±0.67*
	CTG	1.15±0.48	1.98±0.6*	2±0.45*	2.15±0.48*	2.1±0.55*
NIC	CTG+R	12.89±1.09	11.4±1.28*	11.51±1.15*	11.57±1.12*	11.63±1.08*
	CTG	12.85±2.06	11.1±1.84*	11.15±1.72*	11.27±1.7*	11.27±1.17*
RGR	CTG+R	11.79±1.09	9.5±0.87*	9.51±0.88*	9.57±0.81*	9.48±0.82*
	CTG	11.7±2.01	9.12±1.55*	9.15±1.46*	9.12±1.52*	9.17±1.53*
KTT	CTG+R	0.85±0.19	..	..	..	1.95±0.42*
	CTG	0.9±0.23	..	..	..	1.93±0.53*
KTW	CTG+R	2.54±1.17	..	..	..	3.34±0.91*
	CTG	2.38±1.22	..	..	..	3.05±1.11*

* Statistically significant difference intragroup groups ($p<0.05$) by Friedman test.

† Statistically significant difference intergroups ($p<0.05$) by Mann-Whitney test.

CTG+R, connective tissue graft plus resin-modified glass ionomer restoration group; CTG, connective tissue graft group; PD, probing depth; CAL, clinical attachment level; RGR, relative gingival recession; KTT, keratinized tissue thickness; KTW, , keratinized tissue width.

Figures

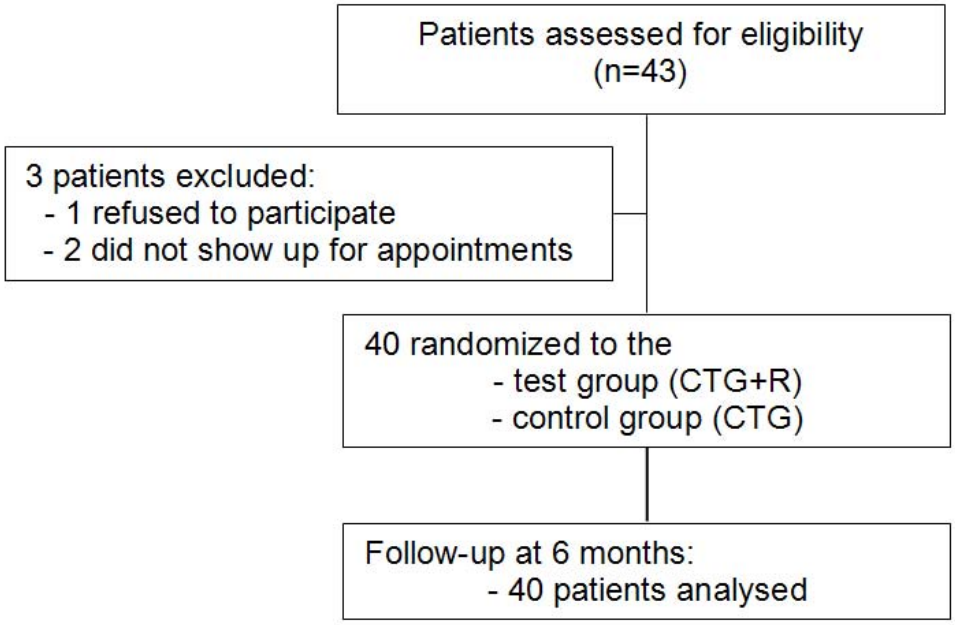

Figure 1. Flowchart for the study patients. CTG, connective tissue graft group; CTG+R, connective tissue graft plus restoration group.

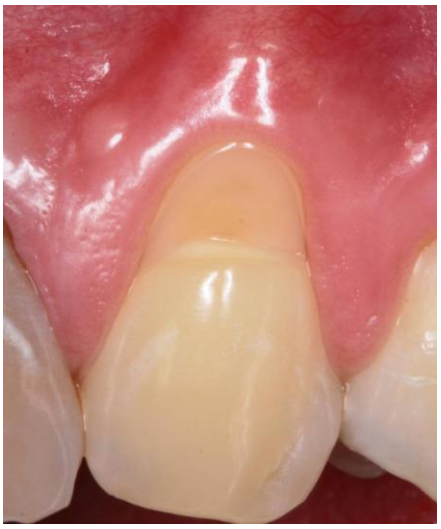

Fig 2. Preoperative view of the CTG+R site.

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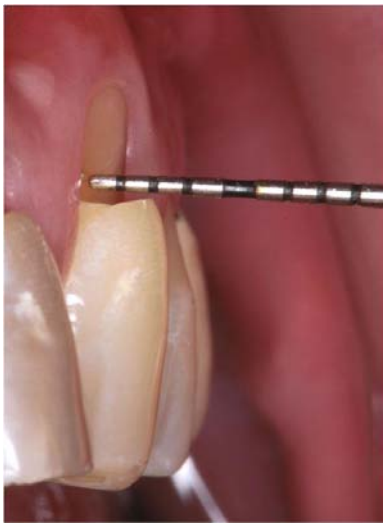

Fig 3. Probing showing the depth of the non-carious cervical lesion.

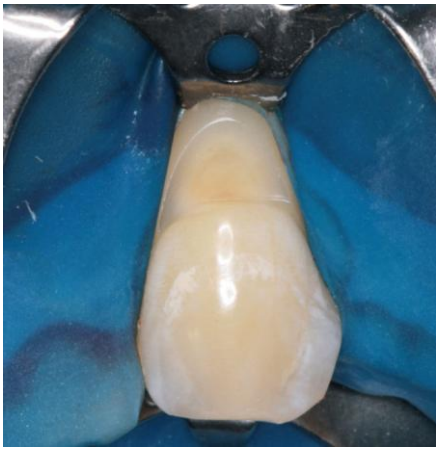

Fig 4. Isolation of the operative field after the flap was raised. Note that the entire length of the non-carious cervical lesion was included.

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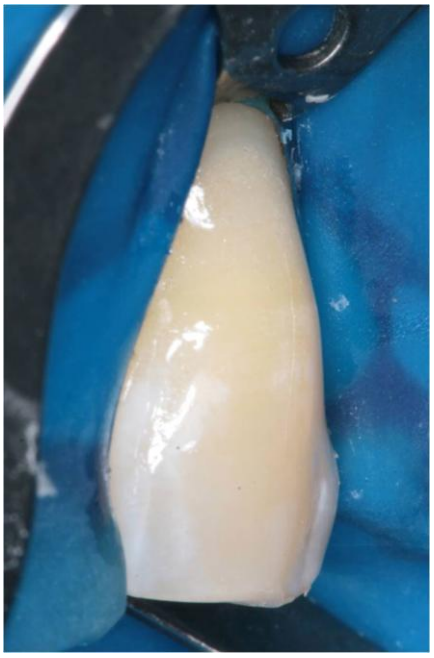

Fig 5. Lateral view of the same tooth of the figure 4, now restored. Note that the entire non-carious cervical lesion was restored.

