

Loïc Baille Barrelle

**Non-carious cervical lesion and gingival recession**  
**A literature review**

Universidade Fernando Pessoa  
Faculdade Ciências da Saúde  
Porto, 2020



Loïc Baille Barrelle

**Non-carious cervical lesion and gingival recession**  
**A literature review**

Universidade Fernando Pessoa  
Faculdade Ciências da Saúde  
Porto, 2020

Loïc Baille Barrelle

**Non-carious cervical lesion and gingival recession**  
**A literature review**

Literature review presented to the Universidade Fernando Pessoa  
as part of the requirements for the obtention of  
Dental Medicine master's degree

---

## RESUMO

**Objetivo:** Em pacientes com recessão gengival (GR) e lesão cervical não cariada (NCCL), em termos de redução da recessão, recobrimento radicular, sensibilidade dentinária e estética:

- 1) A abordagem restauradora/cirúrgica combinada é mais eficaz que a abordagem cirúrgica sozinha ?
- 2) Nos pacientes tratados com a abordagem combinada, quais são os impactos de diferentes materiais restauradores ?

**Materiais e métodos:** Ensaios clínicos randomizados foram pesquisados em dois bancos de dados. 12 publicações foram incluídas. No total foram selecionados 471 pacientes com recessão gengival de classe I ou II de Miller, com períodos de follow-up de até 24 meses.

**Resultados:** A redução média de GR e o recobrimento médio dos estudos são, respectivamente, de cerca de 2,2 mm ( $\pm 0,69$ ) e 89,7% ( $\pm 18,36$ ) com o procedimento cirúrgico e 2,1 mm ( $\pm 0,64$ ) e 86,1% ( $\pm 18,34$ ) com o procedimento combinado. Além disso, ambos os procedimentos apresentaram uma redução significativa da hipersensibilidade dentinária e melhoria estética. No entanto, com a restauração, os resultados de sensibilidade foram próximos de zero. Em relação à estética, quando comparado com o ionômero de vidro modificado por resina, o compósito apresentou melhor estabilidade de cor após um ano.

**Conclusões:** Tanto as abordagens combinada como a cirúrgica parecem ser eficazes para alcançar o recobrimento radicular. Ambas as técnicas podem reduzir a hipersensibilidade dentinária, mas em locais restaurados, essa redução é máxima. Ambas parecem induzir uma melhoria estética, embora, as restaurações com resinas compostas tendam a fornecer resultados ligeiramente mais estéticos, por outro lado, as restaurações de resina de ionômero parecem ser bem toleradas pelo ambiente periodontal.

**Palavras-chave:** recessão gengival, lesão cervical não cariada, enxerto de tecidos moles, retalho de avanço coronal, enxerto de tecido conjuntivo.

## **ABSTRACT**

**Aim:** In patients with gingival recession (GR) and non-carious cervical lesion (NCCL), in terms of recession reduction, root coverage, dentin sensitivity and aesthetic:

- 1) Does the combined restorative/surgical approach is more effective than the surgical approach alone?
- 2) In patients treated with the combined approach, what are the impacts of different restorative materials ?

**Materials and methods:** Randomized clinical trials were searched in two databases. 12 publications were included. 471 patients with a Miller class I or II gingival recession were selected, with follow-up periods up to 24 months.

**Results:** The mean GR reduction and the mean root coverage of the selected studies are respectively about 2,2 mm ( $\pm 0,69$ ) and 89,7% ( $\pm 18,36$ ) with the surgical procedure, and 2,1 mm ( $\pm 0,64$ ) and 86,1% ( $\pm 18,34$ ) with the combined procedure. Besides, both procedures presented a significant dentin hypersensitivity reduction and an aesthetic improvement. Nonetheless, with a restoration, the sensitivity scores were close to zero. Regarding the aesthetic, compared to resin modified glass ionomer, the resin composite showed a better color stability after one year.

**Conclusions:** Both combined and surgical approaches seem to be as effective to achieve root coverage. Both techniques may reduce dentin hypersensitivity, but at restored sites, this reduction is maximal. Both procedures seem to induce an aesthetic improvement, although, when a restoration is performed, composite resins tend to provide slightly more aesthetic results. While ionomer resin restorations appear to be very well tolerated by the periodontal environment.

**Key-words:** gingival recession, non-carious cervical lesion, soft tissue graft, coronally advanced flap, connective tissue graft.

## **ACKNOWLEDGEMENTS**

I would like to say a sincere thank you to Mestre Tiago Ribeiro Amaral, for his availability and his precious help in writing this work. Please find here, the testimony of my deep recognition and respect.

To the Universidade Fernando Pessoa which allowed me to study dentistry, for the education I received, for the opportunities for the discoveries and knowledge that are inherent to this university.

I want to thank my parents from the bottom of my heart for supporting me so much, without you I wouldn't be here today. I am lucky to have you and today I am grateful to you for having contributed to my success. Thank you mom, thank you dad.

I would now like to thank Carla, my sweetheart, my accomplice for almost 7 years. Thank you for your support and your love. Such studies are a real challenge for a couple and I am proud that we have taken them up together.

To my friends and colleagues: Benoit and Augustin, we have not given up since the first days. Difficult to come from more distant places in France, but that did not prevent us from feeling united. For these moments of study, all these parties, these good times: expatriados!

For all those who matter to me, my entire family, Carla's family, and my friends in France.

## INDEX

I. INTRODUCTION .....	1
1. Materials and methods .....	5
II. DEVELOPMENT .....	8
1. Results .....	8
i. Root coverage surgery with or without restoration to treat GR with NCCL .....	8
ii. Restorative/surgical coverage procedure comparing restorative materials .....	9
2. Discussion .....	11
i. Root coverage surgery with or without restoration to treat GR with NCCL .....	11
ii. Restorative/surgical coverage procedure comparing restorative materials .....	13
3. Limitations .....	15
III. CONCLUSION .....	15
IV. BIBLIOGRAPHY .....	16
V. ATTACHMENTS .....	19



**ATTACHMENT INDEX**

Table 1: PICO 1 – Methodological characteristics of the included studies ..... 19

Table 2: PICO 2 – Methodological characteristics of the included studies ..... 22

Figure 1: Flow chart summarizing the results of the search ..... 24

Figure 2: Risk of bias in individual studies ..... 25

Annex 1: A method to predetermine the line of root coverage ..... 26

Annex 2: Decision-making process proposal for selecting the ideal management  
in the treatment of gingival recession and non-carious cervical lesion ..... 27

**ABBREVIATION LIST**

**CAF** – coronally advanced flap

**CEJ** – cemento enamel junction

**CTG** – connective tissue graft

**CRC** – complete root coverage

**GR** – gingival recession

**MGJ** – mucogingival junction

**MRC** – maximum root coverage

**MRES** – modified root coverage aesthetic score

**NCCL** – non carious cervical lesion

**RCT** – randomized clinical trial

**RMGI** – resin modified glass ionomer

**VAS** – visual analog score

## I. INTRODUCTION

A gingival recession (GR) is described as the loss of marginal gingiva, with the radicular surface exposed, driven by an apical migration of the margin beyond the cemento-enamel junction (CEJ) (Cairo *et al.*, 2011). The most commonly affected teeth are the upper molar, pre-molar and canines, and the inferior incisors, canines and premolars. The prevalence of GR is about 80% in the adult population (Nieri *et al.*, 2013), and specially in aged patients with high - or poor - quality oral hygiene (Serino *et al.*, 1994). GR are a frequent motive of consultation, and patients complain about aesthetics, fear of losing their teeth and sensitivity caused by thermal stimuli or contact (Borguetti *et al.*, 2008).

Zucchelli *et al.* (2015) described the etiologies of GR with three factors. The anatomical factor: GR occurs when the alveolar bone is likely to present fenestration or dehiscence, or when the anatomy of the tooth is prone to recession (narrow, long teeth), or when the eruption pathway of a tooth is incorrect. The physiological factor includes tooth malposition that can be caused by orthodontic movement and leads the teeth towards outside the alveolar bone and reduces gingiva thickness. The pathological factors are mostly microtraumas caused by improper toothbrushing or flossing, biting nails, piercings, bacterial plaque (which leads to inflammation and attachment loss).

