Received: 8 January 2018 | Revised: 26 March 2018 | Accepted: 8 May 2018

DOI: 10.1111/jcpe.12923

OTHER

WILEY Journal of Clinical Periodontology

Treatment of class III multiple gingival recessions: Prognostic factors for achieving a complete root coverage

Sofia Aroca[1] | Antoine Barbieri[2] | Marco Clementini[3] | Franck Renouard[4] | Massimo de Sanctis[3]

[1]Department of Periodontolgy, Université of Bern, Bern, Switzerland

[2]Centre de Recherche des Cordeliers, INSERM, UMRS 1138, University Paris Descartes, Sorbonne University, Paris, France

[3]Department of Periodontology, Università Vita-Salute San Raffaele, Milan, Italy

[4]Private practice, Paris, France

Correspondence
Sofia Aroca, 35 Rue Franklin, 78100 Saint Germain en Laye, France.
Email: sofiaaroca@mac.com

Abstract

Background: This report is intended to present a supplemental analysis of data from a prior report (Aroca et al., 2010) to investigate factors associated with a complete root coverage at 1 year. The purpose of the prior report was to investigate at 1 year the adjunction effect of EMD for the treatment of Miller's class III recession defects using a coronally advanced modified tunnel/CTG technique with (test group) or without (control group). The purpose of this report was to investigate additional factors associated with root coverage in the same data set.

Materials and methods: On the 138 observations collected from 20 patients, a regression model was used to highlight the relationship between the percentages of root coverage (RC) and three following covariates: the distance from the tip of the papilla and the contact point (DCP) at baseline, the group membership (control vs. test) and tooth position in the mouth (maxillary vs. mandibular).

Results: The statistical analysis showed that there was a significant effect of the DCP at baseline ($p = 0.01$) and of the tooth type ($p < .001$) on the percentage of RC at 1 year, whereas no significant difference between the two techniques (group membership effect) was shown ($p = 0.69$).

Conclusion: The probability to obtain a complete root coverage decreases when the DCP at baseline increases. Moreover, maxillary teeth are more likely to give better RC than mandibular teeth. However, in this analysis similar to the last, there was no group effect.

KEYWORDS

complete root coverage, connective tissue graft, coronally advanced modified tunnel, Miller's class III recessions, multiple gingival recessions, prognostic factors

1 | INTRODUCTION

Multiple adjacent recessions are challenging defects since they present a number of critical anatomic features as large surgical field, frequently shallow vestibules and prominent roots as well as a variation in the size of defects and residual keratinized tissue.

Different surgical techniques have been proposed for the treatment of multiple adjacent recession, mainly derived from the coronally advanced flap (Zucchelli & De Sanctis, 2000) or from tunnel approaches (Allen, 1994; Azzi & Etienne, 1998; Tozum & Dini, 2003; Zabalegui, Sicilia, Cambra, Gil, & Sanz, 1999; Zuhr, Fickl, Wachtel, Bolz, & Hürzeler, 2007). The predictability of these procedures in the treatment of Miller's class I and class II (Miller, 1985) multiple gingival recessions has been recently reconsidered, reporting high level of efficacy and an improvement in the clinical results when graft-based subepithelial connective tissue procedures were

performed (Chambrone & Tatakis, 2015; Graziani et al., 2014). Few data are available for the treatment of multiple Miller's class III gingival recessions. These defects result more challenging, mainly due to the loss of inter-proximal bone and soft tissues, resulting in an increased avascular surface and a reduced inter-proximal periosteal bed. Despite that, recent studies have shown encouraging results, demonstrating that the loss of inter-dental attachment alone may not represent a limit in terms of recession. (Chambrone & Tatakis, 2015).