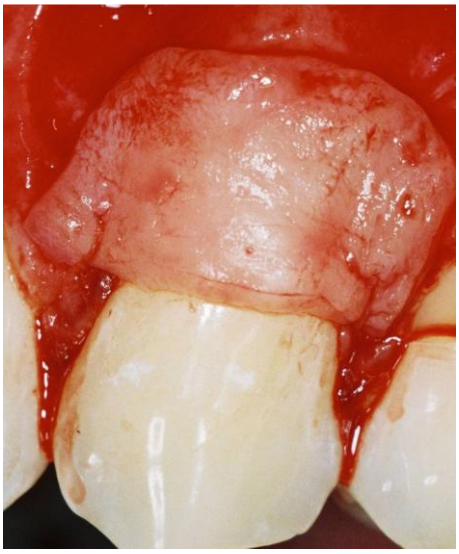

Fig 6. Connective tissue graft positioned. The connective tissue graft was positioned in order to cover the entire restoration in the CTG+R group and the entire non-restored cervical lesion in the CTG group.

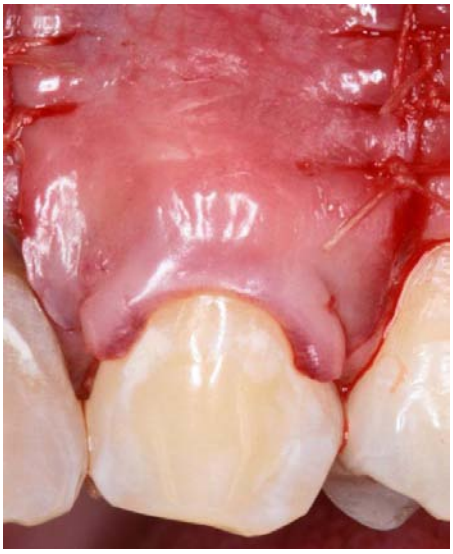

Fig 7. Final suture showing that the connective graft was completely covered.

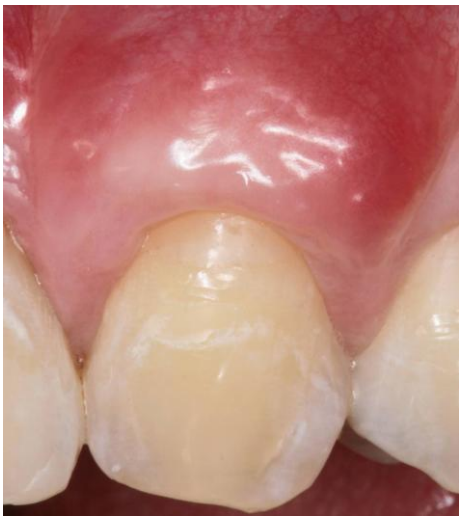

Fig 8. Clinical outcome after 6 month of CTG+R site.

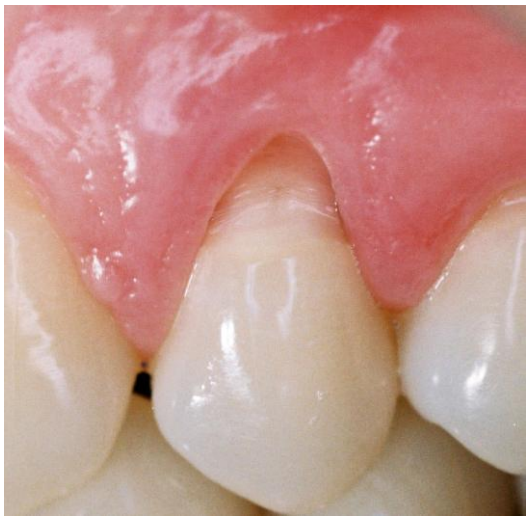

Fig 9. Preoperative view of CTG site.

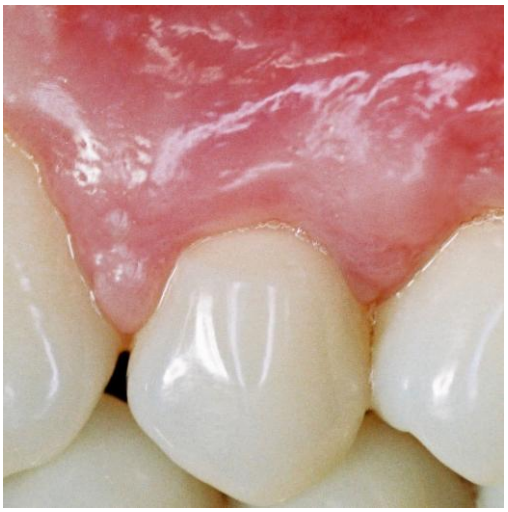

Fig 10. Clinical outcome after 6 month of CTG site.

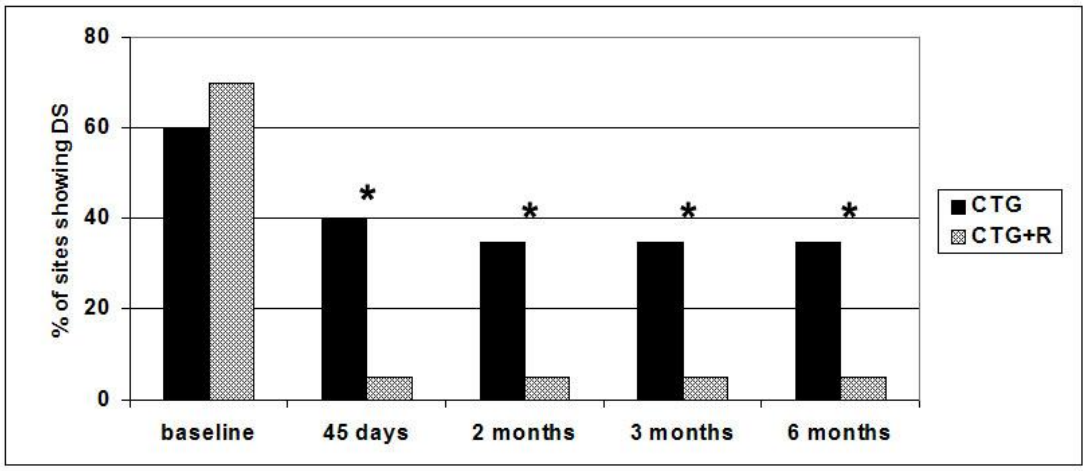

Fig 11. Percentage of dentin sensitivity occurrence. The two groups presented statistically significant reduction in DS after the treatment

* Statistically significant difference between groups ($p<0.05$) by Chi-square test. CTG+R, connective tissue graft plus resin-modified glass ionomer restoration group; CTG connective tissue graft group; DS, dentin sensitivity.

3.3 Capítulo 3

The influence of local anatomy on the outcome of treatment of gingival recession associated with non-carious cervical lesion by different approaches.

Authors:

Mauro Pedrine Santamaria – DDS, MS*.

Gláucia Maria Bovi Ambrosano – MS, PhD Professor**.

Marcio Zaffalon Casati - DDS, MS, PhD, Assistant Professor*.

Francisco Humberto Nociti Júnior - DDS, MS, PhD, Professor*.

Antônio Wilson Sallum - DDS, MS, PhD, Professor*.

Enilson Antônio Sallum - DDS, MS, PhD, Professor*.

* Dept. of Prosthodontics and Periodontics, Division of Periodontics, Piracicaba Dental School, University of Campinas - UNICAMP, São Paulo, Brazil.

** Dept of Social Dentistry, Division of Biostatistics, Piracicaba Dental School, University of Campinas - UNICAMP, São Paulo, Brazil.