Until the last world workshop for periodontal and peri-implant diseases and conditions, clinicians and researchers used Miller's (1985) classification based on the prognosis of root coverage according to the extension of the gingival loss and the presence of the interproximal tissue. It was composed of 4 classes. Class I: GR does not extend to the mucogingival junction (MGJ), a complete root coverage (CRC) is possible. Class II: GR extends to or beyond the MGJ without periodontal attachment loss, a CRC is possible. Class III: GR extends to or beyond MGJ with interproximal loss, a parcial coverage is possible. Class IV: GR extends to or beyond the MGJ with severe interproximal and bone loss, a root coverage is impossible. Later on, Cairo *et al.* (2011) introduced a classification using the level of interproximal clinical attachment. It allows to predict the prognosis of root coverage and divided the recession-types into 3 classes. RT1: there is no loss of interproximal attachment, CRC was observed in 74% of the cases. RT2: the interproximal attachment loss is inferior or equal to vestibular loss, CRC was observed in 24% of the cases. RT3: the interproximal attachment loss is superior to vestibular loss, root coverage was not predictable.

The root coverage procedure is considered as the ideal management of these types of lesions, with one of the objectives to be the achievement of a CRC (Zucchelli *et al.*, 2015). In order to achieve this goal, several surgical techniques were described in the literature. The coronally advanced flap (CAF) was described by Allen & Miller (1989). This flap is a common approach with indications for isolated teeth with aesthetic demands. The procedure involves covering the exposed root surface with a pedicled flap displaced in the coronal direction. Zucchelli & De Sanctis (2000) proposed a modification of the CAF technique that allows multiple recessions defects treatment, with no vertical releasing incisions. Besides, to successfully treat multiple recessions, other technique - the tunnel technique - was first described by Allen *et al.* (1994) and later on by Zabalegui *et al.* (1999). In this minimally invasive procedure, the interpapillae is left intact, there is no vertical incisions, so this technique aims to provide the best aesthetic results and reduction of discomfort for the patient. Moreover, to increase the width of the attached gingiva and improve predictability of the results in the long term, a subepithelial connective tissue graft (CTG) can be associated to these techniques to treat single or multiple GR (Cairo *et al.*, 2008).

However, according to Zucchelli *et al.* (2006), in some cases, incomplete root coverage was observed in Miller class I and II GR when there was an absence of a visible CEJ. Indeed, in 50% of the analyzed teeth, there was no sign left of this anatomical line. This situation can lead to an error in the localization of the CEJ, that can induce an incomplete coverage of the defect area. In the same study, Zucchelli *et al.* (2006) proposed a method for determining the maximum line of root coverage (see annex 1). The authors added that in 90% of the case, a cervical abrasion was responsible for the disappearance of the CEJ.

In the literature, this type of cervical abrasion is described as non-carious cervical lesion (NCCL) (Imfeld, 1996). This lesion is a pathological dental wear, located in the cervical third of the crown. They are manifested by progressive destruction of hard tissue, altering anatomical forms (Jaeggi & Lussi, 2006). Que *et al.* (2013), revealed that out of a total of 1023 individuals, 61,9% had at least one NCCL, including 27,1% with cervical tooth hypersensitivity. According to Jaeggi & Lussi (2006) the vestibular surfaces of the maxilar premolars and canines are preferential sites. Also, the prevalence increases with age, in developed countries and in people with high oral hygiene (Jaeggi & Lussi, 2006).

The etiology of NCCL is multifactorial (Grippo *et al.*, 2004; d'Incau *et al.*, 2012), three factors can be distinguished : the abrasion (with the abrasiveness of brushing and tooth-pastes, piercings), the erosion (caused by an acid aggression of intrinsic or extrinsic origin that induce a phenomenon of demineralization of dental surfaces) and the abfraction (repeated flexion forces in the cervical area caused by occlusal forces ignite the lesion). Besides, both GR and NCCL are mutual etiologic factors: the presence of a GR can induce a NCCL because the root is exposed and thus more susceptible to the erosion (Imfeld, 1996). Also, a cervical lesion can aggravate a GR by increasing the apical migration of the gingiva margin. Indeed, Rasperini *et al.* (2018), revealed in a 9 years follow-up study that the presence of a NCCL negatively affected the root coverage in the treatment of recession by CAF  $\pm$  CTG.

The first classification of NCCL is from Michael *et al.* (2010) - lesions were classified according to five morphological categories, but did not include etiological criteria (abrasion, erosion, abfraction) or treatment plan. The second classification proposed by Pini-Prato *et al.* (2010), is specific to surface defects associated with GR. 4 classes were described according to the identification of the CEJ and the association or not with a step (a pronounced root surface discrepancy). Class A-: the CEJ is visible, without step. Class A+: the CEJ is visible, with step. Class B-: the CEJ is not visible, without step. Class B+: the CEJ is not visible, with step.

Moreover, the loss of cervical tooth substance causes exposure of dental tubulis, which can increase sensitivity to thermal and mechanical stimuli (Brannstrom, 1992). The first-line management consists on etiological identification (abrasion, erosion or abfraction), and treatment: occlusal equilibration (Grippo *et al.*, 2012), teaching brushing technique or an adapted dentifrice, correcting acidic eating habits or gastric reflux (Lussi *et al.*, 2004; Farahmand *et al.*, 2013). The use of topically applied pastes containing casein phosphopeptides and amorphous calcium phosphate can induce remineralization of the enamel after an acid attack (Cochrane *et al.*, 2010). It is also possible to seal open dentinal tubules with the use of desensitizing agents like potassium nitrate and the stannous fluoride, or to apply protective coatings or adhesives (Veitz-Keenan *et al.*, 2013). Nevertheless, when the first-line of treatment is not enough, a restorative treatment can be performed. Resins flow composites (Noble *et al.*, 2016) are recommended for an aesthetic improvement. The clinician could as well use ionomer glasses modiflicated by resin for the biocompatibility

and antibacterial action by fluoride release, and this material can tolerate oral moisture (Francisconi *et al.*, 2009). For the most extensive lesions, an indirect restoration with a ceramic facet may be indicated (Lussi *et al.*, 2002).

Furthermore, the specific management of GR associated with NCCL was discussed during the 2017 world workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions. Jepsen *et al.* (2018) proposed a new classification to describe gingival phenotype and recessions associated to NCCL. This diagnostic table divides the recession-types (no recession, RT1, RT2 and RT3) according to their depth, the gingival thickness, the amount of keratinized tissue width, the presence or not of a visible CEJ, and the presence or not of a NCCL (called step or root surface concavity).

In addition, Zucchelli *et al.* (2011), according to his previous work whereby the CEJ disappears because of the NCCL (Class B- or B+ of Pini Prato *et al.* (2010)), proposed that the ideal treatment of a crown-radicular NCCL should consist of a combined restorative/periodontal treatment, with a coronal restoration reaching the CEJ. Achieving the restorative treatment before the mucogingival surgery presents some clinical advantages for both therapies: the restoration is easily performed without interference of the soft tissues, and this reconstruction of the clinical crown emergence profile facilitates the root-coverage surgery. The composite restoration should finish in a position described as the maximum root coverage level (MRC), that corresponds to the line of root coverage (that should coincide with the anatomic CEJ). The adapted treatments according to the different positions of the MRC are described with 5 cases:

NCCL type 1: the MRC is located > 1 mm coronal to the coronal step of the NCCL. The treatment consisted of a CAF.

NCCL type 2: the MRC is located at the level of the coronal step of the NCCL. The treatment is a CAF + CTG, to prevent the graft to collapse inside the abrasion space.

NCCL type 3: the MRC is located in the deepest portion of the abrasion defect. The treatment is restorative with an odontoplasty and composite restoration finished at the level of the MRC, and surgically with a CAF.

NCCL type 4: due to a papilla loss, the MRC is located apical to the deepest portion of the abrasion defect. The treatment consists of a composite restoration finished at the level of the MRC and a surgical CAF.

NCCL type 5: the MRC is located at the level of the most apical extension of the NCCL due to a severe loss of papilla height. The treatment is a composite restoration finished at the level of the MRC (and a CAF if the NCCL reached or extended beyond the soft tissue margin).

Chambrone and co-workers (2014) performed a literature review aiming to understand if the use of a combined surgical/restorative approach increased the clinical outcomes of a GR with NCCL compared to the surgical approach alone, in terms of root coverage and aesthetics. In this review, only four studies were analyzed and did not consider either the dentin sensitivity or the GR reduction. Indeed, the main challenges in these types of lesions are the need to cover the gingival defect, the aesthetic aspect and the dentin sensitivity. Besides, considering the conservative/periodontal treatment, several materials can be used to treat NCCL, like resin composite or resin glass ionomer. That is why Chambrone *et al.* (2014) recommended that the ideal type of restorative material should be also evaluated.