In a recent randomized clinical trial, Cairo et al. (2012) showed that the use of CTG in single class III recessions leads to high probability of CRC when the inter-dental attachment level (IDAL) was equal or less than 3 mm. In this study, the influence of the distance measured between the contact point and the tip of the papilla (DCP) is not mentioned. Esteibar, Zorzano, Cundín, Blanco, and Medina (2011) in a case series evaluated the pre-surgical and surgical variables to predict the CRC in 121 class III recessions. In this study, where 47% of treated recessions achieved a CRC, the following variables, according to the authors, could explain the outcome: integrity of inter-proximal soft tissue, thickness of CTG greater than 2 mm, inter-proximal bone loss not exceeding 3 mm and an initial recession width not greater than 3 mm.

In a study in which a tunnel technique was modified by separating the entire inter-proximal papilla from the bone, allowing for a more coronal positioning for the connective tissue coverage, complete root coverage (CRC) of all multiple Miller class III recessions was obtained in eight patients of 20 (Aroca et al., 2010).

Classifications of root coverage procedures not only categorize the anatomical situations, but also indicate the possibility of obtaining a CRC, that is the biological healing potential of the lesion. This potential is reduced mainly when multiple class III and class IV recessions type defects (Miller 1985) are treated, at least with a free gingival graft, due to the inter-dental attachment loss. Several factors may contribute to obtain a CRC. Thus, clinicians should consider of paramount importance the identification of prognostic factors for obtaining a full coverage in challenging clinical situations as multiple class III recession defects.

The aim of this report was to further investigate the relationship between root coverage and papilla height in mandibular and maxillary teeth using a regression model applied to data of a randomized, controlled, split-mouth study comparing a CAMT technique with subepithelial CTG with or without the adjunction of EMD for the treatment of Miller's class III recession defects (Aroca et al., 2010). This methodology of data analysis has been widely used in the literature, as in a recent study by Cairo et al., 2015.

Clinical Relevance

Scientific rationale for the study: The knowledge of prognostic factors for obtaining a complete root coverage (CRC) in challenging clinical situations, as for multiple class III recession defects, is of paramount importance for planning surgical treatment.

Principal findings: The lower the distance of the tip of the papilla and the contact point at baseline, the higher the percentages of RC. Moreover, RC results better in maxillary teeth than in mandibular teeth.

Practical implications: The probability to obtain a CRC is more than 89% when the distance from the tip of the papilla to the contact point at baseline is less than 3 mm for maxillary teeth, whereas for mandibular teeth, the probability is 34%.

2 | MATERIALS AND METHODS

2.1 | Sample size calculation

Description of sample size calculation is reported in a previous paper (Aroca et al., 2010).

Twenty patients per treatment group were recruited, allowing for possible dropouts, to provide 80% power to detect a true 20% difference between test and control in root coverage percentages.

2.2 | Study design

This study was a split-mouth, randomized clinical trial in which one side of the maxilla (or mandible) served as test and the opposite side as control.

2.3 | Population

Subject included in this study presented.

1. At least three adjacent gingival recessions on both sides of the maxillary or mandibular arch
2. A full-mouth plaque score of <20% (O'Leary, Drake, & Naylor, 1972)

Exclusion criteria were:

1. Systemic diseases that could affect the outcome of the therapy;
2. Smoking
3. Pregnancy

2.4 | Intervention

Details of intervention were presented in a previous paper (Aroca et al., 2010). The same experienced periodontist (S.A) performed both procedures (at test and control sites) during the same surgical session.

Before incision, composite stops were placed at the contact points and a root planning of the exposed root area was performed with Gracey curettes (Hu-Friedy, Chicago, IL, USA). Ethylenediaminetetraacetic (EDTA) was applied on the test sites, whereas no chemical was used on the control sites.

The surgical procedure, based on a modified tunnel design by Azzi and Etienne (1998) was performed as follows: initial sulcular incisions was carried out with a tunnel knife – elevator instrument. With the same instrument a mucoperiosteal flap elevation was extended beyond the mucogingival junction (MGJ) and under each papilla. In order to move the flap and the papilla in a coronal direction without tension, muscle fibres on the inner part of the mucosa were cut using Gracey curettes.

