Patients' morbidity and root coverage outcomes by means of coronally advanced flap and the application of sub-Eptithelial connective tissue graft with different surgical procedures.

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Summary

Summary

Numerous surgical periodontal techniques have been introduced, over the years, to correct labial, gingival recessions defects. Aesthetic concerns are usually the reason to perform these procedures. The aim of this project was to evaluate by means of an image analysis system the efficacy of two different surgical procedures with and without the use of a sub-epithelial connective tissue graft for the treatment of miller class one and two maxillary gingival recession. Therefore the aim of the first study was to compare the effectiveness of root coverage with coronally advanced flap alone versus a connective tissue graft used in combination with a coronally advanced flap in the treatment of single gingival recessions by analyzing the data with an open source image-processing program.

The result of this study showed better outcomes in terms of recession reduction after 12 months when the coronally advanced flap was combined with the connective tissue graft. Adjunctive application of a connective tissue graft under a coronally advanced flap increased the probability of achieving complete root coverage in maxillary Miller Class I and II defects (61.5% vs. 83.3%, p=0.38). The second article is a case demonstration of the benefit attained using the CAF+CTG in order to meet the patient's needs and fulfilling the clinical outcomes.

More recently, several authors have proposed the application of a connective tissue graft using a tunneling technique, which has recently gained popularity in periodontal mucogingival therapy. However, there is scarce data available regarding postoperative patient-centered outcomes after tunneling technique as compared to other surgical procedures for the treatment of gingival recession. The aim of the second randomized-controlled clinical trial was to compare the patient morbidity and root coverage outcomes

of a connective tissue graft used in combination with a coronally advanced flap or tunneling technique.

Fifty patients completed the study. Healing was uneventful for all test and control patients. The connective tissue graft used in combination with a coronally advanced flap group reported less pain or discomfort in all four sections of the questionnaire: Pain experienced within the mouth as a whole, pain experienced throughout the day, pain experienced at night and edema experienced after the surgery (p=0.002, p=0.001, p=0.001 and p=0,001, respectively). Both treatments showed clinical efficacy in terms of root coverage as no differences per groups were observed in percentage of root coverage (87% vs. 85%, p=704) or patients with complete root coverage (60% vs. 52%, p=0.569).

The tunneling technique is associated with a greater incidence of pain and discomfort compared to the connective tissue graft used in combination with a coronally advanced flap in early postoperative periods, as well as longer chair time. Both treatments showed similar clinical efficacy in terms of root coverage.

The results of this study may influence the surgeon's choice on which root coverage procedure perform considering the need of more chair time and more pain killer assumption with the tunnel technique.

Abbreviations

- Coronally advanced flap: (CAF)
- Connective tissue graft with a coronally advanced flap: (CAF + CTG)
- Complete root coverage: (CRC)
- Root coverage: (RC)
- Recession reduction: (RecRed)
- Keratinized tissue amount: (KT)
- Recession: (REC)
- Probing Depth: (PD)
- Clinical attachment level: (CAL)
- Cemento enamel junction: (CEJ)
- Tunneling technique: (TT)
- Sub-epithelial connective tissue graft: (SeCTG)
- Visual analog scale: (VAS)

Tables

Table 1. Indications for root coverage procedure (with the aim of increasing the lack of KT); (MGS: muco-gingival surgery).

Table 2. Baseline patient and defect-related characteristics

Table 2a. Baseline patient and defect-related characteristics

Table 3. Questionnaire 3 days Post Intervention (Pain/ discomfort evaluation in entire sample) according groups

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Fig. 1: Single RT2 buccal recession. Frontal aspect (*a*) Double oblique releasing incisions (*b*) Soft tissues coronal replacement without any connective tissue graft (*c*) Healing 6 months after surgery (*d*).

Fig. 2: Single RT2 buccal recession. Frontal aspect (*a*) Double oblique releasing incisions and connective tissue graft stabilization (*b*) Healing 6 months after surgery (*c*) Healing 12 months after surgery (*d*).

Fig. 3: Measurement of the gingival recession before treatment. A guide line (AL) joins the most apical point of the buccal margin of the teeth adjacent to treatment site; a second line (TL) parallel to AL indicates the most apical point of the test site buccal margin; a third line (CEJL) parallel to AL joins the CEJ of the tooth needing treatment; a fourth line (REC) measures the recession of the gingival margin. Apico-coronal vertical line (*a*) and the mesio-distal horizontal line (*b*) of the adjacent tooth were chosen as setting parameters to check the reproducibility of each picture.

Fig. 4: Measurement of the gingival recession reduction 12 months after treatment. A guide line (AL) joins the most apical point of the buccal margin of the teeth adjacent to treatment site; a second line (TL) parallel to AL indicates the most apical point of the test site buccal margin; a third line (CEJL) parallel to AL joins the CEJ of the tooth needing treatment; a fourth line (REC 12) measures the recession of the gingival margin. Apico-coronal vertical line (*a*) and the mesio-distal horizontal line (*b*) of the adjacent tooth were chosen as setting parameters to check the reproducibility of each picture.

Fig. 5a.b.c.d:

a: Initial clinical status; b: Sub-epithelial connective tissue graft sutured in place; c: The graft is covered by a coronally advanced flap; d: Clinical stable results at 1 year follow up

Fig. 6a.b.c.d:

a: Miller Class I recession defects on the mandibular left premolars; **b:** Full thickness flap elevation; **c:** the SeCTG is secured in position with continuous sling; **d:** The overlying flap is coronally advanced over the donor tissue covering the latter as much as possible; **e:** Clinically stable results 12 months post interventions

Fig. 7a.b.c.d:

a**:** Miller Class I recession defects on the mandibular left premolars; **b:** A subperiosteal tunnel was created extending through the gingival sulcus? of the lower premolars and beyond the mucogingival junction; **c:** after the insertion, the sub-epithelial connective tissue graft (SeCTG) was secured in place with continuous sling sutures; **d:** Clinically stable results 12 months post interventions

Introduction

Over the years, several surgical techniques have been introduced to correct labial, gingival recessions defects[1]. Recession of the gingival margin remains a highly prevalent problem for its impact on both aesthetics and dentine hypersensitivity[1].

Although different techniques have shown a consistent potential for root coverage, meta-analyses from several systematic reviews revealed great variability of clinical outcomes[2-6]. These reviews showed a greater recession reduction and a larger amount of roots completely covered following bilaminar techniques (Coronally advanced flap + Sub-epithelial connective tissue graft[7] [SeCTG+CAF] as compared with regenerative procedures[8].

Perhaps the most widely used surgical procedures by clinicians for root coverage are coronally advanced flap (CAF) and CAF performed in conjunction with sub-epithelial connective tissue graft (CAF+SeCTG). In CAF, the gingival flap is raised beyond the mucogingival junction, and because of the elasticity of the alveolar mucosa along with periosteal releasing incisions, the flap can be stretched in a coronal direction to cover the exposed root surfaces[9;10]. In CAF + SeCTG (bilaminar technique)[7;11;12], CAF is used to cover the harvested connective tissue graft thereby allowing the graft to receive dual blood supply from periosteum and the flap itself[13].

Systematic reviews have examined the effectiveness of CAF versus CAF + SeCTG at covering exposed root surfaces at gingival recession sites[3;4;14;15]. The first randomized controlled trial comparing CAF and CAF + SeCTG showed no significant differences between CAF versus CAF + SeCTG with respects to reduction in recession depth at 6 months[14]. On the other hand, a multi-center, double-blinded, randomized controlled trial involving 85 patients demonstrated CAF + SeCTG's superiority over CAF alone in

achieving complete root coverage in maxillary Miller Class I and II recession defects at 6 months. The odds of obtaining CRC (Complete root coverage) were 5.09 times greater with the additional use of a graft with respect to the CAF alone[16]. A recent Cochrane systematic review reported the use of SeCTG + CAF to be the most effective periodontal plastic procedure in obtaining root coverage[15].

More recently, several authors have proposed the application of a SeCTG using a tunneling technique (TT), which has recently gained popularity in periodontal mucogingival therapy[17;18]. In all surgical procedures, fast and uneventful wound healing is a fundamental prerequisite for successful treatment outcomes[19;20]. In this context, it is generally acknowledged that microsurgical tunneling flap procedures are associated with more favorable postoperative patient-reported outcomes[17;21]. This notion is based on the assumption that flap elevation without surgical papilla dissection and without vertical releasing incisions contributes to a comparatively low impairment of the local blood supply, as well as to a minimal risk of postoperative scar tissue formation[22].

Mucogingival surgery was shown to cause postoperative pain more frequently than osseous surgery and periodontal flap surgery[23].

In most instances the focus of pain assessment revolves around the tissue donor site, which is normally the palatal region proximal to the maxillary premolars.

Minimal attention has been paid to the exclusive perception of pain emanating from the recipient area or overall oral cavity. More trivial post-operative symptoms such as pain, discomfort, swelling and mild bleeding are experienced routinely by patients undergoing mucogingival surgery[24,25]. In general, such manifestations are short lived and occur over the early post-operative period (3 days) [26].