Finally, the aim of this systematic review is to answer the following (PICO) questions:

(PICO1) In patients with GR and NCCL, does the restorative/surgical approach is more effective than the surgical approach alone in terms of GR reduction, root coverage, level of dentin sensitivity and aesthetic ?

(PICO2) In patients with GR and NCCL treated with the combined restorative/surgical approach, what are the impacts of different restorative materials in terms of GR reduction, root coverage, level of dentin sensitivity and aesthetic ?

## 1. Materials and methods

### Protocol development

This review was reported according to the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analyses) statement (Moher *et al.*, 2009).

### Population (P), Intervention (I), Comparison (C), Outcomes (O) – PICO

The focus questions were developed according to the population, intervention, comparison, and outcome (PICO) study design. The criteria were defined prior to the bibliographic search:

- (P) Population: all type of patients with GR and NCCL in at least one site;
- (I) Interventions: restoration associated to a periodontal surgery (PICO1); or

- different restorative materials (PICO2);
- (C) Comparisons: periodontal surgery alone (PICO1 and PICO2);
  - (O) Outcomes: GR reduction, root coverage, dentin sensitivity and aesthetic.

#### Focused questions

- Does the restorative/surgical approach is more effective than the surgical approach alone in terms of GR reduction, root coverage, level of dentin sensitivity and aesthetic in patients with GR and NCCL?
- Does the type of restorative material in the combined restorative/surgical approach, has an impact in the outcomes in terms of GR reduction, root coverage, level of dentin sensitivity and aesthetic in patients with GR and NCCL?

#### Eligibility criteria and study selection

Randomized control trials (RCT), whose objective was to analyze GR reduction, root coverage, level of dentin sensitivity and aesthetic were included. To be included, studies should have a minimum number of 10 patients and no limit regarding the time of follow-up was set. Systematic review, narrative review, animal studies and case reports were excluded. In addition, studies reporting about compliance with oral hygiene instructions only or with APT were not included.

#### Types of interventions and comparisons

For the question PICO1, to be included these articles must compare the surgical management of GR with NCCL (treated with a CAF or CAF + CTG), with or without previous restoration. For the question PICO2, to be included these articles must compare different restorative materials in the combined treatment of GR associated with NCCL.

#### Primary and secondary outcomes

The two primary outcomes for assessing the efficiency of the use of a restoration (PICO1) or the efficiency of a type of restorative material (PICO2) were the GR reduction (in mm) and the root coverage (in %). The two secondary outcomes were the hypersensitivity (evaluated with the VAS-S: patients had to choose from 0 to 10 (0 indicating no sensitivity, 10 indicating maximum sensitivity) and aesthetic result (evaluated with the VAS-E (0 indicating very bad, 10 excellent) in terms of overall satisfaction, color match and the amount of root coverage; and other methods from the authors of the studies.



### Literature search protocol

Electronic and manual literature searches were conducted independently by two authors (L.B.B. & T.R.A.). A systematic search for RCT assessing the treatment of GR with NCCL was performed in two electronic databases (MEDLINE and the Cochrane Oral Health Group Specialized Register database) without language restriction up to January 2020 using the following MeSH terms, key words, and other free terms: [(gingival recession) OR (recession defect)) OR (recession-type defect)] OR (root exposure)] AND [(non-carious cervical lesion) OR (tooth cervix)] AND [(soft tissue graft) OR CAF OR (coronally advanced flap) OR CTG OR (connective tissue graft)]. Hand searching of reference lists was performed in Journal of Periodontology, Journal of Periodontal Research, Journal of Clinical Periodontology, and International Journal of Periodontics and Restorative Dentistry).

Figure 1 depicts the flowchart summarizing the results of the search. 1601 articles were identified from the screening of the two databases, containing the keywords used for the research: 1073 references in MEDLINE and 528 in the Cochrane library. After duplicates discarded, application of filters, 35 articles fulfilled the inclusion criteria and were relevant for this review. Following the reading of titles and abstracts, 15 articles were kept for complete reading. Three articles (Santamaria *et al.* (2010), Santamaria *et al.* (2013), Cairo *et al.* (2020)) were excluded because the aims and main outcomes of these studies were different from the ones of this review.

### Quality assessment (risk of bias in individual studies)

The methodological quality of RCT studies were assessed by the Cochrane Handbook (Higgins *et al.*, 2019). Each study was classified into the following groups: low risk of bias if all quality criteria were judged as “present,” moderate risk of bias if one or more key domains were “unclear,” and high risk of bias if one or more key domains were not “present”. Figure 2 depicts that no single RCT assessed with Cochrane Handbook demonstrated low risk of bias for all the criteria. Most of them provided a detailed report about randomization, measurement of the outcome and selection of the reported result, but not regarding other key domains such as deviations from the intended interventions (because of the lack of blinding operators and outcomes assessors) and missing outcome’s datas (most of the time patients centered outcomes: sensitivity and aesthetic).

## II. DEVELOPMENT

### 1. Results

The 12 articles selected were randomized controlled trials with a follow-up from 6 to 24 months, and the number of subjects on the studies ranged from 16 to 78 (471 patients in total), males and females, all with a Miller class I or II gingival recession or RT1 from Cairo. All the subjects are non-smokers, without systemic disease.

#### i. Root coverage surgery with or without restoration to treat GR with NCCL

##### *Primary outcomes*

Concerning GR reduction and root coverage improvement, Santamaria *et al.* (2008, 2009), with 19 and 16 patients at 6- and 24-months follow-up, respectively, compared the outcomes of a CAF alone or in combination with a resin modified glass ionomer (RMGI) restoration. The authors shared results of 1,5 mm of GR reduction and 97,48% of root coverage in the CAF group, and 1,39 mm and 88,02% in the RMGI group, respectively. Thus, the restoration by RMGI seemed to have no effect on root coverage after a CAF. Santamaria *et al.* (2009 and 2013) with 40 patients for a period of 6 months and 36 patients in 24 months respectively, compared the results of a CAF + CTG alone with those of a CAF + CTG combined with a restoration (RMGI). In the 2009's study, the CAF + CTG group presented 2,53 mm of GR reduction and 91,91% of root coverage, whereas the CAF + CTG + RMGI group presented 2,31 mm and 88,64%, respectively. Similar results were obtained in 2013's study - the CAF + CTG group presented 2,63 mm of GR reduction and 91,56% of root coverage, whereas the CAF + CTG + RMGI group presented 2,38 mm and 93,29%. No statistically significant difference was observed between the results of the GR reduction and root coverage percentages obtained in these studies. The same authors reported similar results in 2016 and 2018, where CAF + CTG was combined with a resin composite restoration. In 2016, the control group presented 2,82 mm of GR reduction and 82,16% of root coverage and the test group 2,72 mm and 73,84%. In 2018, the control group presented 2,4 mm of GR reduction and 92,2% of root coverage and the test group 2,5 mm and 93%. Gharat *et al.* (2019) performed a study with 30 patients for 6 months, to compare the outcomes of CAF + CTG alone and CAF + CTG + RMGI - the control group revealed a maximum root coverage of 69,24%, and the test group 61,54%.

##### *Secondary outcomes*

Regarding dentin sensitivity reduction, Santamaria *et al.* (2008) revealed a significant reduction in both groups. At baseline 68.42% of the subjects had sensitivity, and after

treatment, the CAF group presented a reduction to 47.36% and the CAF + RGMI group to 5.26%. Santamaria *et al.* (2009) reported 60% of the subjects from the CAF + CTG group and 70% of the subjects from the CAF + CTG + RGMI group with sensitivity at baseline. After 6 months, the CAF + CTG group presented 35% and the CAF + CTG + RGMI group showed 5%. During a 12 months follow-up study (Santamaria *et al.*, 2016), the hypersensitivity decreased respectively from 94% to 44% in control group and 88% to 5,5% in CTG + RC group. Besides, Santamaria *et al.* (2018) during a follow-up of only 6 months, presented a VAS-S result in the CAF + CTG group of 1,3 and in the CAF + CTG + RC group of 0,6. In 2019, Gharat and col, showed results of 1 in the control group VAS-S, while the CAF + CTG + RGMI group had a score of 0.