A 1.0 1.5 mm thick connective tissue harvesting was performed starting from the retromolar area (when possible) and continuing towards the mesial aspect, depending on the required size of the graft. The donor site was then sutured with 5-0 polyglactin 910 (Vicryl, Ethicon, Johnson & Johnson International, St-Stevens-Woluwe, Belgium).

The graft was then inserted under the tunnel as described by Allen (1994). EMD was applied to the test sites only. Suspended horizontal mattress sutures around the contact points (Azzi & Etienne, 1998) maintained the flap in a position slightly coronal to the cementoenamel junction (CEJ), covering the CTG.

Analgesics (3,250 mg acidum nifluminicum) (Donalgin, Richter, Budapest, Hungary) for 3–4 days and antibiotics (3,300 mg Dalacin-C) (Dalacin-C, Pfizer KFT, Budapest, Hungary) for 5 days were given to all patients. They were also informed not to brush their teeth in the surgical areas until suture removal and instructed to rinse their mouths with a 0.12% chlorhexidine solution twice a day for 1 min. Two weeks after surgery, sutures were removed and all patients were checked and instructed in mechanical tooth cleaning of the operated areas using a soft toothbrush and a roll technique. Clinical measurements and sessions of prophylaxis were scheduled at 1, 3, 6 and 12 months.

2.5 | Clinical assessments

A blinded examiner assessed using a Hu-Friedy periodontal probe (PCP-UNC 15 periodontal probe, Hu-Friedy) the gingival recession (REC) and the distance between the contact point and the top of the papilla at the mesial aspect of the tooth (DCP) at 28 days and at 3 months, 6 months, 12 months. The examiner was calibrated evaluating recessions in five subjects not involved in the study on two occasions 24 hr apart (Aroca et al., 2010).

2.6 | Statistical analysis

A statistical analysis was performed using the R software. Repeated measurements were carried out including 138 observations for 20 patients. To assess the percentage of root coverage at 1 year (RC), the analysis was focused on the ordinal variable *Y* with four categories given by:

$$Y=\begin{cases}1 & \text{if } 0\le RC<50\%\\ 2 & \text{if } 50\le RC<75\%\\ 3 & \text{if } 75\le RC<100\%\\ 4 & \text{if } RC=100\%\end{cases}$$

Few observed cases with RC at 1 year ranged between 0% and 25%; for the first category a larger interval was applied, in order to reach a relatively homogeneous number of observations among categories. Descriptive statistics of data were first performed through scatter plots and bar plots, in order to describe dataset.

The main aim in the analysis was to explain the RC at 1 year, represented by categorical variable *Y* the DCP, the clinical attachment

TABLE 1 Clinical parameters at baseline and at 1 year

	Test	Control	*p*-value
PI (1–3)			
Baseline	0.1 ± 0.1	0.1 ± 0.1	>0.999
1 years	0.2 ± 0.3	0.2 ± 0.2	>0.999
p-value	>0.999	>0.999	
GI (1–3)			
Baseline	0.1 ± 0.1	0.1 ± 0.1	>0.999
1 years	0.1 ± 0.2	0.1 ± 0.1	>0.999
p-value	>0.999	>0.999	
REC (mm)			
Baseline	3.5 ± 1.5	3.2 ± 1.4	>0.999
1 years	0.8 ± 1.1	0.6 ± 0.9	>0.999
p-value	>0.999	>0.999	
CAL (mm)			
Baseline	4.8 ± 1.9	4.7 ± 1.7	>0.999
1 years	1.9 ± 1.1	1.9 ± 1.0	>0.999
p-value	<0.001	<0.001	
PD (mm)			
Baseline	1.4 ± 0.7	1.5 ± 0.7	0.645
1 years	1.1 ± 0.4	1.2 ± 0.5	0.478
p-value	0.264	0.294	
KWG (mm)			
Baseline	2.5 ± 1.4	2.6 ± 1.3	0.812
1 years	2.7 ± 1.0	2.8 ± 1.1	0.788
p-value	0.805	0.797	
DCP (mm)			
Baseline	2.9 ± 1.4	2.7 ± 1.3	0.634
1 years	1.7 ± 1.2	1.6 ± 1.2	0.788
p-value	0.004	0.007	
RC (%)			
1 years	82 ± 25	83 ± 26	0.90
CRC (%)			
1 years	40 (8/20)	40 (8/20)	1