However, there is scarce data available regarding postoperative patient-centered outcomes after TT as compared to other surgical procedures for the treatment of gingival recession.

Hypothesis

Hypotheis

Primary objective:

H_0 (null hypothesis): No difference in percentage of CRC will be achieved with CAF+SeCTG when compared to CAF alone and no difference in patient morbidity with CAF+SeCTG when compared to the TT.

H_1 (alternative hypothesis): Higher percentage of CRC will be achieved with CAF+SeCTG when compared to CAF alone. The patient morbidity will be higher with CAF+SeCTG when compared to the TT.

Secondary objective:

H_0 (null hypothesis): No difference in percentage of CRC will be achieved with CAF+SeCTG when compared to the TT.

H_1 (alternative hypothesis): Higher percentage of CRC will be achieved with CAF+SeCTG when compared to the TT.

Objectives

Objectives

General:

To compare the effectiveness of root coverage with a coronally advanced flap with and without the use of a sub-epithelial connective tissue graft.

To compare patient's morbidity and clinical outcomes of a coronally advance flap with the use of a sub-epithelial connective tissue graft and the tunneling technique.

Specifics:

1) To compare the effectiveness of root coverage and clinical outcomes with CAF alone versus CAF + CTG in the treatment of single gingival recessions by analyzing the data with an open source image-processing program.
2) To describe a surgical technique which can successfully achieve root coverage in challenging clinical scenarios.
3) To assess any differences in the post-operative morbidity following two of the most conventional and routinely indicated mucogingival procedures: (SeCTG+CAF) and (SeCTG+TT).
4) To assess clinical outcomes in terms of root coverage for both (SeCTG+CAF) and (SeCTG+TT).

Materials and Methods

Materials and Methods

For this thesis we developed two randomized controlled clinical trials and one case report. In the first RCT article we included 28 patients, while in the second 50 patients have been selected to be part of the study.

In the first article, comparing CAF (Control Group) with CAF+SeCTG (Test Group) treatments were performed between February 2012 and January 2013 at the Dental Clinic of Biomedical Sciences Institute, University of Padua, Italy. The study protocol was approved by the Institutional Review Board (Ref. 399/2010 and 1387/2010). Informed consent was obtained from all the subjects included in the study for treatment of single maxillary recession. The study protocol was carried out in accordance with the ethical standards outlined in the 1964 Declaration of Helsinki, as revised in 2000.

In the second article we reported the indications of root coverage procedures with the use of connective tissue graft analyzing the scientific evidences. Moreover, we described a clinical case, were the use of CTG was of paramount importance to meeting the patient's needs and fulfilling the clinical outcomes.

The third article was designed as a single-center, randomized, clinical trial on the treatment of single gingival recessions. Two different treatment modalities were assessed: the coronally advanced flap with subepithelial connective tissue graft (SeCTG+CAF) (Control Group) was compared to the tunnel technique with subepithelial connective tissue graft (SeCTG+TT) (Test Group) in terms of clinical outcomes, and post operative morbidity. The study protocol was review approved by the Institutional Review Board at the University of Padua, Padua, Italy (Ethics Committee No.: 2566P) and it was registered in clinicaltrials.org (ID: NCT02269748). Informed consent was obtained from all participants

included in the study. In obtaining the informed consent, administering the questionnaires and in conducting the study, the principles outlined in the Declaration of Helsinki, as revised in 2000, were strictly followed.

1st Article: Evaluation of root coverage with and without connective tissue graft for the treatment of single maxillary gingival recession using an image analysis system: a randomized controlled clinical trial.

Patient Selection

Twenty-eight patients that received coronally advanced flap with (CAF+CTG) or without (CAF) connective tissue graft were included in the present prospective study. Two randomized groups were considered: 14 patients treated with coronally advanced flap (CAF) and 14 with coronally advanced flap and connective tissue (CAF+CTG), respectively.

To detect a mean difference of gingival recession at 12 months between the two groups of 0.5 mm with a standard deviation of 0.5 mm, setting a power of 0.80 and an alpha of 0.05, a minimum sample size of 14 patients per group was estimated[27].

Inclusion criteria were: (i) single gingival recession in the anterior maxilla with aesthetic problems and/or dental hypersensitivity (second premolar, canines and incisors); (ii) absence of local inflammation; (iii) No active periodontal disease with no site showing probing depth >4 mm; (iv) Smoking ≤10 cigarettes/day; (v) Full-mouth plaque score (FMPS) and full-mouth bleeding score (FMBS) ≤15% (measured at four sites per tooth); (vi) Presence of at least one Miller class I or class II buccal gingival recession ≥2 mm of

depth.; (vii) Presence of an identifiable Cemento-Enamel Junction (CEJ); (viii) No history of mucogingival or periodontal surgery at the experimental site.

Exclusion criteria were: (i) Teeth presenting with root steps (abrasion, abfraction or erosion) >1 mm at CEJ level or with crowns or restorations at the CEJ level.

Each selected patient contributed with a single gingival recession. If patients presented multiple recessions, the deepest one was selected.

Pre-surgical procedures

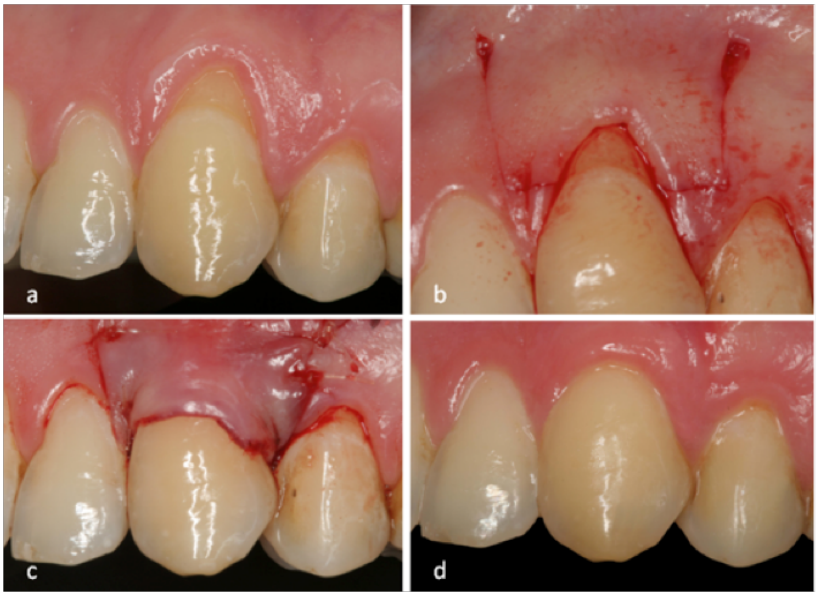
All subjects received a session of prophylaxis after the screening examination; instruction in proper oral hygiene measures, supra-gingival scaling and professional tooth cleaning with the use of a rubber cup and a low abrasive polishing paste were provided. In order to minimize tooth-brushing trauma to the gingival margin a coronally directed roll technique was prescribed for teeth with recession-type defects. All clinical measurements were carried out by a single masked examiner (D.L.) at baseline, 6 months and 1 year after the surgery. D.L. did not perform surgery and was unaware of the treatment assignment. The examiner was calibrated before the study to reduce intra-examiner error (k 38.75) in reliability and consistency. All surgeries were performed by the same clinical experienced periodontist, specifically trained and calibrated to perform the tested surgical approaches.

Full-mouth plaque scores (FMPS) were recorded at four aspects per tooth to reveal the presence of plaque.

Surgical Procedure

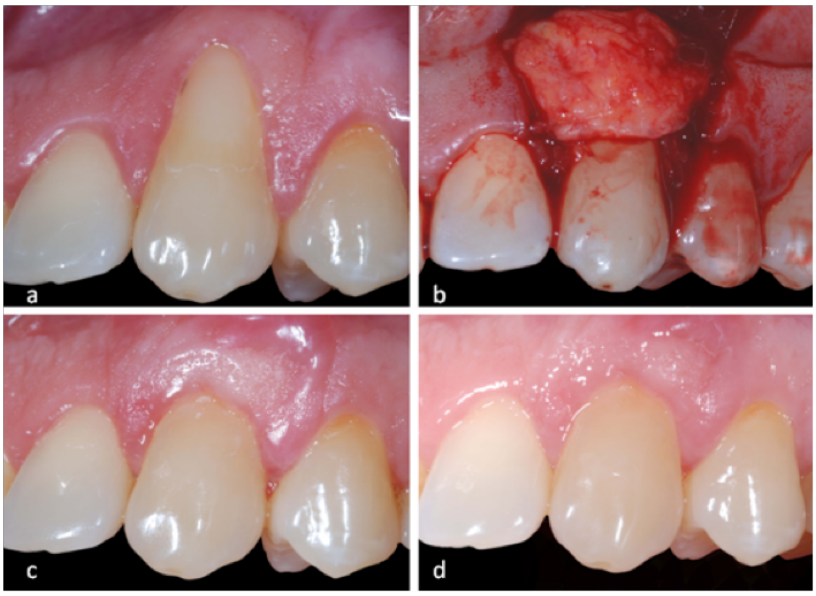
The control group was treated with CAF alone (Fig. 1) whereas the test group received CAF+CTG (Fig. 2). One operator performed all surgical procedures. After local anesthesia, two divergent releasing incisions were performed beyond the mucogingival junction (MGJ). An intra-sulcular incision was performed at the buccal aspect of the selected tooth. A split thickness surgical papillae was then raised, while a full thickness fl ap until the MGJ was elevated; beyond the MGJ a partial-thickness flap was raised, so that any residual tension was eliminated and a passive coronal flap displacement was achieved. Root debridement was performed by using a sharp curette. The papillae adjacent to the recipient site were de-epithelialized.