Corresponding Author:

ENILSON ANTONIO SALLUM

Department of Periodontics and Prosthodontics, Piracicaba Dental School

Av. Limeira, 901, Areião, Piracicaba, São Paulo, Brazil

Cep.13414-903 e-mail: easallum@fop.unicamp.br

Tel: +55 19 21065301 Fax: +55 19 21065301

Tables: 5

Figures: 3

Short title: Anatomical aspects and outcome of treatment of combined defects

Key words: Gingival recession/surgery; surgical flap; cementoenamel junction; glass ionomer cement; tooth abrasion; gingiva/anatomy and physiology.

ABSTRACT

Background: The aim of the present study was to evaluate the possible influence of local anatomy on the amount of soft tissue coverage and gain of clinical attachment level achieved by the use of coronally advanced flap alone (CAF), CAF plus restoration (CAF+R), subepithelial connective tissue graft alone (CTG), and CTG plus restoration (CTG+R), to treat gingival recession associated with non-carious cervical lesion.

Methods: Seventy eight combined defects (gingival recession associated with non-carious cervical lesion) were included. The defects received one of the following treatments: CAF, CAF+R, CTG or CTG+R. The reduction in the relative gingival recession ($\Delta RGR = RGR_f - RGR_{T0}$) and the gain in clinical attachment level ($\Delta CAL = CAL_f - CAL_{T0}$) after six months were correlated with non-carious cervical lesion height (CLH), non-carious cervical lesion width (CLW), non-carious cervical lesions depth (CLD), keratinized tissue width (KTW), keratinized tissue thickness (KTT), adjacent papillae width (PW), adjacent papillae height (PH), bone level (BL) and post-surgical position of the gingival margin (PGM) using Stepwise Multivariate Linear Regression.

Results: The cervical lesion height (CLH) was statistically correlated with ΔRGR when CAF (P=0.02) and CTG+R (P=0.0002) were analyzed. Additionally, it was statistically correlated with ΔRGR when overall data (P= 0.005) from CTG group (CTG and CTG+R) was analyzed. The cervical lesion depth (CLD) was significantly correlated with ΔRGR, when considering data from the CAF group (P=0.0045), however with a moderate correlation in this group (R^2=0.51). The bone level (BL) was statistically correlated with ΔRGR when evaluating the CTG group (P=0.02 and R^2=0.63). Additionally, the bone level presented significant correlation with ΔCAL when considering the CTG (P=0.01) and when the overall data (P=0.04) from CAF (CAF and CAF+R) was considered.

Conclusion: Within the limits of the present study, it can be concluded that the non-carious cervical lesion depth may influence gingival

recession reduction when the coronally advanced flap is performed to treat the combined defect. Additionally, bone level (BL) may not negatively influence the amount of recession reduction provided by the coronally advanced flap or the connective tissue graft technique.

INTRODUCTION

Gingival recession is a common problem that affects a large number of individuals. It is frequently associated with esthetic concerns and dentin hypersensitivity. In attempting to deal with this problem, several surgical techniques have been developed, each showing good predictability and high rates of success [1]. Miller [2] proposed a classification of the gingival recessions based mainly on the bone and soft tissue level of the proximal sites of the tooth presenting the recession. According to Miller, the recessions are classified as Class I and Class II when no loss of bone and soft tissue are observed in the proximal area of the tooth affected by the recession and 100% of root coverage can be anticipated in these cases.

Many studies available in the literature have confirmed that Miller's Class I and Class II recessions can be predictably covered by soft tissue after surgical techniques such as the coronally advanced flap (CAF), connective tissue graft (CTG), and other pedicle flaps [3]. However, even when the same surgical technique is used, a great variability in terms of root coverage and complete root coverage (CRC) is observed. This could be a result, in part, from the influence of the local anatomical characteristics of each site. Previous reports have shown that local characteristics, such as tissue thickness apically to the recession [4], and the dimension of the adjacent papillae [5], may have some influence on the frequency of complete root coverage achieved by CAF. Additionally, some conditions that can be controlled by the surgeon during the procedure, such as flap tension [6] and the position of the flap just after the sutures [7] may also interfere in the final outcome of CAF.

Recently, gingival recession, associated with non-carious cervical lesion, has been treated using different approaches, such as CAF alone, CAF plus resin modified glass ionomer or composite resin, CTG alone, and CTG plus resin modified glass ionomer [8, 9, 10, 11]. The association of non-carious cervical lesion and gingival recession, occurring concurrently in the same tooth, can be seen in about 50% of teeth presenting gingival recession [12, 13] and leads to a combined defect that may have a different prognosis regarding soft tissue coverage after periodontal surgery. It has been shown that CAF may not be able to completely cover the entire extension of the combined defect and that different percentages of coverage may be achieved with such lesions [9, 10, 11, 14] . Additionally, different approaches have resulted in different amounts of non-carious cervical lesion coverage [10, 11]. The influence of the local anatomy on the outcome of treatment of these combined lesions remains to be explored. Thus, the objective of the present study was to assess the possible influence of local anatomical characteristics on the amount of coverage achieved (resulting in relative gingival recession reduction) and on the gain of clinical attachment level using two different surgical approaches to treat gingival recession, associated with non-carious cervical lesion.

MATERIALS AND METHODS

The present study was conducted in 78 combined defects (gingival recession associated with non-carious cervical lesion) included in two previously published studies [10, 11]. The defects were randomly assigned to receive the following treatments:

- 19 defects received coronally advanced flap alone (CAF) and 19 received the coronally advanced flap plus resin-modified glass ionomer restoration (CAF+R) [10]

- 20 defects received connective tissue graft alone (CTG) and 20 received connective tissue graft plus resin-modified glass ionomer restoration (CTG+R) [11]

Before the beginning of each study, consent forms and study protocols were approved by the Institutional Review Board of the University of Campinas.

Informed consent was signed by each subject after a thorough explanation regarding the nature, risks and benefits of the clinical investigation and associated procedures.

Study Population

Fifty nine patients, 30 males and 29 females, aged 19 to 71 years (mean age 36.25 ± 14.2 years) were included. The subjects were selected from the group of patients referred for periodontal treatment at the Graduate Clinic of the Piracicaba Dental School, University of Campinas. The patients were selected from December 2005 to February of 2007, according to the following eligibility criteria:

1. Presence of one Class I Miller gingival recession, associated with non-carious cervical lesion 1-2mm deep in maxillary canines or premolars.
2. Non-smokers.
3. Systemically and periodontally healthy.
4. No contraindication for periodontal surgery.
5. Had not taken medications known to interfere with periodontal tissue health and healing.
6. Probing depth < 3mm without bleeding on probing.
7. Tooth vitality, absence of restoration on cervical area, and absence of severe occlusal interferences in the area to be treated.
8. No previous periodontal surgery in the area.

The patients were referred for periodontal treatment based on their complaints (dentin sensitivity and/or esthetic concerns). Considering that a non-carious cervical lesion may be a consequence of a multifactorial process including tooth structure loss caused by nonbacterial acids (erosion), traumatic tooth brushing (abrasion) and occlusal loading (abfraction), all patients were included in a pre-treatment program in order to eliminate the possible etiologic factors related to non-carious cervical lesion and gingival recession. Oral hygiene instructions with a non-traumatic brushing technique and a soft toothbrush were given. Patients were also encouraged to avoid excessive consumption of acidic beverages or acidic foods. When necessary, selective grinding was performed to

remove oclusal interferences on the teeth included in the study. Scaling, root planning and crown polishing were performed as necessary.