Furthermore, the aesthetic aspect was studied by Santamaria *et al.* (2014) with the modified root coverage aesthetic score (MRES). It revealed the CAF group obtained a score of 6,3; the CAF + RGMI 5,2; the CAF + CTG 7,3 and the CAF + CTG + RGMI 5,0. In Santamaria *et al.* (2016), the aesthetic factor was evaluated with MRES and VAS with respectively 7,44 and 8,29 in the control group, and 7,52 and 8,66 in the CAF + CTG + RGMI group. Besides, Santamaria *et al.* (2018), presented a VAS-E in the CAF + CTG group of 9,2 and in the CAF + CTG + RC group a result of 9,1.

## **ii. Restorative/surgical coverage procedure comparing restorative materials**

### ***Primary outcomes***

Concerning GR reduction and root coverage improvement, Lucchesi *et al.* (2007) evaluated the treatment of GR associated with NCCL in 59 patients. At 6 months following surgery, three groups were compared (control group without NCCL treated with a CAF presented a GR reduction of 2,2 mm and a root coverage of 80,83% ; NCCL restored by RMGI + CAF had a result of 2,1 mm and 71,99% ; NCCL restored by micro-filled resin composite + CAF presented a result of 2,15 mm and 74%). Comparison of these results did not reveal significant differences, all treatments showed root coverage improvement without damage to periodontal tissues. Santos *et al.* (2007) with 54 patients after 6 months follow-up, presented results of recession reduction of 2,2 mm in control group (CAF), 2,1 mm in the group treated by CAF + RMGI, and 2,3 mm in the group with micro-filled resin composite. All groups had a significant root coverage improvement. Isler *et al.* (2018) did a study with 23 patients for 12 months, treating the recession and NCCL with CAF + CTG in association with different materials to be tested in three distinct groups. The group 1 was

treated with nano-filled composite resin and presented a root coverage of 71,18%, the group 2 was treated with RMGI and had a root coverage of 71,33% and the group 3 was treated with giomer (fluoride-releasing resin materials with pre-reacted glass) and showed a root coverage of 64,23%. Nano-filled composite and RMGI showed similar clinical results, but giomer may be less effective compared to other groups. Dursun *et al.* (2018) in a 12 months follow-up with 36 patients, compared the effectiveness of RMGI or nano-ionomer cement associated with CAF + CTG in 36 patients, for the treatment of a recession with NCCL. The control group presented a recession reduction of 3,16 mm and a root coverage of 96,22%, The RMGI group had a GR reduction of 3,22 mm and a root coverage of 89,49%, The nano-ionomer cement group presented a GR reduction of 3,08 mm and a root coverage of 90,12%. The three groups had improvements in terms of GR reduction and root coverage, but there were no statistically significant differences between the groups.

### ***Secondary outcomes***

As for the dentin sensitivity reduction, Isler *et al.* (2018) used the VAS-S, with a jet of air directed to the root surface. The nano-filled composite group had 0,73/10, the RMGI group 0,95 and the giomer group 1,26. VAS-S between the groups didn't reach any statistically significant differences. Dursun *et al.* (2018) recorded the dentin sensitivity according to the answers of the participants regarding the presence or absence of cervical sensitivity in the teeth. A significant sensitivity reduction was presented in all groups at 12 months and there were no significant differences between groups regarding sensitivity reduction ( $P = 0.66$ ).

Moreover, the aesthetic factor was studied by Isler *et al.* (2018) according to the VAS-E. The nano-filled composite group had 8,93/10, the RMGI group 8,52/10 and the giomer group 8,57/10. The scores of the nano-filled composite were higher than the other groups at 1 year after the surgery. However, these differences were not statistically significant ( $p > 0.05$ ). In the study led by Dursun *et al.* (2018) the aesthetic score was recorded according to the marginal tissue contour, soft tissue texture, mucogingival junction alignment, and gingival color values. The ideal aesthetic score was 10. The score was similar in the RMGI and nano-ionomer cement groups ( $9.06 \pm 1.43$ ) and was higher in the control group than in the test groups. No statistically significant difference was detected between groups when 12-month values were analyzed ( $P > 0.05$ ).

## 2. Discussion

### i. Root coverage surgery with or without restoration to treat GR and NCCL

#### *Main findings*

Concerning the presence of a restoration combined with the root coverage procedure, the results tend to indicate that the root coverage improvement is not affected by the presence of restoration - whether in composite resin or in resin glass ionomer - whatever the surgical technique chosen: CAF or CTG + CAF (Santamaria *et al.*, 2008, 2009, 2013, 2016, 2018 and Gharat *et al.*, 2019). The presence of restoration does not ensure better success in root coverage than surgery alone. Indeed, the mean GR reduction and the mean root coverage of the selected studies are respectively about 2,2 mm ( $\pm 0,69$ ) and 89,7% ( $\pm 18,36$ ) with the surgical procedure, and 2,1 mm ( $\pm 0,64$ ) and 86,1% ( $\pm 18,34$ ) with the combined procedure. However, surgical techniques and restorative/surgical procedures presented a significant dentin hypersensitivity reduction. Nonetheless, performing a restoration showed vastly better results in the hypersensitivity reduction, with sensitivity scores close to zero (Santamaria *et al.*, 2008, 2009, 2016, 2018; Gharat *et al.*, 2019). Regarding the aesthetic outcome, the MRES and the VAS showed no significant difference between surgical and combined group. Compared to RGMI, the resin composite showed a better color stability after one year (Santamaria *et al.*, 2014, 2016, 2018).

#### *Agreements and disagreements*

Performing a restoration before a root coverage surgery does not appear to improve the coverage results. These results were observed as well by Chambrone *et al.* (2014). However, in this review, only four studies (Lucchesi *et al.*, 2007; Santamaria *et al.*, 2008; 2009; 2009) were analyzed and did not considered either the dentin sensitivity or the GR reduction. Indeed, the main challenges in these types of lesions are the need to cover the gingival defect, the aesthetic aspect and the dentin hypersensitivity. Nevertheless, when performed, these cervical restorations seem to be well tolerated and to not affect negatively the gingival environment. Indeed, the two years follow-up of RGMI and the one-year follow-up of composite resin restoration revealed good biocompatibility over time and stable results: no filling was lost, as commonly occurs in Class V restorations (Santamaria *et al.*, 2014, 2016, 2018).

The hypersensitivity reduction can be related to the fact that some cervical lesions did not achieve complete coverage with gingival tissue, due to the coronal placement of the NCCL

(Zucchelli *et al.*, 2011). Thus, part of the cervical lesion was still exposed to the oral environment in the surgical groups, whereas in the restorative/surgical group, the exposed dentinal tubules of the cervical lesion were sealed, reducing the chances of symptoms. Nevertheless, the subjective nature of dentin sensitivity evaluation in the present study should be recorded. It should be noted that the impact of the anatomy of the lesion on the amount of coverage achieved was observed by Santamaria *et al.* (2010), after CAF or CAF + CTG ± RGMI restoration. When the CAF is applied alone, data showed that the deeper the cervical lesion, the greater the coverage in the CAF group. The explanation could be the absence of root convexity due to the NCCL. Indeed, according to Miller, the excessive convexity of the root surface may negatively influence the amount of root coverage (Miller *et al.*, 1987). Furthermore, according to Cairo *et al.* (2020) the keratinized tissue thickness influences the results and thus the choice of a technique: CAF or CAF + CTG. Indeed, the CAF + CTG procedure is indicated when the keratinized tissue thickness is inferior to 0,8 mm.

Regarding aesthetic results, the RGMI restored sites provide less color stability than the resin composite sites and it will probably provide less suitable long-term aesthetic results (Gladys *et al.* 1999). Long-term follow-up is necessary to confirm this hypothesis. Another interesting finding about aesthetic result is the gingival margin contour. The groups that received a restoration achieved better gingival margin contour, while the groups without restoration presented a flattened margin more often (Santamaria *et al.*, 2014). Indeed, the tooth anatomy drives the gingival anatomy (Olsson, Lindhe, Marinello. 1993). In the groups that received the restorations, the gingival margin contour was more scalloped and anatomic, and thus more aesthetic (Santamaria *et al.*, 2014).

However, these conclusions should be interpreted with caution based on the following considerations. To achieve a maximum root coverage, restorations are performed extending up to the maximum root covered line where the CEJ was previously located, combined with a graft/flap sutured 1 mm above this point. By using this protocol, the apical part of the defect would be free of restorative material and a new connective tissue attachment could form, probably avoiding the increased probing depth. Besides, the operators that performed these restorations respected strict isolation procedures: a rubber dam isolated the operative field to keep the cervical cavity dry and decontaminated during the restorative procedure. Additionally, the possible etiological factors of NCCL were controlled, which would have positively influenced the stability of the restorations.