Fig. 1: Single RT2 buccal recession. Frontal aspect (*a*) Double oblique realising incisions (*b*) Soft tissues



coronal replacement without any connective tissue graft (*c*) Healing 6 months after surgery (*d*).

Fig. 2: Single RT2 buccal recession. Frontal aspect (*a*) Double oblique realising incisions and connective tissue graft stabilization (*b*) Healing 6 months after surgery (*c*) Healing 12 months after surgery (*d*).



The randomization was applied at this time and the clinician was instructed whether or not to perform a CTG under the flap. The randomized treatment code (CAF or CAF+CTG) was available in closed non-transparent envelopes that were opened after flap elevation.

In the test group a 1-2 mm-thick CTG was harvested using a single incision approach from the palate in the area between the second pre-molar and the first molar[7].

The graft was positioned on the instrumented root surface immediately apical or at the level of the CEJ. Graft stabilization was performed by using a compressive crossing suture, anchored to the periosteum apical to the graft (Monocryl 6-0 P-3 needle, Ethicon; Johnson & Johnson, St-Stevens-Woluwe, Belgium). The flap was coronally displaced 1–2 mm above the CEJ in both test and control groups. A sling suture was placed to stabilize

the flap in a coronal position, followed by interrupted sutures on the releasing incisions with an apico-coronal direction, using Monocryl 5-0 sutures.

For 2 weeks following the treatments, patients were instructed to avoid any mechanical trauma and tooth brushing. Chlorhexidine rinses were prescribed twice daily for 1 min. Seven days after surgery, sutures were removed and prophylaxis was performed. Two weeks after surgery, patients were instructed to start mechanical tooth cleaning by using a soft toothbrush. Patients were recalled 3 and 6 months after surgery for professional oral hygiene procedures and measurements.

Parameters analysed

The buccal gingival margin modification was the main clinical parameter investigated. A computerized analysis (Image-J® image processing software, NIH, Montgomery County, Maryland, USA) was performed for the photograph measurements[22;24;26]. In order to avoid any image distortion a frontal projection was used, and two setting parameters were chosen to check the reproducibility of each picture (Fig.3).

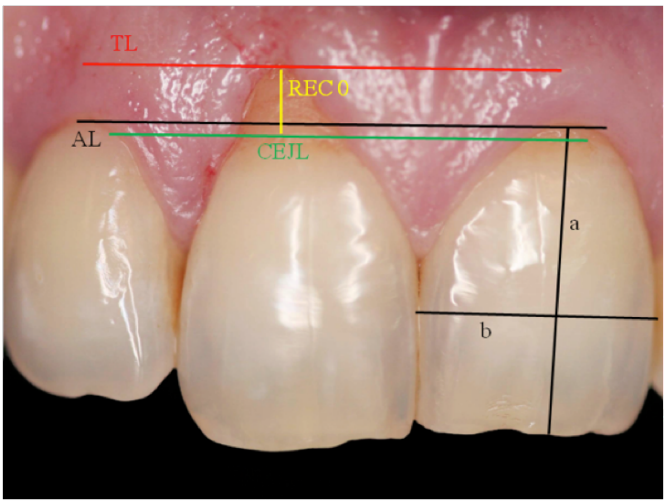


Fig. 3: Measurement of the gingival recession before treatment. A guide line (AL) joins the most apical point of the buccal margin of the teeth adjacent to treatment site; a second line (TL) parallel to AL indicates the most apical point of the test site buccal margin; a third line (CEJL) parallel to AL joins the CEJ of the tooth needing treatment; a fourth line (REC) measures the recession of the gingival margin. Apico-coronal vertical line (*a*) and the mesio-distal horizontal line (*b*) of the adjacent tooth were chosen as setting parameters to check the reproducibility of each picture.

They were: i) Apico-coronal vertical line (*a*) from the most apical point of the buccal gingival margin to the most coronal portion of the crown edge. ii) A mesio-distal horizontal line (*b*) at the widest part of the crowns adjacent to the treatment site. One of the teeth adjacent to the treatment site was used for *a* and *b* measurements. A calibrated plastic probe (TPS probe, Vivadent, Schaan, Liechtenstein) was used on the same tooth to compare the values of *a* and *b* with those measured with the computerized analysis. For data calculation, only differences of ≤ 0.5mm were accepted. The photographs were taken using a Canon 30D SLR camera with a 100-mm macrolens and Canon ring flash. The photographs were taken at a proportion of 1.5:1 with a 100-shutter speed and 14F stop in manual mode.

Four lines were drawn on each photograph in order to measure the gingival margin modification on the treated tooth: a guide line (AL) was drawn joining the most apical point of the gingival margin of the teeth adjacent to the treatment site; a second line (TL) parallel to AL was used to indicate the most apical point of the gingival margin at the recession site; a third line (CEJL), parallel to AL was drawn joining the CEJ of the treated tooth; finally, a fourth line (REC) measured the distance between TL and CEJL. The difference between REC before treatment (REC 0) and at baseline (REC B), after 6 (REC 6) and 12 months (REC 12) of follow-up measured the recession reduction (REC red) of the gingival margin (Fig 3-4).

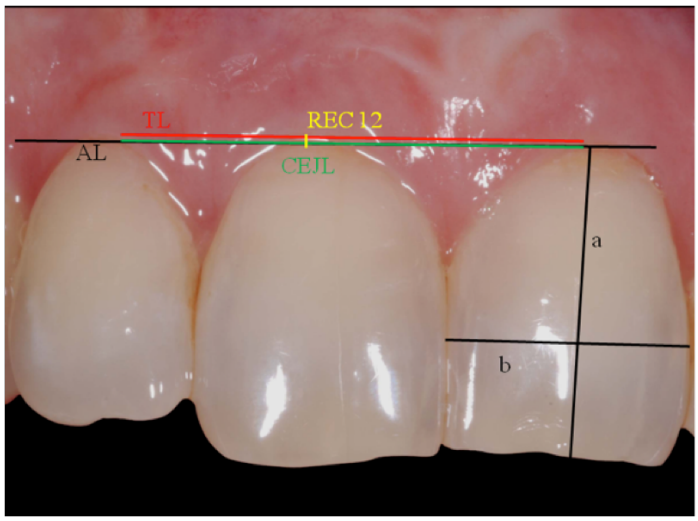


Fig. 4: Measurement of the gingival recession reduction 12 months after treatment. A guide line (AL) joins the most apical point of the buccal margin of the teeth adjacent to treatment site; a second line (TL) parallel to AL indicates the most apical point of the test site buccal margin; a third line (CEJL) parallel to AL joins the CEJ of the tooth needing treatment; a fourth line (REC 12) measures the recession of the gingival margin. Apico-coronal vertical line (*a*) and the mesio-distal horizontal line (*b*) of the adjacent tooth were chosen as setting parameters to check the reproducibility of each picture.

Only apical shrinkage of ≥0,5 mm was considered as soft tissue recession. REC red variable was assessed for each patient at the following time points: after treatment and after 6 and 12 months of follow-up. In order to evaluate the modification of the gingival margin, digital photographs were taken at time points for each patient, respectively.

Measurements were made at mesial and distal aspect of each tooth and were reported in millimeters.

Measurements were made by one of the authors (D.L.) and rounded off to the nearest half millimeter.

Any adverse event or biological or technical complication was recorded if present at any time point.

Statistical analysis

Continuous data were expressed as median and interquartile range (IQR), because Shapiro test rejected the hypothesis of normal distribution of data for all continuous variables (not reported in Results). Categorical data were compared between the two groups using Fisher test, whereas continuous data using Mann-Whitney test. Gingival recession at 12 months (primary outcome) was compared between the two groups using a one-sided Mann-Whitney test. Variables recorded at three different time points (baseline, 6 months, 12 months) were analyzed using Friedman's two-way nonparametric ANOVA, including time, group and the interaction time*group in the model. A p-value less than 0.05 was considered statistically significant. Statistical analysis was performed using R 2.12 language.

2nd Article: Is the connective tissue graft needed for the treatment of denude root surfaces?

As the demand for esthetics in dentistry has increased, subepithelial CTGs have increasingly become an integral component of periodontal therapy. Although the purest indication for soft tissue grafting is lack of attached gingiva, indications for SeCTG have grown to include root coverage (either partial or complete) for many reasons, including improving esthetics, root sensitivity, cervical abrasion, and covering a crown margin or an exposed implant collar.

All the various techniques, although similar, have subtle differences in outcomes and indications. The technique presented here is ideal for achieving uniform esthetic tissue contours and rarely requires a second procedure of gingivoplasty.