Clinical assessments

After this initial therapy, the following parameters were recorded:

1) Full-mouth visible plaque index [15] (FMPI) and presence or absence of visible plaque accumulation at the site included in the study (PI);

2) Full-mouth sulcus bleeding index [16] (FMBI) and presence or absence of bleeding on probing at the site included in the study (BOP);

3) Probing depth (PD), assessed as the distance from the gingival margin to the apical end of the gingival sulcus;

4) Relative gingival recession (RGR), measured as the distance from the gingival margin to the incisal border of the tooth;

5) Relative clinical attachment level (CAL), defined as PD + RGR;

6) Non-carious cervical lesion height (CLH), defined as the distance between the coronal and apical margins of the non-carious cervical lesion;

7) Non-carious cervical lesion width (CLW), defined as the distance between the mesial and the distal margins, at the level of the incisal border of the non-carious cervical lesion;

8) Non-carious cervical lesions depth (CLD), defined as the distance between the deepest point on the facial wall of the non-carious cervical lesion and the apical projection of the most external point of the incisal border of the non-carious cervical lesion. This parameter was measured using an endodontic spreader, a silicone stop and a digital caliper;

9) Keratinized tissue width (KTH), measured as the distance from the gingival margin to the mucogingival junction;

10) Keratinized tissue thickness (KTT). This parameter was measured using a pierced endodontic spreader, perpendicular to a midpoint location between the gingival margin and mucogingival junction and through the soft tissue with light pressure until a hard surface was felt. The silicone stop was then placed in tight

contact with the external soft tissue surface. After carefully removing the spreader, penetration depth was measured with a digital caliper;

11) Adjacent papillae width (PW), mesial and distal papilla width were measured along the imaginary line connecting the incisal border of the non-carious cervical lesion of the involved tooth with the adjacent teeth. An average was obtained using the values of the mesial and the distal papilla width, and this average was considered as the PW value for each tooth.

12) Adjacent papillae height (PH), the mesial and distal papilla heights were measure as the distance between the midpoint of the imaginary line connecting the incisal border of the non-carious cervical lesion of the involved tooth to the adjacent teeth and the tip of the papilla. As for the papilla width parameter, an average was obtained, and was considered as the PH.

13) Bone level (BL), defined as the distance between the most apical part of the bone crest at the facial aspect of the involved tooth and the incisal border of the non-carious cervical lesion. This parameter was measured during the surgical procedure, just after the elevation of the flap.

14) Post-surgical position of the gingival margin (PGM), defined as the distance between the gingival margin and the incisal border of the tooth, in order to measure the position of the gingival margin just after the placement of the final suture. Figures 1 and 2 schematically depict the measurements.

The probing depth, the bone level, and the post-surgical position of the gingival margin were measured using a manual periodontal probe[†]. The relative gingival recession, non-cervical lesion height, non-cervical lesion width, keratinized tissue width, adjacent papillae width, and adjacent papillae height were measured using a pair of dividers[‡] and a digital caliper[§] with 0.01-mm precision. All the parameters were measured at the baseline and the PI, BOP, PD, RGR, CAL were measured at baseline, 45 days, 2, 3, and 6 months after surgery.

Reproducibility of these measurements has been addressed in previously published papers [10, 11]. Prior to the beginning of studies, the examiner (MPS) measured the probing depth and relative gingival recession of all patients, twice,

within 24 hours, with at least 1 hour between the examinations. The examiner was judged to be reproducible after fulfilling the pre-determined success criteria. The Kappa index was calculated for the probing depth, resulting in 91% of reproducibility and the Intra-class correlation was calculated for relative gingival recession, resulting in 89% of agreement. Blinding of the examiner was not possible, since it was possible to observe whether the glass ionomer restoration was applied at the site.

Surgical procedures

All the surgical procedures were carried out by one operator (EAS). The sites were randomly assigned to one of the following treatments:

- Coronally advanced flap alone (CAF)
- Coronally advanced flap plus resin-modified glass ionomer restoration (CAF+R)
- Connective tissue graft alone (CTG)
- Connective tissue graft plus resin-modified glass ionomer restoration (CTG+R)

After local anesthesia‖, an intrasulcular incision was made at the buccal aspect of the involved tooth. Two horizontal incisions were made at right angles to the adjacent interdental papillae, 1-mm apically to the level of the coronal border of the non-carious cervical lesion, without interfering with the gingival margin of neighboring teeth. Two oblique vertical incisions were extended beyond the mucogingival junction and a trapezoidal mucoperiosteal flap was raised up to the mucogingival junction. After this point, a split-thickness flap was extended apically, releasing the tension and favoring the coronal positioning of the flap. On the teeth that were selected for the group without restoration, the root and non-carious cervical lesion were planed with a finishing bur¶ and curettes until the tooth surface became smooth. On the teeth selected to receive the CAF, the flap was pulled in such a way as to cover the entire non-carious cervical lesion height and was then sutured. In the CTG, a connective tissue graft was harvested from the palate using a scalpel with parallel blades (1.5 mm distance from each other) and was placed

covering the entire non-carious cervical lesion. The flap was coronally positioned covering the graft and sutured. On the teeth selected to receive restoration, a sterile rubber dam was placed to isolate the operative field and the non-carious cervical lesion restoration was performed with resin-modified glass ionomer cement[#], following the manufacturer's instructions. The restoration was performed in order to reestablish the entire defect caused by the cervical wear. Afterwards, the epithelium on the adjacent papillae was stripped away and the flap was sutured to cover the entire restoration (CAF+R). On the teeth enrolled in the CTG+R, the graft was harvested using the same method and was placed in such a way to cover the entire restoration. The flap was then coronally positioned and sutured[††] to completely cover the graft.

Post-operative care

Patients were instructed to take analgesics (500 mg sodium dipyrone every 6 hours for 2 days) and were instructed to discontinue toothbrushing around the surgical sites during the initial 30 days after surgery. During this period, plaque control was achieved with a 0.12% chlorhexidine solution rinse used twice a day. After this period, gentle toothbrushing with a soft-bristle toothbrush was allowed.

Sutures were removed after 7 days and the patients were enrolled in a periodontal maintenance program (professional plaque control and oral hygiene instruction) weekly during the first month, and monthly during the following 6 months.

Statistical analysis

Descriptive statistics were expressed as mean ± standard deviation (SD). The values of each local anatomical factor were compared by intergroup analysis, according to the surgical technique performed. The Shapiro-Wilk test was used to evaluate normality. When CAF was used (CAF and CAF+R), the Paired t-test was applied if the normality test demonstrated normal distribution, and the Wilcoxon Signed Rank Test was used when normality failed. When CTG was used (CTG and CTG+R), the t-test was used if the normality test demonstrated normal distribution, and the Mann-Whitney Rank Sum Test was used when normality

failed. The reduction in the relative gingival recession ($\Delta RGR = RGR_f - RGR_{T0}$) and the gain in clinical attachment level ($\Delta CAL = CAL_f - CAL_{T0}$) after six months ($RGR_f$ and CAL_f) was calculated for each group and correlated with non-carious cervical lesion height (CLH), non-carious cervical lesion width (CLW), non-carious cervical lesions depth (CLD), keratinized tissue width (KTW), keratinized tissue thickness (KTT), adjacent papillae width (PW), adjacent papillae height (PH), bone level (BL) and post-surgical position of the gingival margin (PGM) using Stepwise Multivariate Linear Regression analysis in order to evaluate whether these parameters play a role in the amount of soft tissue coverage achieved and in the clinical attachment level gain observed for each modality of treatment performed. The existence of the multicolinearity was verified by evaluating the correlations between independent variables. In order to choose the best model, the Mallows' C(p) analysis was used [17]. All analyses were made using the SAS software‡‡.