## ii. Restorative/surgical coverage procedure comparing restorative materials

### *Main findings*

The analysis of the results tends to confirm that the root coverage improvement is not affected by the presence of restoration, whether in micro-filled or nano-filled composite resin, resin modified glass ionomer, nano-ionomer cement, or giomer (fluoride-releasing resin materials with pre-reacted glass) (Lucchesi *et al.*, 2007; Santos *et al.*, 2007; Isler *et al.*, 2018; Dursun *et al.*, 2018). All treatments resulted in a root coverage improvement without damage to periodontal tissues. Indeed, the GR reduction and root coverage outcomes were similar between the micro-filled or nano-filled composite resin and the nano-ionomer cement. Nevertheless, the giomer presented an inferior root coverage percentage compared to others ( $p > 0,05$ ).

Nano-filled composite, RGMI and nano-ionomer cement restorations showed a great sensitivity reduction (the micro-filled composite restoration sensitivity score was not evaluated). The VAS-S score revealed that the nano-filled composite restoration presented the greater reduction of pain or hypersensitivity compared to RGMI, and even greater than giomer. However, the giomer restoration showed the worst sensitivity reduction, with the only VAS-S score superior to 1.

Besides, aesthetic assessment is very important and subjective in root coverage procedures. The VAS-E scores increased for all groups ( $p < 0.05$ ), but inter-group differences were not statistically significant for the VAS-E scores ( $p > 0.05$ ) but it would be fair to say that the score of the CAF + CTG + nano-composite restoration was slightly superior than the RGMI and giomer groups after one year follow-up.

### *Agreements and disagreements*

Chambrone *et al.* (2014) recommended that the ideal type of restorative material should be evaluated, but at this time, there were not any studies comparing restorative materials when the combined procedure was performed. However, regarding the composite resins, the major advantage of nano and micro-filled composites is the textural characterization after finishing and polishing that could lead to a lower plaque adherence and minimal soft tissue inflammation. RMGI materials have many properties (self-adhesion to dentin and enamel, epithelial and connective tissue adherence, better mechanical strength, and smoother surface compared to conventional glass ionomers) that allow them to be used successfully in the restoration of NCCL and in the subgingival area. Alternatively, the major advantages

of nano-ionomer filling are better polishability and smoother surface texture (Alkan *et al.*, 2006; Perdigao *et al.*, 2002).

This situation can be considered that resin composite materials show better wear resistance and aesthetics than the other restorative materials (Isler *et al.*, 2018). The results of using nano-composites for restoring cervical defects of teeth before root coverage procedures seem promising in terms of both clinical and patient-centered parameters.

Moreover, concerning the microbiological level, it has been recognized that some restorations provide a favorable environment for a periodontopathic microbiota. Santos *et al.* (2007) noticed that the decrease in periodontal pathogens from the red and orange complexes was more evident in the RMGI group after 6 months than in the micro-filled group. In addition, the proportion of *F. nucleatum polymorphum*, a suspected periodontal pathogen, was significantly higher in the micro-filled group compared to control and RMGI group. These data agree with a previous study in which composite resin, in contrast to glass ionomer, showed some negative effects on the composition of the subgingival biofilm (Paolantonio *et al.*, 2004). The properties of the RMGI could explain the better microbiological results: a good marginal adaptation, reduced surface roughness and fluoride and aluminum release. Therefore, it seems that RMGI may have more positive effects on subgingival biofilm composition compared to micro-filled resin. However, it may be suggested that well-finished RMGI or micro-filled subgingival restorations do not significantly affect periodontal health.

To conclude, as shown in the proposed decision-making process (see annex 2), performing a restoration before a root coverage surgery does not appear to improve the coverage results. Thus, the ideal management of a GR and NCCL may consist of performing a surgical procedure alone most of the time. However, when the coronal location of the cervical lesion (corresponding to a type 3 or 4 NCCL of Zucchelli) prevents its complete coverage, dentin hypersensitivity may persist. Restoration to the MRC line is then recommended before any surgery. The few studies about materials do not allow to give definitive conclusions, but composite resins and ionomer resins materials seems both very effective to reduce sensitivity. The major differences are about aesthetic and the periodontal environment. Aesthetic outcomes tend to be in favor of composite resins and more specifically in nano-filled composite resins. While the RGMI is well tolerated by the periodontal environment and seems to be more indicated for his microbiological proprieties and fluoride release.



### **3. Limitations**

Because of the limited number of included RCT and their methodologic designs with high and unclear risks of bias, it should be noted that there is not enough information to precisely foresee the long-term results of the treatments. Indeed, at least one additional parameter should be considered in the future: the most adequate type of restorative material in terms of resistance or long-term mechanical stability.

## **V. CONCLUSION**

Few studies have been published to evaluate the management of GR and NCCL. According to the results of this systematic review, the presence of restoration seems to have no effect on root coverage outcomes. However, a significant dentin hypersensitivity reduction was observed in all restored sites. Concerning the aesthetic result, both techniques, surgical alone and combined, resulted in an aesthetic improvement. Although restorations with composites resins seems to provide slightly more aesthetic results, ionomer resin restorations appear to be very well tolerated by the periodontal environment. Nevertheless, most of the studies addressing these topics were conducted by the same group. Finally, evaluating the effectiveness of the combined technique compared to the surgical technique alone, and looking for the ideal restorative material should be further investigated by future studies. Hence, more well-designed RCT with longer-term follow-ups, from different research groups, are needed.

## VI. BIBLIOGRAPHY

- Alkan A, Keskiner I, Yuzbasioglu E. (2006). Connective tissue grafting on resin ionomer in localized gingival recession. *J Periodontol*, 77, pp. 1446-1451.
- Allen A. (1994). Use of the supraperiosteal envelope in soft tissue grafting for root coverage. I. Rationale and technique. *Int J Periodontics Restorative Dent*, 4(3), pp. 216-27.
- Allen EP, Miller PD Jr. (1989). Coronal positioning of existing gingiva: short term results in the treatment of shallow marginal tissue recession. *J Periodontol*, 60, pp. 16–319.
- Borghetti A, Monnet-Corti V. (2008). *Chirurgie plastique parodontale*. Rueil-Malmaison: Editions CdP. XIV+449p.
- Brannstrom M. (1992.) Etiology of dentin hypersensitivity. Proceedings of the Finnish Dental Society. *Suomen Hammaslaakariseurien Toimituksia*, 88(1), pp. 7-13.
- Cairo F. *et al.* (2011). The interproximal clinical attachment level to classify gingival recessions and predict root coverage outcomes: an explorative and reliability study. *J Clin Periodontol*, 38, pp. 661–666.
- Cairo F. *et al.* (2020). Coronally Advanced Flap and Composite Restoration of the Enamel with or without Connective Tissue Graft for the treatment of single maxillary gingival recession with non-carious cervical lesion. A randomized controlled clinical trial. *J of periodontology*, 47(3), pp. 362-371.
- Cairo F, Pagliaro U, Nieri M. (2008). Treatment of gingival recession with coronally advanced flap procedures: a systematic review. *J Clin Periodontol*, 35, pp. 136–162.
- Chambrone L and Rodrigo Carlos Nahas de Castro Pinto. (2014). Does the Use of Combined Surgical/Restorative Approaches Enhance the Clinical Outcomes of Recession-Type Defects With Non-Carious Cervical Lesions?. *Clin Adv Periodontics*, 4, pp. 127-132.
- Cochrane NJ. *et al.* (2010). New approaches to enhanced remineralization of enamel. *J Dent Res*, 89, pp. 1187–1197.
- De Sanctis M, Zucchelli G. (2007). Coronally advanced flap: a modified surgical approach for isolated recession-type defects: three-year results. *J Clin Periodontol*, 34, pp. 262–268.
- Dursun E. *et al.* (2018). Nanofilled and conventional resin-modified glass ionomer fillings combined with connective tissue grafts for treatment of gingival recessions with non-carious cervical lesions. *J of oral science*, 60(3), pp. 344-351.
- Farahmand F. *et al.* (2013). Gastroesophageal reflux disease and tooth erosion: a cross-sectional observational study. *Gut Liver*; 7, pp. 278–281.
- Francisconi LF. *et al.* (2009). Glass ionomer cements and their role in the restoration of non-carious cervical lesions. *J Appl Oral Sci*, 17(5), pp. 364-9.
- Gladys S. *et al.* (1999). Evaluation of esthetic parameters of resin-modified glass-ionomer materials and polyacid-modified resin composite in Class V cervical lesion. *Quintessence Int*, 30, pp. 607-614.
- Gharat M. *et al.* (2019). Treatment of gingival recession associated with non carious cervical lesions using resin modified glass ionomer cement with connective tissue graft – a randomised controlled trial. *J of dental materials & techniques*, 8(2), pp. 85-94.
- Grippio JO, Simring M, Coleman TA. (2012) Abfraction, abrasion, biocorrosion, and the enigma of noncarious cervical lesions: a 20-year perspective. *J Esthet Restor Dent*, 24(1), pp. 10–23.
- Grippio JO, Simring M, Schreiner S. (2004). Attrition, abrasion, corrosion and abfraction revisited. *J Am Dent Assoc*, 135(8), pp. 1109-18.
- Higgins JPT. *et al.* (2019). Chapter 8: Assessing risk of bias in a randomized trial. In: Higgins JPT, Thomas