In the following clinical case the use of CTG was of paramount importance to meeting the patient's needs and fulfilling the clinical outcomes.

The medical history of this 35-year-old patient was not significant and she received regular dental care with periodic professional dental hygiene care every 6 months. She received orthodontic care as a teenager with treatment lasting approximately 2 years.

The patient describes brushing her teeth 4 times a day, and using a medium brush somewhat aggressively.

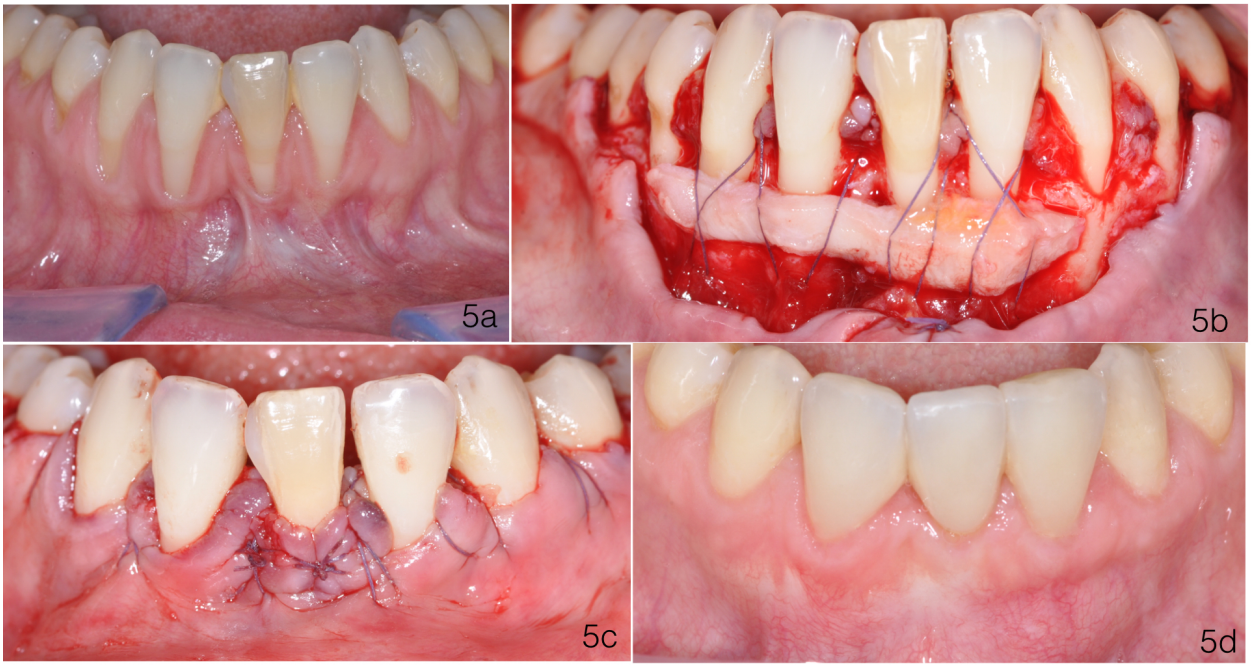
After evaluation of the initial clinical status (Figure 5a), the patient's oral hygiene techniques were observed and the patient was instructed to change her brushing technique with a soft brush. After the re-evaluation, a decision was made to perform a CAF with the graft to be obtained from the palate. (Figures 5b-5c)

Figure 5d shows the final result after 1 year.

In this particular case there were several reasons to perform CTG. These included the inadequate band of attached gingiva, the need to improve the esthetics, the need to decrease

root sensitivity, improve cleansability, and stop the progression of the recession by increasing the keratinized mucosa. (Table 1)

Figure 5.
a: Initial clinical status
b:Sub-epithelial connective tissue graft sutured in place
c:The graft is covered by a coronally advanced flap.
d: Clinical stable results at 1 year follow up



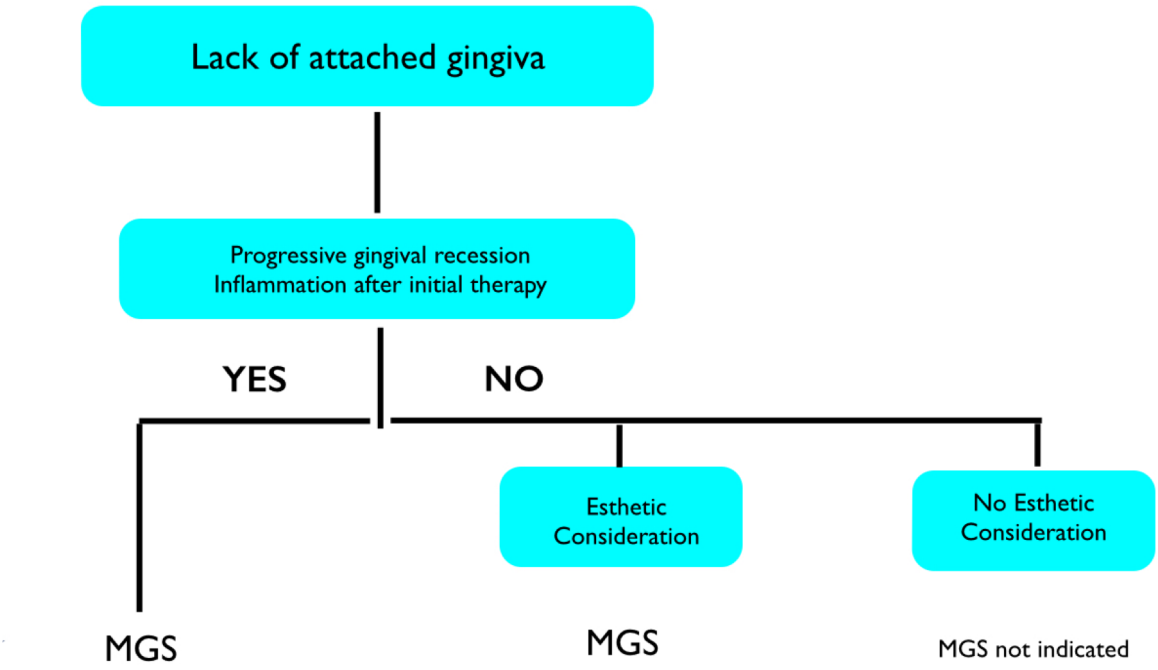


Table 1. Indications for root coverage procedure (with the aim of increasing the lack of KT); (MGS: muco-gingival surgery).

3rd Article: Patient morbidity and root coverage outcomes after the application of subepithelial connective tissue graft in combination with coronally advanced flap or via tunneling technique: A randomized controlled clinical trial.

Participants

Eligibility criteria for participants:

Patients were selected, on a consecutive basis, among individuals referred to the University of Padova School of dental medicine, department of Periodontology. All patients agreed to participate in the study and signed a written informed consent.

All participants met the study inclusion criteria: single or multiple Miller's Class I and II recession defects[28] (>= 2mm in depth; not exceeding 5 mm in depth); presence of identifiable cemento-enamel junction (CEJ); presence of a step <=1mm at the CEJ level and/or the presence of a root abrasion, but with an identifiable CEJ; periodontally and systemically healthy, with full mouth plaque and bleeding scores[29] < 20%; During recruitment of the patients, the following exclusion criteria were employed: contraindications for periodontal surgery; taking medications known to interfere with periodontal tissue health or healing; anti-inflammatory drugs or antibiotics for the last 6 months; participants who underwent periodontal surgery on the involved sites; smokers were also excluded form the study. Excluded sites were recession defects associated with caries or restoration as well as teeth with evidence of a pulpal pathology, molar teeth; teeth showing any kind of malpositioning (rotation or extrusion) as well as teeth with any history of mucogingival or periodontal surgery. In case of multiple recessions, only an area of no more than 3 consecutive teeth was considered eligible for the study.

The study protocol involved a screening appointment to verify eligibility, followed by initial periodontal therapy to establish optimal plaque control and gingival health conditions, surgical therapy, evaluation of patient morbidity 3 days after the surgery, maintenance phase and post-operative clinical evaluation 1 year after the surgery.

Settings and locations where the data were collected

The same operator (L.G.) performed all surgical procedures at University of Padova, Padova, Italy. Data collection included clinical measurements at baseline and 12 months post intervention. Questionnaires were given to the participants before scheduling the surgery. To insure that the forms were completed, patients were reminded by a telephone call when their form needed completion. Clinical measurements were undertaken at the same clinic by a trained examiner E.B. Statistical analyses were performed at the Universitat Internacional de Catalunya, Barcelona, Spain.