RESULTS

The probing depth, relative gingival recession and relative clinical attachment, keratinized tissue width (KTW) and the keratinized tissue thickness (KTT) have been previously reported [10, 11]. These earlier studies showed that all groups presented a statistically significant reduction in relative gingival recession (ΔRGR) and in the gain of clinical attachment level (ΔCAL). Overall, there were no statistically significant differences between the CAF and CAF+R and between CTG and CTG+R.

The mean value of non-carious cervical lesion height (CLH), non-carious cervical lesion width (CLW), non-carious cervical lesions depth (CLD), keratinized tissue width (KTW), keratinized tissue thickness (KTT), adjacent papillae width (PW), adjacent papillae height (PH), bone level (BL), and post-surgical position of the gingival margin (PGM) are shown in Table 1. These values were correlated with the reduction in the relative gingival recession (ΔRGR) and with the clinical attachment level gain (ΔNIC) using multiple linear regression analysis.

Anatomical factors *vs* clinical outcomes

The results of the multiple linear regression analyses for the reduction in relative gingival recession are reported in Tables 2 and 3. Analyses for clinical attachment level gain are reported in Tables 4 and 5.

Correlation of CAF and CAF+R's parameters with ΔRGR

When the coronally advanced flap was applied, keratinized tissue width was statistically correlated with the reduction in the relative gingival recession using the overall data (P=0.01) and when the values from CAF+R were analyzed (P=0.01). However, the correlation was weak for both (R2=0.12 for overall data and R2=0.28 for CAF+R). The cervical lesion height and the cervical lesion depth were significantly correlated to *ΔRGR,* when considering data from the CAF group (P=0.02 and P=0.0045, respectively). Both parameters showed a moderate correlation in this group (R^2=0.51) (Table 3). Figure 3 shows a dispersion graph demonstrating the correlation between the cervical lesion depth (CLD) and the reduction in the gingival recession in the CAF group

Correlation of CAF and CAF+R's parameters with ΔCAL

Bone level was significantly correlated with *ΔCAL* when the overall data (P=0.04) was considered. No other parameter correlated with ΔCAL, when CAF was used.

Correlation of CTG and CTG+R's parameters with ΔRGR

The cervical lesion height and the bone level were significantly correlated to *ΔRGR,* when considering overall data (P= 0.005 and P=0.0006, respectively and R^2=0.53). Additionally, the bone level presented a significant moderate correlation with *ΔRGR,* when evaluating the CTG group (P=0.02 and R^2=0.63). The cervical lesion height significantly correlated with *ΔRGR,* when considering the CTG+R group (P=0.0002, respectively, and R^2=0.55).

Correlation of CTG and CTG+R's parameters with ΔCAL

Only the bone level presented a significant correlation with *ΔCAL* when considering the CTG group (P=0.01 and R^2=0.30). No other parameter showed a significant correlation.

DISCUSSION

The objective of the present study was to evaluate whether any of the anatomical parameters measured would be correlated to gingival recession reduction and gain of the clinical attachment level, when the coronally advanced flap or connective tissue graft techniques were used to treat gingival recession associated with non-carious cervical lesion. These 9 anatomical characteristics (CLH, CLW, CLD, KTW, KTT, PW, PH, BL, and PGM) were carefully measured during the course of two previously published studies [10, 11] and the results of these correlations are presented now.

Previous studies have suggested that some local anatomical characteristics can be used as prognostic factors for root coverage. Baldi et al [4] showed that the tissue thickness adjacent to the recession may play an important role in root coverage, reporting that if the gingival tissue is thicker than 0.8mm, the case would have a better prognosis. This observation was confirmed later by Berlucchi et al [18]. The same group showed that the position of the gingival margin just after the sutures may also influence the final outcome, suggesting that if the flap is sutured more coronally, greater coverage could be achieved [7, 19]. In the present study, these two parameters were evaluated, i.e., the thickness of the flap and the position of the gingival margin after the suture. However, no correlation between these two parameters and the reduction in gingival recession was observed for either surgical technique. Conversely, the keratinized tissue width was significantly correlated with the reduction in gingival recession when overall data (CAF and CAF+R) and CAF+R were analyzed. However, these correlations were low (R^2=0.12; R^2=0.28, respectively).

One interesting observation found in the present study was a statistically significant correlation among the characteristics of the cervical lesion and the

reduction in the recession. A significant correlation between the cervical lesion height (CLH) and the reduction in gingival recession was observed after the use of either the coronally advanced flap or the connective tissue graft technique. It can be speculated that, for larger defects, a greater absolute reduction in the gingival recession may be achieved, although complete coverage of the defect may not necessarily be accomplished. Nieri et al[19] reported that for larger recessions, lower rates of complete coverage are achieved. This observation may also be valid when gingival recession is associated with non-carious cervical lesion. When these two defects are concurrent, part of the tooth crown, just above the CEJ, is destroyed by the non-carious cervical lesion and may represent the most coronal zone of the combined defect. This condition turns the complete coverage of the combined lesion unpredictable. Previous data [10, 11] support this statement, since only 7 out of 78 sites presented complete coverage of the defect.

Another interesting observation is the statistically significant correlation ($P=0.0045$; $R^2=0.51$) seen between the cervical lesion depth (CLD) and the reduction in gingival recession when the coronally advanced flap was applied alone (without the restoration). Data show that the deeper the cervical lesion, the greater the coverage in the CAF group. The explanation for this finding may lie in the absence of root convexity when the non-carious cervical lesion is present concurrently with the recession. According to Miller [20], the excessive convexity of the root surface may negatively influence the amount of root coverage. Thus, the presence of the cervical lesion may eliminate the excessive convexity of the root and the flap could be well adapted and sutured without tension. Figure 3 shows a dispersion graph demonstrating the correlation between the cervical lesion depth (CLD) and the reduction in the gingival recession in the CAF group. However, the same correlation could not be observed when the connective tissue graft was applied.

The distance between the bone crest and the incisal border of the non-carious cervical lesion, which represents the bone level parameter (BL), was significantly correlated to the reduction in the relative gingival recession when

overall data and CTG group were analyzed (P=0.0006 and R^2=0.53 for overall data and P=0.02 and R^2=0.63 for CTG group). This finding may confirm the positive correlation between the cervical lesion height and the amount of recession reduction, as discussed previously, since larger recessions are associated with a greater distance between the bone crest and the incisal border of the cervical lesion [21]. This observation could indicate that bone dehiscence does not negatively interfere in root coverage, corroborating previous reports [22, 23].