J, Chandler J, Cumpston M, Li T, Page MJ, Welch VA (editors). *Cochrane Handbook for Systematic Reviews of Interventions* version 6.0

Imfeld T. (1996). Dental erosion. Definition, classification and links. *Eur J Oral Sci*, 104(2 (Pt 2)), pp. 151-5.

d'Incau E, Couture C, Maureille B. (2012). Human tooth wear in the past and the present: tribological mechanisms, scoring systems, dental and skeletal compensations. *Arch Oral Biol*, 7(3), pp. 214-29.

Isler SC. *et al.* (2018). Clinical evaluation of combined surgical/resorative treatment of gingival recession type defects using different restorative materials: a randomised clinical trial. *J Dent Sci*, 13(1), pp. 20-29.

Jaeggi T, Lussi A. (2006). Prevalence, incidence and distribution of erosion. *Monogr Oral Sci*, 20, pp. 44-65.

Jepsen S. *et al.* (2018). Periodontal manifestations of systemic diseases and developmental and acquired conditions: Consensus report of workgroup 3 of the 2017 World Workshop on the Classification of Periodontal and Peri-Implant Diseases and Conditions: Classification and case definitions for periodontal manifestations of systemic diseases and developmental and acquired conditions. *J Periodontol*, 2(89)S, pp. 237-48.

Lucchesi JA. *et al.* (2007). Coronally positioned flap for treatment of restored root surfaces: a 6-month clinical evaluation. *J Periodontol*, 78(4), pp. 615-23.

Lussi A. *et al.* (2002). Diet and dental erosion. *Nutrition*, pp. 780-81.

Lussi A, Jaeggi, T, Zero D. (2004). The role of diet in etiology of dental erosion. *Caries Res*, 238, pp. 34-44.

Michael JA, Kaidonis JA, Townsend GC. (2010). Non-carious cervical lesions on permanent anterior teeth: a new morphological classification. *Aust Dent J*, 55(2), pp. 134-7.

Miller PD Jr. (1985). A classification of marginal tissue recession. *Int J Periodontics Restorative Dent*, 5, pp. 8-13.

Miller PD Jr. (1987). Root coverage with the free gingival graft. Factors associated with incomplete coverage. *J Periodontol*, 58, pp. 674-681.

Moher, D., Liberati, A., Tetzlaff, J., & Altman, D. G. (2009). Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Journal of Clinical Epidemiology*, 62(10), 1006-1012.

Nieri M. *et al.* (2013). Patient perceptions of buccal gingival recessions and requests for treatment. *Journal of clinical periodontology*, 40(7), pp. 707-12.

Noble W. *et al.* (2016). Non carious Cervical Lesions. *Decisions in dentistry*.

Olsson, Lindhe, Marinello. (1993). On the relationship between crown form and clinical features of the gingiva in adolescents. *J Clin Periodontol*, 20, pp. 570-577.

Paolantonio M. *et al.* (2004). Clinical and microbiological effects of different restorative materials on the periodontal tissues adjacent to subgingival class V restorations. *J Clin Periodontol*, 31, pp. 200-207.

Perdigão J. *et al.* (2012). Randomized clinical trial of two resin-modified glass ionomer materials: 1-year results. *Oper Dent*, 37, pp. 591-601.

Pini-Prato G. *et al.* (2010). Classification of dental surface defects in areas of gingival recession. *J Periodontol*, 81(6), pp. 885-90.

Prato G. *et al.* (2018). Long-term Evaluation (20 years) of the Outcomes of Subepithelial Connective Tissue Graft plus Coronally Advanced Flap in the Treatment of Maxillary Single Recession-type Defects. *J of periodontology*, 89(11), pp. 1290-1299.

Que K. *et al.* (2013). « a cross-sectional study: non carious cervical lesions, cervical dentine hypersensitivity and related risk factors. » *Journal of oral rehabilitation*, 40(1), pp. 24-32.

Rasperini G. *et al.* (2018). Predictor factors for long-term outcomes stability of coronally advanced flap with or without connective tissue graft in the treatment of single maxillary gingival recessions : 9 years results. *Periodontol*, 45(9), pp. 1107-1117.

Santamaria MP. *et al.* (2008) Coronally positioned flap plus resin-modified glass ionomer restoration for the treatment of gingival recession associated with non-carious cervical lesions: a randomized controlled clinical trial. *J Periodontol*, 79(4), pp. 621-8.

Santamaria MP. *et al.* (2009). 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*, 36(5), pp. 434-41.

Santamaria MP. *et al.* (2009). 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*, 36(9), pp. 791-8.

Santamaria MP. *et al.* (2010). The influence of local anatomy on the outcome of treatment of gingival recession associated with non-carious cervical lesions. *J Periodontol*, 81(7), pp. 1027-34.

Santamaria MP. *et al.* (2013). Connective tissue graft plus resin-modified glass ionomer restoration for the treatment of gingival recession associated with non-carious cervical lesions: microbiological and immunological results. *Clin Oral Investig*, 17(1), pp. 67-77.

Santamaria MP. *et al.* (2013). Randomized controlled clinical trial evaluating connective tissue graft plus resin-modified glass ionomer restoration for the treatment of gingival recession associated with non-carious cervical lesion: 2-year follow-up. *J Periodontol*, 84(9), pp. e1-8.

Santamaria MP. *et al.* (2014). Esthetic evaluation of different approaches to treat gingival recession associated with non-carious cervical lesion treatment: a 2-year follow-up. *Am J Dent*, 27(4), pp. 220-4.

Santamaria MP. *et al.* (2016). Resin composite plus connective tissue graft to treat single maxillary gingival recession associated with non-carious cervical lesion: randomized clinical trial. *J Clin Periodontol*, 43(5), pp. 461-8.

Santamaria MP. *et al.* (2018). Treatment of single maxillary gingival recession associated with non-carious cervical lesion: randomized clinical trial comparing connective tissue graft alone to graft plus partial restoration. *J Clin Periodontol*, 45(8), pp. 968-976.

Santos VR. *et al.* (2007). Effects of glass ionomer and microfilled composite subgingival restorations on periodontal tissue and subgingival biofilm: a 6-month evaluation. *J Periodontol*, 8(8), pp. 1522-8.

Serino G. *et al.* (1994). The prevalence and distribution of gingival recession in subjects with a high standard of oral hygiene. *J Clin Periodontol*, 21, pp. 57-63.

Veitz-Keenan A, Barna JA, Thompson V. (2013). Treatments for hypersensitive noncarious cervical lesions. *J Am Dent Assoc*, 144(5), pp. 495-506.

Zucchelli G, De Sanctis M. (2000). Treatment of multiple recession-type defects in patients with esthetic demands. *J Periodontol*, 71, pp. 1506-1514.

Zucchelli G. *et al.* (2011). Non-carious cervical lesions associated with gingival recessions: a decision

making process. *J Periodontol*, 82, pp. 1713–1724.

Zucchelli G. *et al.* (2010). Predetermination of root coverage. *J Periodontol*, 81, pp. 1019- 1026.

Zucchelli G, Mounssif I, (2015). Periodontal plastic surgery. *Periodontology 2000*, 68, pp. 333–368.