Interventions

Pre-Surgical preparations

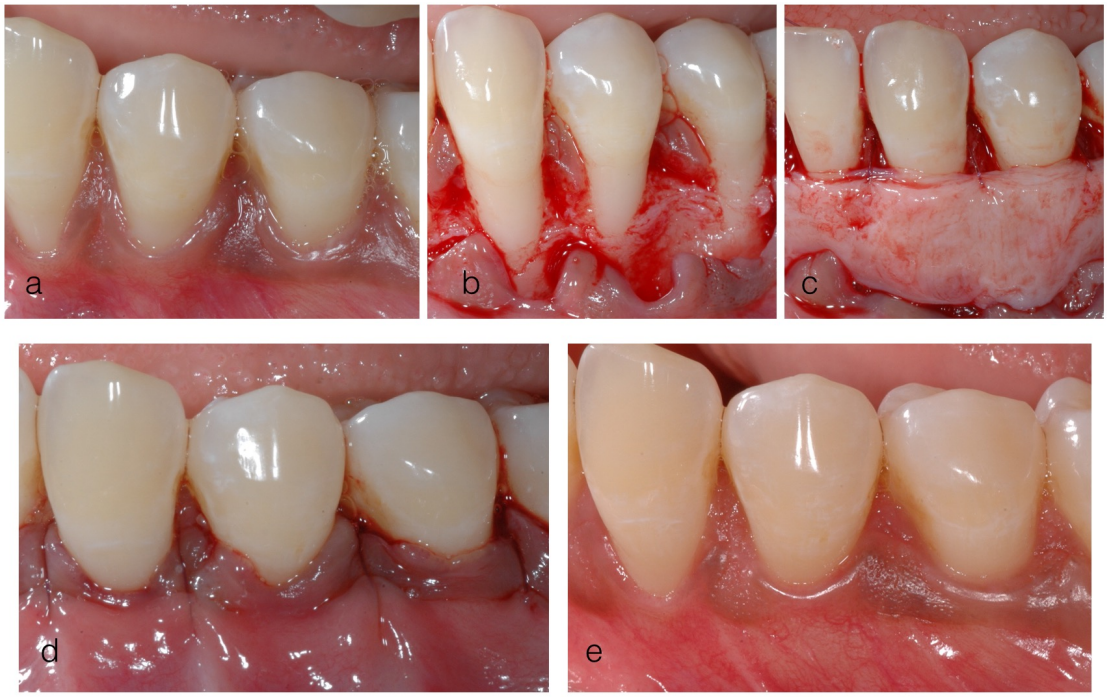
Following the screening examination, all participants received a session of prophylaxis including oral hygiene instructions, scaling and professional tooth cleaning with the use of a rubber cup and a low abrasive polishing paste. A coronally directed roll technique, using a soft toothbrush, was recommended for teeth with recession-type defects in order to eliminate wrong habits associated with the etiology of gingival recessions. Surgical

treatment of the recession defects was not scheduled until the patient could demonstrate an adequate standard of supragingival plaque control.

Surgical procedures

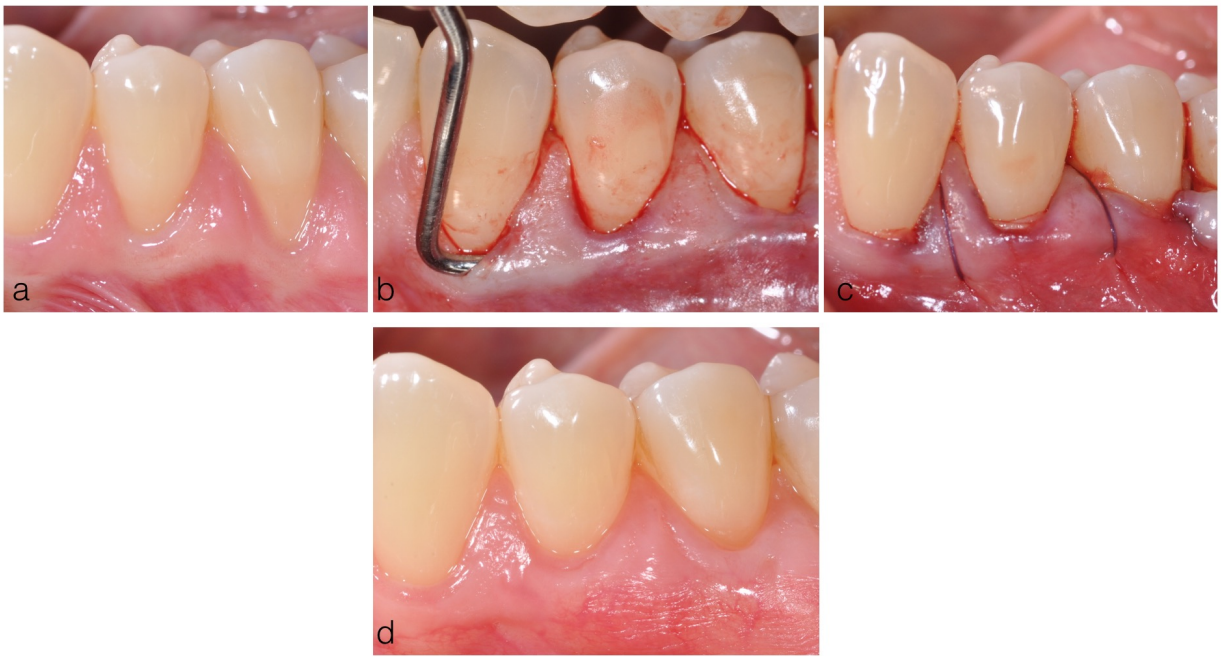
The control group (CAF+SeCTG) was treated with a coronally advanced flap procedure combined with a sub-epithelial connective tissue graft (Fig. 6a,b,c,d,e);

Fig. 6:
a:Miller Class I recession defects on the mandibular left premolars. **b:** Full thickness flap elevation. **c:** the SeCTG is secured in position with continuous sling; **d:** The overlying flap is coronally advanced over the donor tissue covering the latter as much as possible. **e:** Clinically stable results 12 months post interventions



whereas in the test group the tunneling technique with subepithelial connective tissue graft was performed (TT) (Fig. 7a,b,c,d).

Fig. 7a: Miller Class I recession defects on the mandibular left premolars **b:** A subperiosteal tunnel was created extending through the gingival sulci of the lower premolars and beyond the mucogingival junction. **c:** after the insertion, the sub-epithelial connective tissue graft (SeCTG) was secured in place with continuous sling sutures **d:** Clinically stable results 12 months post interventions



Following local anesthesia, the exposed root surfaces were polished with a rubber cup and pumice powder prior to flap elevation. The pre-molar area of the palate was injected with local anesthesia (2% lidocaine with epinephrine at a concentration of 1:100,000). The surgical technique adopted for harvesting the SeCTG in both groups was the approach described by John F. Bruno[30].

Briefly, the first incision on the palate was made perpendicular to the long axis of the teeth, approximately 2 to 3 mm apical to the gingival margin of the maxillary teeth. The mesiodistal length of the incision was determined by the length of the graft necessary for the recipient site. The second incision was made parallel to the long axis of the teeth, 1 to 2 mm apical to the first incision. The incision was carried far enough apically to provide a sufficient height of connective tissue to cover the denuded root and the adjacent periostium of the recipient site. The thickness of the graft was maintained uniform while proceeding apically with the blade. The donor tissue was then removed from the palate as atraumatically as possible. Care was taken not to remove the periostium protecting the underlying bone. Once the graft was removed, the fatty tissue (yellow in color) was eliminated as well as the 1-2 mm band of epithelium at the coronal aspect of the graft. The primary flap was repositioned and interrupted single 5-0 sutures‡* were made to achieve primary closure of the palatal wound.

Control Group:

In the control group (SeCTG+CAF) the incision for the flap advancement was performed as described by Zucchelli[31]. In brief, following local anesthesia, a horizontal incision was made with a scalpel to design an envelope flap. The horizontal incision of the envelope flap consisted of oblique submarginal incisions in the interdental areas, incisions that continued with the intrasulcular incision at the recession defects. The envelope flap was raised a split-full-split approach in the coronal-apical direction. Flap mobilization was considered “adequate” when the marginal portion of the flap was able to passively reach a level coronal the CEJ at each single tooth in the surgical site. The root surface (only that

portion of the root exposure) was mechanically treated with the use of curettes. After the flap was elevated, the donor connective tissue was secured in position with continuous sling suture 5-0 sutures‡* ; The overlying flap was then coronally advanced over the donor tissue covering the latter as much as possible. The flap was secured in placed with 5-0 sutures‡*;

Test Group:

The test group, SeCTG+TT treatment was performed in accordance with the description on a microsurgical tunnel technique by Allen[32]. Following initial sulcular incisions with a microsurgical blade, tunneling knives were used to undermine the buccal gingiva by means of a split-thickness flap preparation, aiming for the preparation of a continuous tunnel in the buccal soft tissues of the recessed area. The supra-periosteal dissection was extended well into the mucosal tissues in order to gain sufficient flap mobility. The adjacent papillary tissues were carefully detached by means of a full-thickness preparation in their buccal aspect, thus to allow for a coronal displacement of the mobilized buccal soft tissue complex. A sub-epithelial connective tissue graft (SeCTG) was trimmed to a thickness of 1-1.5 mm and then inserted into the tunnel. Double-crossed sutures‡* were applied to stabilize the buccal soft tissue complex in a coronal position about 1-2 mm above the CEJ. Small parts of the CTG were left uncovered when necessary to achieve a harmonious line of the gingival margin.

Surgical chair time was measured using a chronometer from the first incision to the last suture in both groups.