Parameters relating to the adjacent papillae (PW and PH) did not show any correlation with coverage. The papillae height was measured as the distance between the incisal border of the non-carious cervical lesion and the tip of the papilla. In the present study, only Miller Class I recessions were included, signifying that, in all cases, the tip of the papilla was just below the contact point. It can be assumed that for lower papilla heights, the incisal border of the non-carious cervical lesion is closer to the contact point. This condition may suggest that the non-carious cervical lesion affects a large zone of the crown and, as a consequence, not much coverage would be expected. However, regression analysis did not show any correlation, probably because of the small sample size of the present study.

Within the limits of the present study, it can be concluded that the non-carious cervical lesion depth (CLD) may influence gingival recession reduction when the coronally advanced flap is selected to treat the combined defect. Additionally, bone dehiscence (BL) may not negatively influence the amount of recession reduction provided by the coronally-advanced flap or the connective tissue graft technique. The keratinized tissue height (KTH) showed significant correlation when the coronally-advanced flap was used, however with a low R^2. Caution should be exercised when considering the findings of the present study due to the small sample size. Studies with larger sample sizes are needed in order to evaluate whether other local anatomical factors could have some influence on the outcomes of the treatment of this combined defect.

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FOOTNOTES

† Hu-Friedy, Jacarepagua, Rio de Janeiro, Brazil.

‡ Dentaurum, nº 030-395, Ispringen, Germany

§ Absolute, Mitutoyo Sul Americana, Suzano, Brazil.

‖ Alphacaine –2% Lidocaine with 1:100.000 Epinephrine,DFL, Rio de Janeiro, RJ,Brazil.

¶ KG Sorensen 9803FF, São Paulo, Brazil

Vitremer - 3M ESPE, St. Paul, MN, USA

†† 6.0 Polygalactin 910 (Vicryl), Ethicon INC, São José dos Campos, Brazil.

‡‡ SAS 9.01, SAS Institute, Cary, NC.

Tables

Table 1. Mean ± standard deviation values the local anatomical factors at the baseline of all groups (mm).

	CAF Groups			CTG Groups		
	CAF	**CAF+R**	***P value***	**CTG**	**CTG+R**	***P value***
CLH	2.6±0.39	2.63±0.57	0.67	3.22±0.52	3.27±0.68	0.81
CLW	4.1±0.72	3.82±0.89	0.38	4.15±0.5	4.28±0.55	0,44
CLD	1.05±0.3	--	--	0.92±0.26	--	--
KTT	1.1±0.18	1.06±0.2	0,18	0.9±0.23	0.85±0.19	0.48
KTW	3.05±0.86	2.86±0.85	0,66	2.38±1.22	2.54±1.17	0.43
PH	3.88±1.43	3.97±1.12	0.84	3.72±0.85	4.02±1.21	0,39
PW	3.29±0.62	3.25±0.59	0,92	3.7±0.77	3.66±0.67	0.80
BL	5.50±1.81	5.92±2.25	0.37	6.01±1.09	5.93±0.98	0.34
PMG	8.18±1.5	7.92±0.94	0.43	8.1±1.2	8.1±1.52	0.93

CAF, coronally advanced flap group; CAF+R, coronally advanced flap plus restoration group; CTG, connective tissue graft group; CTG+R connective tissue graft plus restoration group; CLH non-carious cervical lesion height; CLW, non-carious cervical lesion width; CLD, non-carious cervical lesion depth; KTT, keratinized tissue thickness; KTW, keratinized tissue width, PH papilla height; PW, papilla width; BL, bone level; PMG post-surgical position of the gingival margin.

Table 2. Multiple linear regression analysis for CAF and CAF+R when ΔRGR was correlated with the local anatomical factors.

Group	estimate	SE	P level	R2	F	P
CAF and CAF+R						
Intercept	1.94	0.21	<0.0001			
KTW	0.16	0.06	0.0174	0.12	6.21	0.0174
CAF+R						
Intercept	2.05	0.27	<0.0001			
KTW	0.25	0.09	0.0115	0.28	8.02	0.0115
CAF						
Intercept	0.44	0.47	0.3553			
CLH	0.43	0.18	0.0287	0.51	5.71	0.0287
CLD	0.58	0.20	0.0045			

CAF, coronally advanced flap group; CAF+R, coronally advanced flap plus restoration group; CTG, connective tissue graft group; CTG+R connective tissue graft plus restoration group; ΔRGR, reduction of the gingival recession; CLH non-carious cervical lesion height; CLD, non-carious cervical lesion depth; KTW, keratinized tissue width.

Table 3. Multiple linear regression analysis for CTG and CTG+R when ΔRGR was correlated with the local anatomical factors.

Group	estimate	SE	P level	R2	F	P
CTG e CTG+R						
Intercept	-1.99	0.68	0.0063			
CLH	0.48	0.16	0.0050	0.53	22.55	<0.0001
BL	0.20	0.05	0.0006			
CTG						
Intercept	-2.48	0.92	0.0157			
CLW	0.60	0.31	0.0722	0.63	17.16	<0.0001
BL	0.17	0.06	0.0219			
CTG+R						
Intercept	-0.35	0.57	0.5506	0.55	23.49	0.0002
CLH	0.82	0.17	0.0002			

CAF, coronally advanced flap group; CAF+R, coronally advanced flap plus restoration group; CTG, connective tissue graft group; CTG+R connective tissue graft plus restoration group; ΔRGR, reduction of the gingival recession; CLH non-carious cervical lesion height; CLW, non-carious cervical lesion width; BL, bone level.

Table 4. A Multiple linear regression analysis for CAF and CAF+R when ΔCAL was correlated with the local anatomical factors.

Group	estimate	SE	P level	R2	F	P
CAF and CAF+R						
Intercept	-1.21	1.27	0.3485			
BL	0.20	0.10	0.0425	0.08	4.43	0.0425
CAF+R						
Intercept	-0.10	1.67	0.9524			
BL	0.22	0.10	0.0504	0.23	3.70	0.0477
PW	-0.43	0.25	0.1141			
CAF						
	No variable met the 0.1500 significance level for entry into the model.					

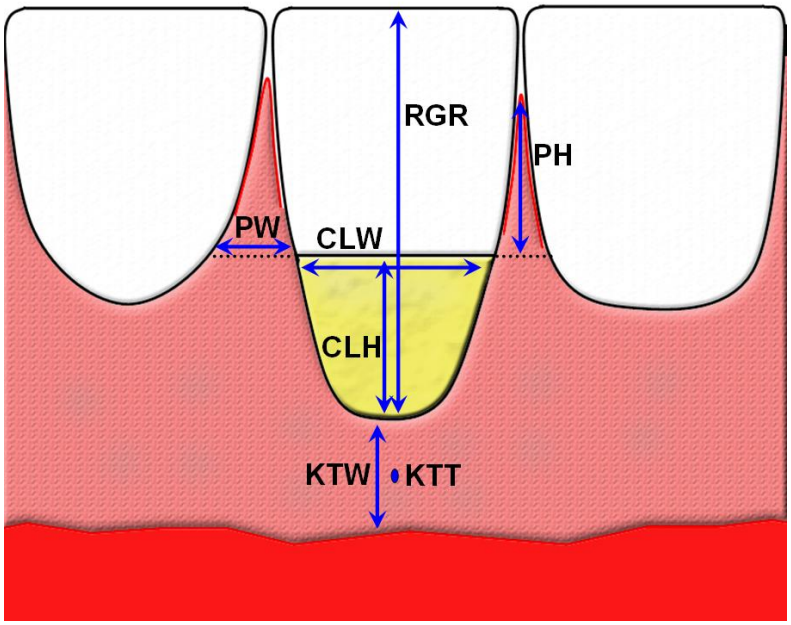
CAF, coronally advanced flap group; CAF+R, coronally advanced flap plus restoration group; CTG, connective tissue graft group; CTG+R connective tissue graft plus restoration group; ΔCAL, clinical attachment level gain; PW, papilla width; BL, bone level.