## VII. Attachments

Table 1: PICO 1 – Methodological characteristics of the included studies

Authors, year, study design, follow-up	Patients (drop- outs)	Inclusion criteria	Control Group	Test Group	Treatment Outcomes			
					GR reduction (mm) (SD)	Root coverage (%) (SD)	Hyper sensitivity	Aesthetic
Santamaria <i>et al.</i> 2008  RCT  6 months	19	GR bilateral Miller class I  NCCL: 19 patients	GR treated with CAF	GR treated CAF  +  RMGI	Control: 1,5 ± 0,3  Test: 1,39 ± 0,29	Control : 97,48 ± 15,36  Test: 88,02 ± 19,45	Control: 68.42 to 47.36%  Test: 68.42 to 5.26%	
Santamaria <i>et al.</i> 2009  RCT  6 months	40	GR Miller class I  NCCL: 40 patients	GR treated with CAF + connective tissu graft (CTG)	GR treated with CAF+CTG  +  RMGI	Control: 2,53 ± 0,78  Test: 2,31 ± 0,74	Control: 91,91 ± 17,76  Test: 88,64 ± 11,9	Control: 60 to 38%  Test: 70 to 5%	
Santamaria <i>et al.</i> 2009  RCT  24 months	16	GR bilateral Miller class I  NCCL: 16 patients	GR treated with CAF	GR treated with CAF  + RMGI	Control: 1,39 ± 0,41  Test: 1,31 ± 0,37	Control: 83,46 ± 20,79  Test: 80,37 ± 25,44		

Non-carious cervical lesion and gingival recession - A literature review

Authors, year, study design, follow-up	Patients (drop-outs)	Inclusion criteria	Control Group	Test Group	Treatment Outcomes			
					GR reduction (mm) (SD)	Root coverage (%) (SD)	Hyper sensitivity	Aesthetic
Santamaria <i>et al.</i> 2013  RCT  24 months	40  (4)	GR Miller class I  NCCL: 40 patients	CAF+CTG	CAF+CTG+RMGI	Control: 2,63 ± 0,78  Test: 2,38 ± 0,72	Control: 91,56 ± 11,74  Test: 93,29 ± 7,97		
Santamaria <i>et al.</i> 2014  RCT  24 months	78	GR Miller class I, canines and premolars  NCCL: 78 patients	CAF / CAF+CTG	CAF+RMGI / CAF+CTG+RMGI				CAF / CAF + CTG have shown the better aestetical results (numerical results not provided)
Santamaria <i>et al.</i> 2016  RCT  12 months	36	GR Miller class I & II  NCCL: 36 patients	CAF+CTG	CAF+CTG + RC	Control: 2,82 ± 0,74  Test: 2,72 ± 0,72	Control: 82,16% ± 16,1  Test: 73,84% ± 19,2	Control: 94 to 44%  Test: 88 to 5,5%	MRES and VAS Control: 7,44 ± 2,3 and 8,29 ± 2,3 Test: 7,52 ± 2,27 and 8,66 ± 1,13

Authors, year, study design, follow-up	Patients (drop- outs)	Inclusion criteria	Control Group	Test Group	Treatment Outcomes			
					GR reduction (mm) (SD)	Root coverage (%) (SD)	Hyper sensitivity	Aesthetic
Santamaria <i>et al.</i> 2018  RCT  12 months	40	GR Miller class I or II  NCCL B+: 40 patients	CAF+CTG	CAF+CTG+Parcial RC	Control: 2,4 ± 1,1  Test: 2,5 ± 1	Control: 92,2% ± 28,4  Test: 93% ± 26,1	VAS-S At 6 months Control: 1,3 ± 2  Test: 0,6 ± 1,8	VAS-E Control: 9,2 ± 1,1  Test: 9,1 ± 1
Gharat <i>et al.</i> 2019  RCT  6 months	30	GR Miller class I  NCCL: 30 patients	CAF+CTG	CAF+CTG + RGMI		Maximum root coverage Control: 69,24 Test: 61,54	Sensitivity VAS Control: 1  Test: 0	

CAF: coronally advanced flap ; CAF+CTG: coronally advanced flap + connective tissue graft ; GR: gingival recession ; MRC: micro-filled resin composite ; MRED: modification of the root coverage aesthetic score ; NCR: nano-filled composite resin ; NIC: nano-ionomer cement ; NCCL: non carious cervical lesion ; QCE: qualitative cosmetic evaluation ; RC: composite restoration ; RCT: randomized control trial ; RGMI: resin modified glass ionomer cement ; VAS: visual analog score.



Table 2: PICO 2 – Methodological characteristics of the included studies

Authors, year, study design, follow-up)	Patients (drop-outs)	Inclusion criteria	Control Group	Test Group	Treatment Outcomes			
					GR reduction (mm) (SD)	Root coverage (%) (SD)	Hyper sensitivity	Aesthetic
Lucchesi <i>et al.</i> 2007  RCT  6 months	59	GR Miller class I NCCL: 39 patients  Without NCCL: 20	GR without NCCL treated with CAF	GR and NCCL treated with:  1) RMGI+ CAF  2) MRC restoration + CAF	Control: 2,2 ± 0,7  Test 1: 2,1 ± 0,64  Test 2: 2,15 ± 0,56	Control: 80,83 ± 21,1  Test 1: 72 ± 18,69  Test 2: 74,18 ± 15,02		
Santos <i>et al.</i> 2007  RCT  6 months	54	GR Miller class I NCCL: 36 patients  Without NCCL: 18	GR without NCCL treated with CPF	GR and NCCL treated with:  1) RMGI + CAF  2) MRC restoration + CAF	Control: 2,2 ± 0,7  Test 1: 2,1 ± 0,59  Test 2: 2,3 ± 0,49			

Non-carious cervical lesion and gingival recession - A literature review

Isler <i>et al.</i> 2018 RCT 12 months	23	3 NCCL associated with GR in 3 different adjacent teeth		GR and NCCL treated with: 1) NCR + CAF+CTG  2) RMGI+CAF+CTG  3) giomer + CAF+CTG		Test 1: 71, 18 ± 23,16  Test 2: 71,33 ± 22,33  Test 3: 64, 23 ± 20,33	VAS-S Test 1: 0,73 ± 1,38  Test 2: 0,95 ± 1,63  Test 3: 1,26 ± 1,76	VAS-E Test 1: 8,93 ± 1,11  Test 2: 8,52 ± 1,65  Test 3: 8,57 ± 1,53
Dursun <i>et al.</i> 2018 RCT 12 months	36 (54 teeth)	GR Miller class I NCCL: 36 patients	GR without NCCL treated with CAF + subepitelial CTG	GR and NCCL treated with: 1) RMGI + CAF + CTG  2) NIC + CAF + CTG	Control: 3,16 ± 0,2  Test 1: 3,22 ± 0,66  Test 2: 3,08 ± 0,71	Control: 96,22 ± 10,75  Test 1: 89,49 ± 18,15  Test 2: 90,12 ± 16,58	Significant reduction in all groups (numerical results not provided)	Control: > 9,06/10  Test groups: 9,06

CAF: coronally advanced flap ; CAF+CTG: coronally advanced flap + connective tissue graft ; GR: gingival recession ; MRC: micro-filled resin composite ; MRED: modification of the root coverage aesthetic score ; NCR: nano-filled composite resin ; NIC: nano-ionomer cement ; NCCL: non carious cervical lesion ; QCE: qualitative cosmetic evaluation ; RC: composite restoration ; RCT: randomized control trial ; RGMI: resin modified glass ionomer cement ; VAS: visual analog score.