Post-surgical protocol

Patients were instructed to avoid any mechanical trauma or tooth brushing in the surgical sites for 2 weeks. They received 600mg ibuprofen directly at the end of the surgical intervention and were instructed to take additional analgesic-antiphlogistic medication as required (ibuprofen). 0.12% chlorhexidine rinses was prescribed two times per day for two weeks. Sutures were removed after 7 days. Two weeks after surgery, patients were instructed to resume mechanical tooth cleaning with a soft toothbrush. Patients were recalled at 1, 3, 6 and 12 months for professional oral hygiene procedures.

Outcomes

The primary aim of this randomized controlled clinical trial was to assess any differences in the post-operative morbidity following two of the most conventional and routinely indicated mucogingival procedures: (SeCTG+CAF) and (SeCTG+TT). The secondary aim was to assess clinical outcomes in terms of root coverage for both techniques.

Patient morbidity

Post-operative pain was indirectly evaluated on the basis of the mean consumption (in mg) of analgesics (Ibuprofen) [26;33].

All patients were asked to complete a questionnaire (Appendix I) designed to evaluate pain experience at early (3 days) stages following surgical procedure such as post-operative discomfort, bleeding and inability to chew. To insure that the forms were completed, patients were reminded by a telephone call when their form needed completion. The survey utilized was a Visual Analogue Scale (VAS) scores from 1 to 10, with 1 indicating minimal

pain and 10 indicating severe pain. If a patient indicated that no pain was present, a score of 0 was given. Each question allowed the patient to rate their pain experience from "NO PAIN" to "WORST POSSIBLE PAIN" in response to various stimuli, activity and time of day. Moreover, specific instructions on how to complete the surveys were explained to each participant. To ensure subjects understood how to complete the VAS accurately, and to validate the scores of the primary survey further, each patient completed a *primer* VAS under the supervision of the investigator. (Appendix II).

Different parameters were investigated (dichotomous fashion, yes or no): post-operative bleeding; quantity and type of analgesic medication taken; patient eventual undergoing a similar procedure in the future if recommended by their dentist. Discomfort was defined as the level of soreness/pain experienced by the patients during the first three days in the grafted area. Bleeding was considered to be the prolonged hemorrhaging during the first three days post-surgical, reported by the patients.

Inability to chew was described as the level of variation of the patient's eating and drinking habits due to the presence of the wound.

Clinical Measurements at baseline and 12 months

The following clinical parameters were assessed to the nearest 0.5 mm with the use of a PCP-UNC 15 periodontal probe‡** by a single masked examiner:

- Gingival recession height (GH), measured from the CEJ to the most apical extension of the gingival margin;

- Probing depth (PD), measured from the gingival margin to the bottom of the gingival sulcus at the central buccal site;
- Clinical attachment level (CAL), measured from the CEJ to the bottom of the gingival sulcus at the central buccal site;
- Height of keratinized tissue (KTH): the distance between the gingival margin and the mucogingival junction (MGJ). The MGJ was identified by means of Lugol staining.

Sample size calculation

Sample size was calculated based on the primary outcome (i.e. pain killer consumption) reported in a previous study with similar techniques[26]. Accepting an alpha risk of 5% and a beta risk of 15% in a two-sided test, 25 participants pre group were considered necessary to recognize as statistically significant a difference greater than or equal to 1800 mg. The common standard deviation is assumed to be 2000 mg. A drop-out rate of 10% was anticipated.

Randomization and allocation concealment

Each patient was assigned to one of the two treatment groups using a computer-generated randomization table to ensure a balanced allocation of treatments. All patients participated in the study with a single tooth. Twenty-five teeth were assigned to the control group (SeCTG+CAF) and 25 teeth to the test group (SeCTG+TT). In the case of patients presenting with multiple recessions, the deepest one was selected; in the case of two or

more recessions of the same depth, tossing a coin performed the selection. Allocation concealment was performed by opaque, sealed, coded envelopes that were opened immediately prior to the surgical interventions.

Implementation

A computer generated the random allocation sequence, L.G. enrolled the participants and F.M. assigned participants to interventions.

Blinding

A single masked examiner carried out all clinical measurements at baseline and 1 year after the surgery. The examiner did not perform surgery and was unaware of the treatment assignment. Before the study, the examiner was calibrated to reduce intra-examiner error: measurement of the distance between the CEJ and gingival margin, was repeated three times by the examiner for a total of 50 defects with a K coefficient > 0.75.

Table 2. Baseline patient and defect-related characteristics

Variables*	CAF+SeCTG= 25	TT=25
Age	27.6 (SD:6.0) (20–35)	28.2 (SD:5.80) (21–37)
Sex (female)	13	11
Type of Tooth		
Maxillary Incisor	4	3
Maxillary Canine	7	3
Maxillary Premolar	6	2
Mandibular Incisor	3	11
Mandibular Canine	3	2
Mandibular Premolar	2	4
Number of involved teeth		
One	4	4
Two	9	12
Three	12	9
GH (mm)	3.48 (0.8) Mean (SD)	3.44 (0.9) Mean (SD)
PD (mm)	1.24 (0.4) Mean (SD)	1.28 (0.5) Mean (SD)
CAL (mm)	4.72 (0.9) Mean (SD)	4.72 (1.1) Mean (SD)
KTH (mm)	2.24 (0.93) Mean (SD)	2.24 (0.97) Mean (SD)

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS Inc., v. 20 software, Chicago, IL, USA) was used for all analyses. Kolmogorov-Smirnov test was used to analyze distribution of continuous variables. Continuous variables are expressed as means ± standard deviation (SD) and compared at baseline by the U Mann-Whitney test. This test was also used to

compare mean changes post vs. baseline measurements between groups. The Wilcoxon test was used to compare post vs. baseline measurements. Spearman correlation was used to evaluate associations. Complete coverage was evaluated after one year by calculating the percentage of cases, in each treatment group, with the gingival margin at the level or coronal to the CEJ. Percentage of root coverage was calculated after 12 months according to the following formula:

{[(Baseline GH) – (12 months GH)] / (Baseline GH)} x 100.

Unadjusted and adjusted associations between groups and pain or discomfort were calculated with linear regression models. Study group was included in each model as independent variable. In adjusted models, painkiller doses were included as confounder factor. The dependent variable was pain, according to the items of the questionnaire with statistical differences between groups in the bivariate analysis. Level of significance was set at 0.05.

Published Articles

First Article:

Pubmed Reference: Int J Periodontics Restorative Dent. 2015 Mar-Apr;35(2):247-54. doi: 10.11607/prd.2241.

Journal: International J. Periodontics Restorative Dentistry. Impact Factor:

Title: Evaluation of root coverage with and without connective tissue graft for the treatment of single maxillary gingival recession using an image analysis system: a randomized controlled clinical trial.

Authors: Lops D, Gobbato L, Nart J, Guazzo R, Ho DK, Bressan E.

Second Article:

Reference: http://www.trendsperioimplantresourcecenter.com/.

Journal: Trends in Clinical Periodontology & Implant Dentistry

Title: IS THE CONNECTIVE TISSUE GRAFT NEEDED FOR THE TREATMENT OF DENUDED ROOT SURFACES? Advantages and Disadvantages of Soft Tissue Grafting

Authors: Gobbato L, Nart J

Third Article:

Pubmed Reference: Clin Oral Investig. 2016 Jan 27. [Epub ahead of print]

Journal: Clinical Oral Investigation

Title: Patient morbidity and root coverage outcomes after the application of a subepithelial connective tissue graft in combination with a coronally advanced flap or via a tunneling technique: a randomized controlled clinical trial.

Authors: Gobbato L, Nart J, Bressan E, Mazzocco F, Paniz G, Lops D.

Discussion

Discussion

1st Objective:

The aim of the first study was to compare the effectiveness of root coverage with CAF alone versus CAF + CTG in the treatment of single gingival recessions by analyzing the data with an open source image-processing program.

The 1-year follow up results showed in patients in CAF+CGT group a better primary outcome - gingival recession at 12 months - than CAF patients and a greater number of treated sites with complete root coverage (CRC) in patients receiving CAF + CTG than in those receiving CAF alone even if this last result is not statistically significant (Table 1a). Patients receiving CAF + CTG did not exhibit more gain in keratinized tissue at 1-year compared to those receiving CAF alone (Table 2a).

Both the test and the control procedures were effective in reducing the recession depth; 0.5 mm greater recession reduction was observed in the cases treated with the CTG technique (Table 1a), but this difference did not reach statistical significance. These data confirm the outcomes of a previous small sample controlled study[14] and are consistent with a multicenter, double-blind clinical trial published by Cortellini et al[16]. As reported in those studies, sites treated with CAF+CTG showed improved clinical outcomes with respect to CAF alone, but the difference did not reach statistical significance. In the present clinical trial, however, the adjunctive application of a CTG under a CAF increased the probability of achieving CRC in Miller Class I and II defects (61.5% vs. 83.3%, p=0.38).

The sites treated with a combination of CAF + CTG resulted in a higher number of recessions completely covered (83.3%) with respect to sites treated with CAF alone (61.5%), (Table 2a).