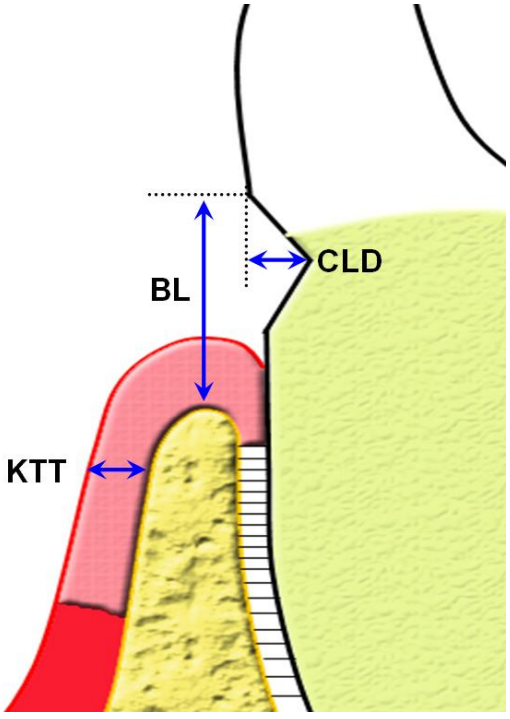
Table 5. Multiple linear regression analysis for CTG and CTG+R when ΔCAL was correlated with the local anatomical factors.

Group	estimate	SE	P level	R2	F	P
CTG e						
CTG+R						
Intercept	0.02	0.72	0.9739			
CLH	0.62	0.30	0.0612	0.0612	5.71	0.0070
CTG						
Intercept	-0.09	1.03	0.9282			
BL	0.18	0.06	0.0111	0.30	5.18	0.0175
KTT	-0.98	0.60	0.1186			
CTG+R						
Intercept	1.98	0.50	0.001	0.08	2.56	0.1280
KTW	-0.29	0.18	0.1280			

CAF, coronally advanced flap group; CAF+R, coronally advanced flap plus restoration group; CTG, connective tissue graft group; CTG+R connective tissue graft plus restoration group; ΔCAL, clinical attachment level gain; CLH non-carious cervical lesion height; KTT, keratinized tissue thickness; KTW, keratinized tissue width; BL, bone level.

Figures





Figures 1 and 2. Schematic drawings illustrating the clinical anatomical characteristics measured at the buccal aspect of the defect

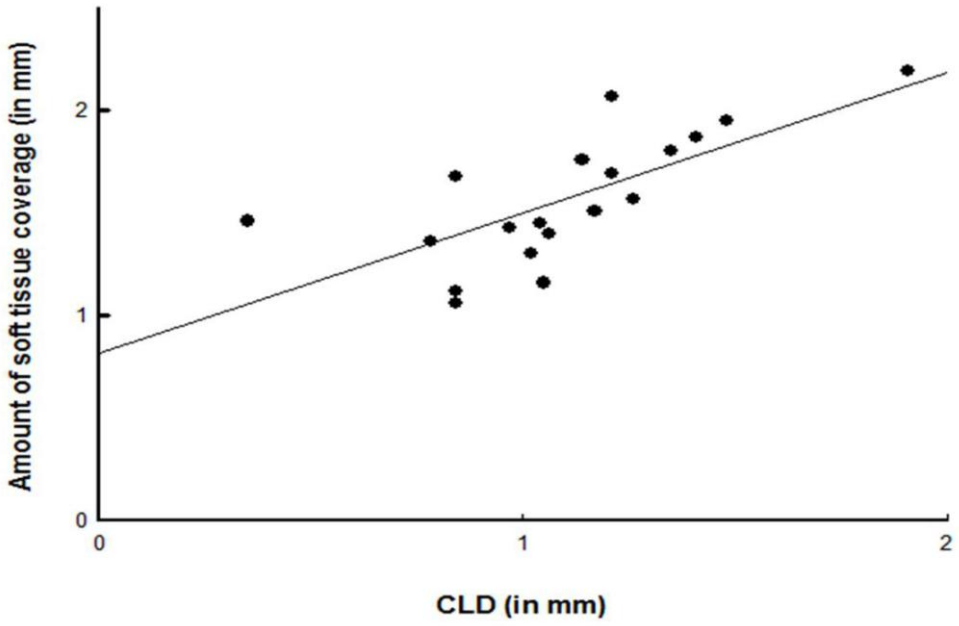


Figure 3. Dispersion graph showing the correlation between the cervical lesion depth (CLD) and the reduction of the gingival recession in the CAF group

4. Conclusão

Dentro dos limites desse estudo, pode-se concluir que:

1. A restauração de ionômero de vidro modificado por resina parece não interferir na saúde do tecido gengival nem no recobrimento da lesão combinada após a utilização de CAF ou CTG no tratamento da lesão combinada.
2. Quando os fatores anatômicos locais foram avaliados, a profundidade da lesão cervical parece exercer uma influência no recobrimento da lesão combinada quando o CAF é empregado de forma isolada, e a altura da crista óssea parece não influenciar no recobrimento quando CTG é utilizado. O resultado obtido com a técnica de enxerto de tecido conjuntivo parece ser menos sensível aos fatores anatômicos locais.

5. Referência*

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* De acordo com a norma da UNICAMP/FOP, baseada na norma do International Committee of Medical Journal Editors – grupo Vancouver. Abreviatura dos peródicos em conformidade com o Medline.

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COMITÊ DE ÉTICA EM PESQUISA
FACULDADE DE ODONTOLOGIA DE PIRACICABA
UNIVERSIDADE ESTADUAL DE CAMPINAS

CERTIFICADO

O Comitê de Ética em Pesquisa da FOP-UNICAMP certifica que o projeto de pesquisa "**Cirurgia periodontal associada à restauração de ionômero de vidro modificado por resina para tratamento de dentes com recessão gengival e lesão cervical não-cariosa**", protocolo nº **104/2005**, dos pesquisadores **MAURO PEDRINE SANTAMARIA e ENILSON ANTONIO SALLUM**, satisfaz as exigências do Conselho Nacional de Saúde – Ministério da Saúde para as pesquisas em seres humanos e foi aprovado por este comitê em 07/02/2006.

The Research Ethics Committee of the School of Dentistry of Piracicaba - State University of Campinas, certify that project "**Periodontal surgery associaded with a resin glass ionomer restoration to treat teeth with gingival recession and noncarious cervical lesion**", register number **104/2005**, of **MAURO PEDRINE SANTAMARIA and ENILSON ANTONIO SALLUM**, comply with the recommendations of the National Health Council – Ministry of Health of Brazil for researching in human subjects and was approved by this committee at 07/02/2006.

Cínthia Pereira Machado Tabchoury
Secretária
CEP/FOP/UNICAMP

Jacks Jorge Júnior
Coordenador
CEP/FOP/UNICAMP

Nota: O título do protocolo aparece como fornecido pelos pesquisadores, sem qualquer edição.
Notice: The title of the project appears as provided by the authors, without editing.