Figure 1: Flow chart summarizing the results of the search

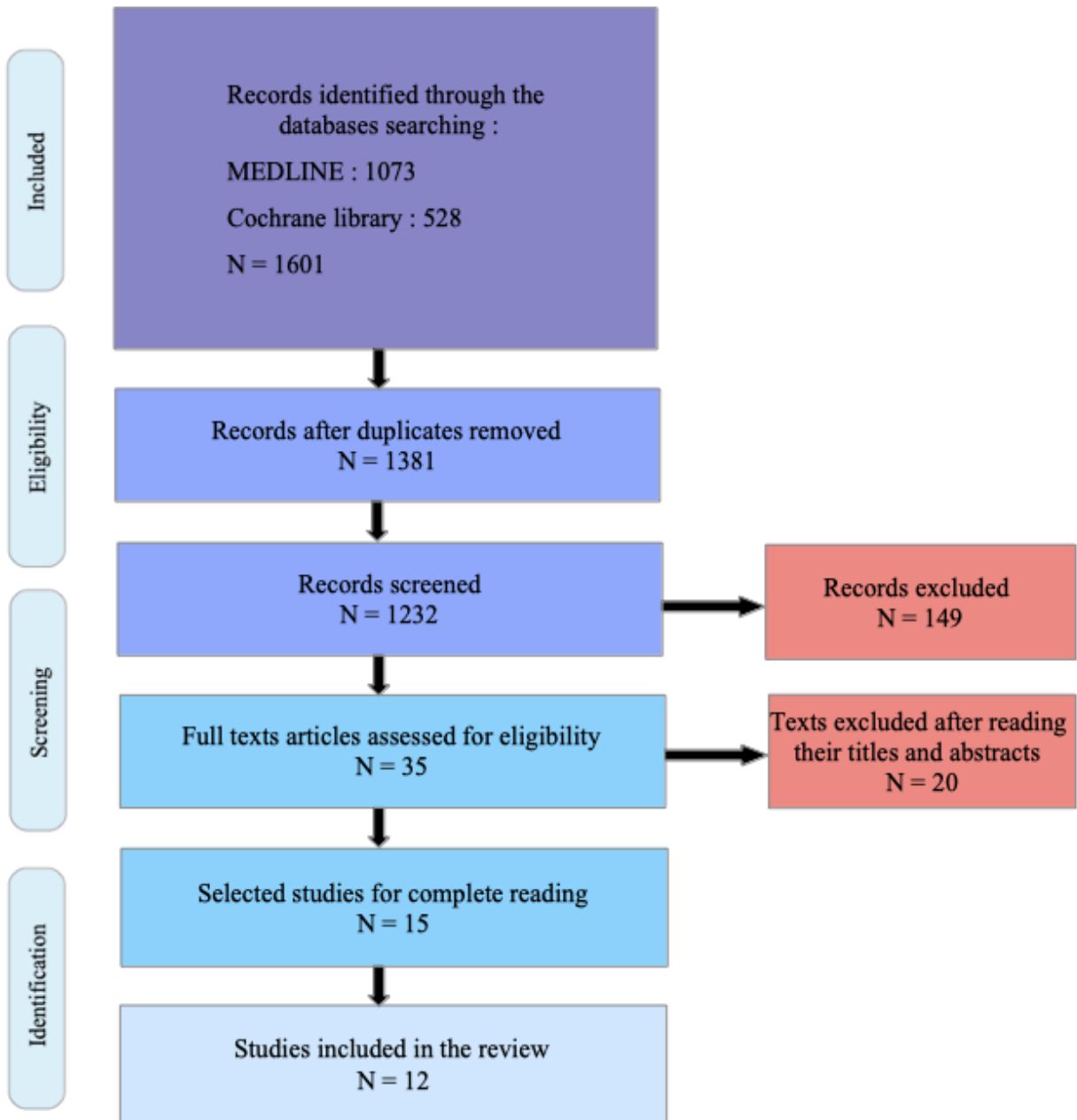


Figure 2: Risk of bias in individual studies

Authors/ Year	Random sequence generation	Deviations from the intended interventions	Missing outcome data	Measurement of the outcome	Selection of the reported result	Overall risk of bias
Lucchesi <i>et al.</i> (2007)	Low risk	Low risk	High risk	Low risk	Low risk	High risk
Santos <i>et al.</i> (2007)	Unclear risk	Low risk	Unclear risk	Low risk	Low risk	High risk
Santamaria <i>et al.</i> (2008)	Low risk	Unclear risk	Unclear risk	Low risk	Low risk	Unclear risk
Santamaria <i>et al.</i> (2009)	Low risk	Unclear risk	Unclear risk	Low risk	Low risk	Unclear risk
Santamaria <i>et al.</i> (2009)	Low risk	Unclear risk	High risk	Low risk	Low risk	High risk
Santamaria <i>et al.</i> (2013)	Low risk	Unclear risk	High risk	Low risk	Low risk	High risk
Santamaria <i>et al.</i> (2014)	Low risk	Unclear risk	High risk	Low risk	Low risk	High risk
Santamaria <i>et al.</i> (2016)	Low risk	Unclear risk	Low risk	Low risk	Low risk	Unclear risk
Santamaria <i>et al.</i> (2018)	Low risk	Unclear risk	Low risk	Low risk	Low risk	Unclear risk
Dursun <i>et al.</i> (2018)	Low risk	Low risk	Low risk	Unclear risk	Low risk	Unclear risk
Isler <i>et al.</i> (2018)	Low risk	Low risk	Unclear risk	Low risk	Low risk	Unclear risk
Gharat <i>et al.</i> (2019)	Low risk	Unclear risk	High risk	High risk	Low risk	High risk

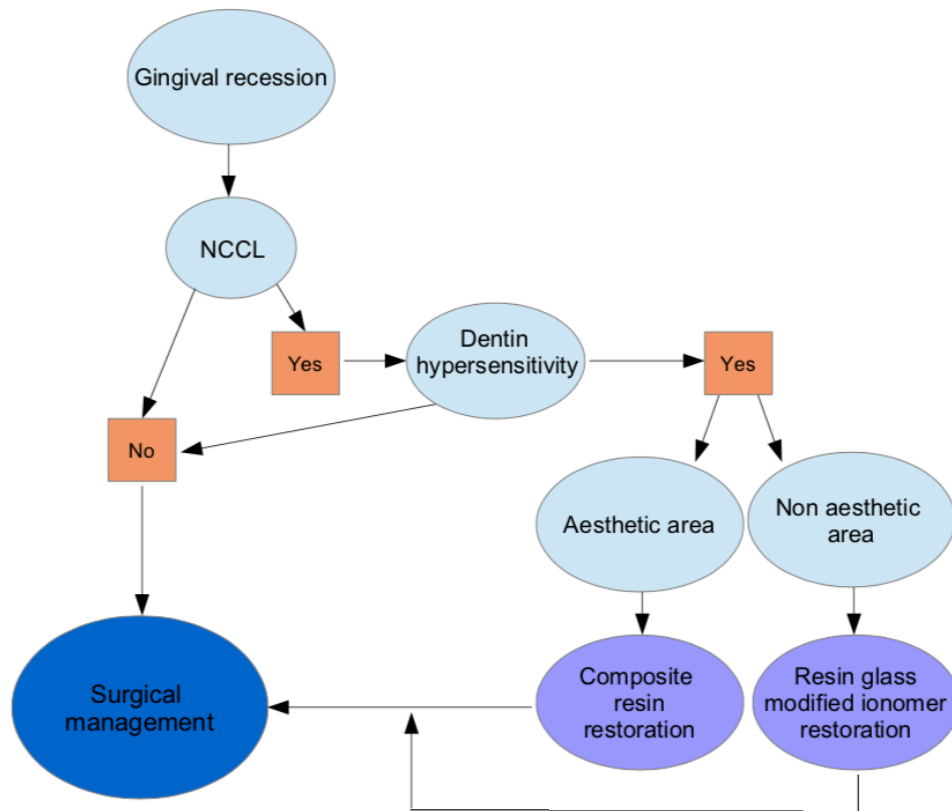
## **Annex 1**

A method to predetermine the line of root coverage by Zucchelli *et al.* (2006):

When a GR is associated with a NCCL, the CEJ may not be visible. That is why achieving a complete root coverage without this parameter is frequently difficult. Although, Zucchelli *et al.* (2006) proposed a method for determining the maximum line of root coverage (the line to which the soft tissue margin will be stable after the healing process of a root coverage surgical procedure), that line should replace the anatomical CEJ when this is not clinically detectable on the tooth. The height of ideal anatomic papilla is measured as the distance between the line connecting the line angles of adjacent teeth and the point of contact of the tooth. Once the ideal papilla has been measured, this dimension is reported apically starting from the tip of both papillae mesial and distal to the tooth with the recession defect. The projections on the recession margin of these measurements allow identification of two points that are connected by a curved line, the outline of which varies according to the patient's biotypes and the shape of the anatomical CEJ of other adjacent teeth: the line of root coverage. Root coverage predetermination facilitates restorative treatment, and thus facilitates the periodontal root coverage surgery.

## Annex 2

Decision-making process proposal for selecting the ideal management in treatment of gingival recession associated with non-carious cervical lesion.



The ideal management of simple gingival recession should be surgical. Nevertheless, when a GR is associated to a cervical lesion, the coronal location of the NCCL (corresponding to a type 3 or 4 NCCL of Zucchelli) could prevent a complete surgical coverage. Thus, a dentin hypersensitivity due to the exposition of dentin tubulis may persist. When there is no hypersensitivity, the surgical management should be recommended. But if a sensitivity appears, a restoration to the maximum root coverage line previous to the surgery may be considered. When the combined lesion is located in an aesthetic area, micro-filled composite resins may be recommended because of the aesthetics proprieties of composite resins, while when the lesion is located in a non aesthetic area, a resin modified glass ionomer restoration may be preconized due to the fluoride release and microbiological proprieties.