	CAF	CAF+CGT
N	13	12
Tooth: Central incisor Lateral incisor Canine Premolar	 2 1 6 4	 0 1 6 5
CRC 6 months: yes [a]	9 (69.2%)	10 (83.3%)
CRC 12 months: yes [a]	8 (61.5%)	10 (83.3%)
Rec [b] Baseline 6 months 12 months	 3.1 (2.9-3.3) 0.9 (0.7-1.1) 1.0 (0.9-1.1)	 2.9 (2.8-3.0) 0.5 (0.5-0.6) 0.5 (0.5-0.6)
Kt [b] Baseline 6 months 12 months	 2.6 (2.5-2.7) 2.9 (2.9-3.0) 3 (2.9-3.0)	 2.5 (2.4-2.6) 2.8 (2.7-2.9) 2.8 (2.7-2.9)
Pd Buc [c] Baseline 6 months 12 months	 1.5 (1.5-1.5) 1.5 (1.0-1.5) 1.0 (1.0-1.5)	 1.5 (1.0-1.5) 1.0 (1.0-1.5) 1.0 (1.0-1.5)
Cal Buc [a]	4.5 (3.9-4.8)	4.5 (3.9-4.7)
Cal Mes [c] Baseline 6 months 12 months	 2.1 (2.0-2.3) 2.2 (2.0-2.3) 2.1 (1.9-2.3)	 2.5 (2.3-2.8) 2.5 (2.3-2.7) 2.5 (2.3-2.7)
Cal Dist [c] Baseline 6 months 12 months	 2.5 (2.3-2.8) 2.5 (2.3-2.7) 2.4 (2.3-2.6)	 2.5 (2.3-2.8) 2.5 (2.3-2.7) 2.5 (2.2-2.6)

Data expressed as n(%) or median(IQR).
[a]Similar between the two groups.

[b]Affected only by time.
[c]Not affected by group, time or their interaction.

Our results are comparable with data reported by several authors;[3;14;16;34] therefore ImageJ software analysis, which has been utilized in the present study, has been shown to be a reproducible and reliable method in assessing the percentage of root coverage[35]. This software has already been utilized for several publications regarding tooth anatomy, mucogingival surgery and peri-implant soft tissue analysis[34-37].

Clinical measurements with periodontal probes may be less precise than ImageJ measurements because rounding of numbers in clinical measurement may lead to greater percentage of variation errors than making measurements using digital image pixels with ImageJ software[35]. In fact, from different publications[35-37], it may be assumed that the risk of error with ImageJ is less important than with the standard clinical measure. As Kerner et Al. reported in two papers, a typical value of the clinical recession depth is 4 mm[34,35]. This value is rounded to the nearest millimeter. This corresponds to a potential 25% error of variation of the measurements. With ImageJ, the corresponding potential error for recession depth=4mm is 1/330 pixels, corresponding to 0.003%. It may be considered that clinical measurements are less precise than the ImageJ measurements. One can assume that the use of a custom stent to perform clinical measurements may improve the accuracy of the results. However, very few root coverage studies use this device (stent) for clinical parameters assessment. The reason that may be invoked is the lack of evidence in the literature showing an advantage in the use of acrylic stents compared with standard clinical measurements in the specific evaluation of recession depth.

The ImageJ analysis provides a simple and reliable method of quantifying root coverage without the need for complex device. It is a useful, fast, sensitive technique, and can be advised for clinicians and researchers for the evaluation of the percentage of root coverage.

Nevertheless, the accuracy of ImageJ evaluation heavily depends on the quality of the digital photographs. Poor quality photographs cannot be analyzed due to the difficulty in defining the CEJ location. It may be assumed that the use of a digital camera would improve the image analysis and reproducibility. Taking photographs from slightly different angulations may lead to distortion of the actual dimensions of the measured structures, which may result in less precise measurements. In addition, ImageJ evaluation itself does not allow recordings of absolute number of measured parameters unless a caliber such as a periodontal probe is also included in the photograph so clinicians can measure the parameters (e.g. recession depth) by comparing the image pixels to the actual dimension of a periodontal probe. Despite these drawbacks, the ImageJ analysis is an easy and reliable method in quantifying root coverage following periodontal plastic procedures. It is objective and may provide an image database for future research.

2nd Objective:

In the case described in the second article there were several reasons to perform a CAF in conjuction with a SeCTG . These included the inadequate band of attached gingiva, the need to improve the esthetics, the need to decrease root sensitivity, improve cleansability, and stop the progression of the recession by increasing the keratinized mucosa. The

successful result of the treatment and the two years follow up pictures has shown the efficacy of this clinical approach in this particular case.

3rd Objective:

Differences in patient perceptions can influence the levels of reported postoperative pain[38].

As clinicians we often try to objectify the pain experience as being strictly an algesic phenomenon when in fact, pain is a multidimensional experience. Clinical examination assessing various signs, symptoms and biomarkers has been the focal point of understanding pain stimuli and subsequent manners to reduce pain perception[39]. Certain physiological pathways such as nociception and endogenous substances associated with pain tend to be targeted. In doing so, the gold standard for addressing "pain" has become the administration of analgesic medications addressing the aforementioned underlying causes.

Any study attempting to quantify the pain experience must consider that pain experience is both subjective and multidimensional. It can be presumed that different patients have different thresholds when it comes to pain. Many inform us in advance that they will require an "extra" dose of local anesthetic, or will "need" a certain narcotic because of past history. This phenomenon is commonly referred to as pain catastrophizing, "reflecting an excessively negative cognitive and emotional orientation toward pain[40]" and can be an important determinant in evaluating our patients' pain experience.

This study utilized a VAS in an effort to accurately extract data regarding the patients' pain and other experiences during early and late post-operative phases.

Common risks of undergoing periodontal surgical therapy include but are not limited to, swelling, bleeding, pain and infection[24]. Efforts have been made in the literature to compare different surgical interventions and the prevalence of such complications[23;41]. An investigation by Curtis[23], found that patients undergoing osseous resective surgery had the highest occurrence of bleeding, infection, swelling or adverse tissue changes. Although over half the study population reported minimal to no post-operative pain, mucogingival surgery was significantly more associated with pain, and was 3.5 times more likely to cause pain when compared to osseous surgery. When analyzing a number of patient outcomes including post-operative pain following various periodontal procedures, Matthews and McCulloch[41] found soft tissue graft surgery to cause the most post-operative discomfort.

In spite of these findings and anecdotal inferences implying a great deal of discomfort or morbidity associated with mucogingival procedures, the present study showed contrasting results. Our findings are in agreement with those of Harris[25] who reported a minimal degree of complications when mucogingival procedures are performed.

In most of the available literature pain assessment focused mostly on the tissue donor site[24;26;42] which is normally the palatal region proximal to the maxillary premolars. Minimal attention has been paid to the exclusive perception of pain emanating from the recipient area or overall oral cavity. No studies so far have addressed the patient morbidity when two different mucogingival surgical techniques where performed at the recipient site. Improving patient outcomes is important in clinical practice.

The post operative sequelae induced by the microsurgical tunneling flap procedure and the coronally advanced flap in combination with a sub-epithelial connective tissue graft have been investigated in this paper.

The surgical chair time required to develop a tunnel has been shown to be significantly higher than in the SeCTG+CAF group. On average, the surgeon required 33.6 (3.6) minutes and 23.6 (4.2) minutes for the SeCTG+TT and the SeCTG+CAF respectively. A positive linear correlation was observed between surgical time and use of analgesic medication ($r=0.456$, $p=0.001$). In other word the longer the surgery, the greater the dosage of the painkillers consumed. This may be explained in that the preparation of an adequate tunnel requires extreme care and attention in particular in patients with thin gingival soft tissue. The dissection is made through the gingival sulcus making the procedure more complicated and time consuming rather than the coronally advanced procedure. In addition, in order to adequately prepare a tunnel the area of interest has to be extended at least one tooth mesial and one tooth distal; this could explain why the SeCTG+CAF group has less pain or discomfort in all four aspects of the questionnaire: pain experienced within the mouth as a whole, pain experienced throughout the day, pain experienced at night and edema experienced after the surgery ($p=0.002$, $p=0.001$, $p=0.001$ and $p=0.001$) respectively.

No significant difference was demonstrated between the control and the test patients in terms of the other VAS related parameters: Pain expressed while drinking ($P=0.686$), pain expressed while chewing ($P=0.202$) and pain expressed in the morning ($P=0.788$). The percentage of patients that would be willing to go through this surgery again is similar in both groups (76% vs. 84%; $P=0.724$) and the percentage of patients that did experience bleeding is higher in SeCTG+CAF, but not statistically significant difference was observed

between groups (P=0.667) suggesting that both treatments are well tolerated by patients. The pain perception and oral function gradually improved during the first week, but social and recreational activities, and daily routines are affected, especially during the first 3 postoperative days[43;44;45], that is why, in the current study, the authors asked the patients to record the pain perception and the discomfort during the first three days post intervention.