Journal of Clinical Periodontology

J Clin Periodontol 2009; 36: 434–441 doi: 10.1111/j.1600-051X.2009.01389.x

Journal of Clinical Periodontology

Cervical restoration and the amount of soft tissue coverage achieved by coronally advanced flap: A 2-year follow-up randomized-controlled clinical trial

Mauro Pedrine Santamaria, Daniela da Silva Feitosa, Francisco Humberto Nociti Jr., Marcio Zaffalon Casati, Antonio Wilson Sallum and Enilson Antônio Sallum

Department of Prosthodontics and Periodontics, Division of Periodontics, Piracicaba Dental School, University of Campinas – UNICAMP, São Paulo, SP, Brazil

Santamaria MP, Feitosa DS, Nociti Jr. FH, Casati MZ, Sallum AW, Sallum EA. Cervical restoration and the amount of soft tissue coverage achieved by coronally advanced flap: A 2-year follow-up randomized controlled clinical trial. J Clin Periodontol 2009; 36: 434–441. doi: 10.1111/j.1600-051X.2009.01389.x.

Abstract

Background: The aim of this study was to evaluate the 2-year follow-up success of the treatment of gingival recession associated with non-carious cervical lesions by a coronally advanced flap (CAF) alone or in combination with a resin-modified glass ionomer restoration (CAF+R).

Material and Methods: Sixteen patients with bilateral Miller Class I buccal gingival recessions, associated with non-carious cervical lesions, were selected. The defects received either CAF or CAF+R. Bleeding on probing (BOP), probing depth (PD), relative gingival recession (RGR), clinical attachment level (CAL) and cervical lesion height (CLH) coverage were measured at the baseline and 6, 12 and 24 months after the treatment.

Results: Both groups showed statistically significant gains in CAL and soft tissue coverage. The differences between groups were not statistically significant in BOP, PD, RGR and CAL, after 2 years. The percentages of CLH covered were $51.57 \pm 17.2\%$ for CAF+R and $53.87 \pm 12.6\%$ for CAF ($p > 0.05$). The estimated root coverage was $80.37 \pm 25.44\%$ for CAF+R and $83.46 \pm 20.79\%$ for CAF ($p > 0.05$).

Conclusion: Within the limits of the present study, it can be concluded that both procedures provide acceptable soft tissue coverage after 2 years, with no significant differences between the two approaches.

Key words: cemento-enamel junction; gingival recession/surgery; glass ionomer cement; surgical flap; tooth abrasion

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Conflict of interest and source of funding statement

The authors report no conflicts of interest related to this study.

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Owing to the reduction of caries prevalence in several populations, teeth are functional for longer periods. This may expose the teeth to conditions other than caries and, as a consequence, different problems can arise. Gingival recession is an apical shift of the gingival margin with exposure of the root surface (Wennström 1996, Cairo et al. 2008). This is a common finding in patients with a high standard of oral hygiene, as well as in periodontally untreated populations with poor oral hygiene, especially in elderly people (Löe et al. 1992, Serino et al. 1994).

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Journal of Clinical Periodontology

Connective tissue graft plus resin-modified glass ionomer restoration for the treatment of gingival recession associated with non-carious cervical lesion: a randomized-controlled clinical trial

Mauro Pedrine Santamaria[1], Glaucia Maria Bovi Ambrosano[2], Marcio Zaffalon Casati[1], Francisco Humberto Nociti Júnior[1], Antônio Wilson Sallum[1] and Enilson Antônio Sallum[1]

[1]Department of Prosthodontics and Periodontics, Division of Periodontics; [2]Department of Social Dentistry, Division of Biostatistics, Piracicaba Dental School, University of Campinas – UNICAMP, Piracicaba, SP, Brazil

Santamaria MP, Ambrosano GMB, Casati MZ, Nociti Júnior FH, Sallum AW and Sallum EA. Connective tissue graft plus resin-modified glass ionomer restoration for the treatment of gingival recession associated with non-carious cervical lesion: a randomized-controlled clinical trial. J Clin Periodontol 2009; 36: 791–798. doi: 10.1111/j.1600-051X.2009.01441.x.

Abstract

Background: The aim of this clinical study was to evaluate the treatment of gingival recession, associated with non-carious cervical lesions by a connective tissue graft (CTG) alone, or in combination with a resin-modified glass ionomer restoration (CTG+R).

Materials and Methods: Forty patients presenting Miller Class I buccal gingival recessions, associated with non-carious cervical lesions, were selected. The defects were randomly assigned to receive either CTG or CTG+R. Bleeding on probing (BOP), probing depth (PD), relative gingival recession (RGR), clinical attachment level (CAL) and cervical lesion height (CLH) coverage were measured at baseline and 45 days, and 2, 3 and 6 months after treatment.

Results: Both groups showed statistically significant gains in CAL and soft tissue coverage. The differences between groups were not statistically significant in BOP, PD, RGR and CAL, after 6 months. The percentages of CLH covered were $74.88 \pm 8.66\%$ for CTG and $70.76 \pm 9.81\%$ for CTG+R ($p > 0.05$). The estimated root coverage was $91.91 \pm 17.76\%$ for CTG and $88.64 \pm 11.9\%$ for CTG+R ($p > 0.05$).

Conclusion: Within the limits of the present study, it can be concluded that both procedures provide comparable soft tissue coverage. The presence of the glass ionomer restoration may not prevent the root coverage achieved by CTG.

Key words: cemento-enamel junction; gingival recession/surgery; glass ionomer cement; surgical flap; tooth abrasion.

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Conflict of interest and source of funding statement

The authors report no conflicts of interest related to this study.

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During the past few decades, the periodontal literature has presented a huge number of clinical trials aimed to evaluate different surgical approaches for root coverage. It has been recognized that buccal gingival recession, presenting no loss of inter-proximal periodontal attachment and bone (Miller Class I and II), can be predictably covered by a variety of surgical procedures (Roccuzzo et al. 2002, Cairo et al. 2008). The main outcomes of these studies were to evaluate the complete root coverage and percentage of root coverage achieved by the procedures. For this, the cemento-enamel junction (CEJ) was used as the reference point.

It has also been recognized that gingival recession is frequently associated with cervical wear. Sangnes & Gjermo

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The influence of local anatomy on the outcome of treatment of gingival recession associated with non-carious cervical lesion by different approaches.

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Complete List of Authors:	Santamaria, Mauro; Piracicaba Dental School, Department Prosthodontics and Periodontics Ambrosano, Glaucia; University of Campinas - Dental Schoo at Piracicaba, Biostatistics CASATI, MARCIO; Piracicaba Dental School, Department Prosthodontics and Periodontics; Prosthodontics and Periodontics Nociti, Francisco; Piracicaba Dental School, Department Prosthodontics and Periodontics; Faculdade de Odontologia de Piracicaba, Periodontics SALLUM, ANTONIO; Piracicaba Dental School, Department Prosthodontics and Periodontics; School of Dentistry at Piracicaba, Departament of Prosthodontics and Periodontics Sallum, Enilson; School of Dentistry at Piracicaba, Prosthodontics and Periodontics
Key Words:	Connective tissue graft(s), Cosmetic periodontal plastic surgery, Plastic periodontal surgery