Table 3. Questionnaire 3 days Post Intervention (Pain/ discomfort evaluation in entire sample) according groups

Statistical differences were observed between groups in:

- General pain in mouth: higher in TT group (5.2 vs. 4.3)
- Pain during the day: higher in TT group (3.1 vs. 1.7)
- Pain at night: higher in TT group (2.6 vs. 1.5)
- Edema: higher in TT group (3.8 vs. 1.4)

Pain/discomfort	**Treatment**	*N*	Mean	SD
VAS Pain experienced within the mouth as a whole	TT	25	5.244	1.02
P=0.006[1]	SeCTG + CAF	25	4.280	1.09
VAS Pain experienced while drinking beverages	TT	25	2.26	1.03
P=0.686[1]	SeCTG + CAF	25	2.05	0.72
VAS Pain experienced while chewing	TT	25	2.38	0.97
P=0.202[1]	SeCTG + CAF	25	2.02	0.74
VAS Pain experienced in the morning	TT	25	2.268	1.04
P=0.788[1]	SeCTG + CAF	25	2.240	0.56
Pain experienced throughout the day	TT	25	3.12	1.11
P=<0.001[*]	SeCTG + CAF	25	1.65	0.59
Pain experienced at night	TT	25	2.55	1.30
P=<0.001[*]	SeCTG + CAF	25	1.51	0.59
Edema experienced after the surgery	TT	25	3.812	1.31
p<0.001[*]	SeCTG + CAF	25	1.376	0.40

4th Objective:

In the present study both techniques were shown to be clinically effective in the treatment of gingival recessions. Percentage of root coverage was 86% (SD: 17%) and the number of patients with complete root coverage in the entire sample was 28 (56%).

In the SeCTG+TT group measurements decreased significantly in GH (from 3.48 to 0.56; $p<0.001$) and CAL (from 4.72 to 1.84; $p<0.001$). A significant increase was observed in KTH (from 2.24 to 4.84; $p<0.001$). No difference was observed in PD ($p=0.705$).

Similar results were found in the SeCTG+CAF groups, measurements decreased significantly in GH (from 3.44 to 0.52, $p<0.001$) and CAL (from 4.72 to 1,8; $p<0.001$). A significant increase was observed in KTH (from 2.24 to 3.92; $p<0.001$). No difference was observed in terms of PD ($p=1.000$). No differences were observed in percentage of root coverage (87% vs. 85%, $p=704$) or patients with complete root coverage (60% vs. 52%, $p=0.569$).

Only one randomized controlled clinical trial is reported in the literature comparing the clinical efficacy of the tunneling technique and the coronally advanced flap (in conjunction with enamel matrix derivate) in terms of root coverage[11]. The aforementioned study shows significantly better clinical outcomes of the tunneling technique when compared to the CAF. Twelve months post intervention the mean percentage of root coverage achieved in the tunnel group was 98.4% versus 71.8% in the CAF group and the complete root coverage was 78.6% of sites treated with the tunnel technique compared to 21.4% in CAF treated sites. The evidence in the published literature supports that the presence of the SeCTG is a prerequisite for a higher predictability in the treatment of gingival recession[16].

The tunneling technique is a technique that needs to be combined with a SeCTG or soft tissue substitute. In order to overcome the certain limitations in flap mobility and advancement of the TT technique, it is possible to leave a small collar of the SeCTG uncovered without risking the necrosis of the entire graft. The TT provides a good option for the treatment of gingival recession, however, it has clinical limitations in regards to the treatment of deep single recession defects: in these instances, due to the limited flap mobility, an unfavorable high amount of the graft would have to be left uncovered, presumably undergoing subsequent necrosis. For this reason, defects deeper than 5 mm were excluded from this clinical trial.

Table 4. Changes 12 months vs. baseline in clinical variables according groups

Variables	12 months-baseline		P value*
	SeCTG+TT	SeCTG+CAF	
	N=25	N=25	
% Root Coverage (RC). *mean (SD)*	87 % (SD:17.5)	85% (SD:17)	0.704
Complete Root Coverge (CRC). *N (%)*	15 (60%)	13 (52%)	0.569 †
GH changes. *mean (SD)*	-2.92 (0.7)	-2.92 (0.75)	0.983
PD changes. *mean (SD)*	0.04 (0.53)	0 (0.64)	0.817
CAL changes. *mean (SD)*	-2.88 (0.97)	-2.92 (0.95)	0.694
KTH changes *mean (SD)*	2.60 (0.81)	1.68 (1.10)	0.002

Changes in each clinical variable were calculated: 12 months measurements minus baseline measurements and then these variables were compared between groups.

*U Mann Whitney Test ; See text for abbreviations.

† Chi Square test; See text for abbreviations.

No differences were observed in dif_GH. dif_PD or dif_CAL between groups. Declines in GH. PD and CAL are similar in both groups. Only statistical difference was observed in dif_KTH. in TT group increase is higher (2.6 vs 1.68; p=0.002). No differences between groups in % root coverage or complete root coverage.

Future Perspectives

Future Perspectives

As the demand for esthetics in dentistry has increased, SCTGs have increasingly become an integral component of periodontal therapy. Over the years, numerous surgical techniques have been introduced to correct labial, gingival recession defects. Aesthetic concerns are usually the reason to perform these procedures. Clinical studies have evaluated many of the techniques with or without grafting procedure valuating the results in terms of mid-surface root coverage.

Nowadays, clinical efficacy, chair time and patient post-operative morbidity seem to drive most of the clinician's treatment options. However, It is the patient, not the surgeon, who primarily should judge the success of root coverage procedures. Thus, a key metric should be patient satisfaction. For other conditions, such qualitative outcome is usually measured by Visual Analog Scales, other scores or questionnaires. Surprisingly, this has not been part of the available literature. A system for patient's own evaluation, adapted to root coverage procedures, is highly needed and should be included in future research.

All the various techniques, although similar, have subtle differences in outcomes and indications. The techniques presented here are ideal for achieving uniform esthetic tissue contours and rarely require a second procedure of gingivoplasty.

In the future we will see further evolution of materials and techniques for increasing zones of attached gingiva, covering roots and implants, and reconstructing lost papillae. Periodontal plastic surgery continues to be a challenging and exciting area of the specialty of periodontology. New procedures should be developed to improve complete root

coverage in Class I and Class II decision-making in root coverage. They should be simplified to ensure a wider reproducibility and to decrease the cost benefit ratio. Progress in the creation of gingival papillae in Class III and Class IV recession defects is desirable. Further research is needed to evaluate the influence of soft and hard tissue attachment to the root on the stability of the results.

Conclusions

Conclusions

- the treatment of maxillary gingival recession with coronally advanced flap and connective tissue showed better primary outcome in terms of recession reduction after 12 months of follow-up;
- both treatments are equally effective in providing a consistent reduction of the baseline recession;
- the use of a computerized image analysis system may be simple and reliable in order to measure the soft tissue modifications during a follow-up period.
- Both SeCTG+TT and CAF+SeCTG rendered satisfactory clinical outcomes. Both treatments showed similar efficacy in terms percentage of root coverage (87% vs. 85%, p=704) or patients with complete root coverage (60% vs. 52%, p=0.569). Healing was uneventful for both test and control patients.
- The SeCTG+TT group required longer chair time and higher painkiller assumption. Patients treated with SeCTG+CAF reported significantly less pain or discomfort in all four sections of the questionnaire: pain experienced within the mouth as a whole, pain experienced throughout the day, pain experienced at night and edema experienced after the surgery (p=0.002, p=0.001, p=0.001 and p=0.001 respectively).

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Attachments

Appendix I

1. Pain experienced within the mouth as a whole:

no pain worst possible pain

2. Pain experienced while drinking hot beverages:

no pain worst possible pain

3. Pain experienced while drinking cold beverages:

no pain worst possible pain

4. Pain experienced in the morning:

no pain worst possible pain

5. Pain experienced throughout the day:

no pain worst possible pain

6. Pain experienced at night:

no pain worst possible pain

7. Edema experienced after the surgery:

no pain worst possible pain

8. Would you be willing to go through with this surgery again if recommended by your dentist?

YES NO

9. Did you experience bleeding (ie "bright red" color in saliva)?

YES NO

10. Did you take the pain medication?

YES NO

11. If YES, how many pills did you take?

0-5 5-10 10-15

Appendix II

Here is a sample scale that we call a visual analogue scale (VAS). Please place a mark on the line that shows how intense the blackness of each box is. To practice using a VAS, you need to understand that placing a mark on the very left of the line means that the box is either not black at all, or slightly black, while a mark placed on the right end of the line means that the box is very black. Please practice with the diagrams/VAS below and then please answer the survey questions. In regard to these questions, the more you agree with a statement your mark on the line will be farther to the right.

Here's a sample for you showing where you'd probably place your mark on the scale...

The temperature in the middle of August is generally:

Not Hot at all _____**/__Extremely Hot**

The temperature in the middle of February is generally:

Not hot at all__/_____**Extremely Hot**

NOW... can you please practice for us?

1) How black/dark is this square?

Not at all ——————————— Extremely

2) How black/dark is this square?

Not at all ——————————— Extremely

3) How black/dark is this square?

Not at all ——————————— Extremely

4) How black/dark is this square?

Not at all ——————————— Extremely