loss (CAL), the group membership and the tooth position in the mouth. Given the repeated measurements done on subjects, the analysis was performed through a mixed effect regression model for ordinal responses to assess the influence of these factors (Agresti, 2010). More precisely, the cumulative model with probit link was considered to make the analysis such as the cumulative probability that the ordinal variable Y_{ij} for the tooth $j(j = 1,..., n_i)$ of the subject $i(i = 1,..., 20)$ is lower than the category $m(m = 1,...,4)$, is defined by:

$$\Pr(Y_{ij} \leq m|b_i) = F(\tau_m - g_{ij}\beta_{group} - d_{ij}\beta_{DCP} - t_{ij}\beta_{type} - l_{ij}\beta_{CAL} - b_i) \quad (1)$$

where g_{ij} is the group membership indicator which is equal to 0 for the control group (modified tunnel/CTG technique without EMD) and 1 for the test group (modified tunnel/CTG technique with EMD), d_{ij} is the DCP (in mm) at baseline, t_{ij} is the tooth type indicator which is equal to 0 for the maxillary (MX) tooth and 1 for the mandibular (MD) tooth, l_{ij} is the clinical attachment loss (in mm), β_{group}, β_{DCP}, β_{type} and β_{CAL} are the parameters associated with the group effect, the DCP effect and the tooth type effect, respectively. To take into account the dependence among multiple sites in the same patient (n_i measurements from a same subject i) in the regression model, the subject-specific random effect b_i was included, assuming to be normally distributed with zero mean. Then, the parameters $(\tau_m)_{m = 1,...,4}$ are the thresholds associated with the category, and F is the standard normal cumulative distribution function.

3 | RESULTS

One hundred thirty-eighth recession defects were treated in 20 patients. Ten subjects presented recessions in the maxillary arch and the other 10 had defects in the mandibular arch. Ten patients presented recessions only at the anterior teeth (five on the maxilla and five on the mandible), seven subjects had sites that also involved bicuspids (two in the maxilla and five in the mandible) and three subjects had sites involving maxillary bicuspids and molars.

Baseline data were homogeneous for all of the 20 patients enrolled. At 1 year, PI, GI, PD and KGW values were not statistically different within and between groups (Table 1).

A significant post-surgical improvement in root coverage was observed at 1 year in both groups when compared with baseline. In the test group, the mean recession depth decreased significantly from 3.5 ± 1.5 mm (baseline) to 0.8 ± 1.1 mm (1 year), with a percentage of RC of 82 ± 25 and a CRC in eight of 20 patients (40%). In the control group, mean recession depth significantly decreased from 3.2 ± 1.4 (baseline) to 0.6 ± 0.9 mm. (1 year), with a percentage of RC of 83 ± 26 and a CRC in eight of 20 patients (40%). Both treatments resulted in a significant CAL gain (3.11 and 2.86 mm for test and control groups, respectively), without significant differences at 1 year between test and control group.

In the test group and control group the DCP decreased significantly from 2.9 ± 1.4 mm (test) and 2.7 ± 1.3 mm (control) at baseline to 1.7 ± 1.5 mm (test) and 1.6 ± 1.3 mm (control) at 28 days and to 1.7 ± 1.2 mm (test) and 1.6 ± 1.2 mm (control) at 1 year. When expressed as a percentage, DCP decreased at 1 year of 58.6% (test) and 59.2% (control), showing a vertical gain of the papillae of 41.3% (test) and 40.7% (control) in both groups. These results were not statistically different between the two treatment groups.

Figure 1 shows the distributions of the numerical variables over the four ordinal classes of RC. The DCP at baseline demonstrates a tend on the RC classes, where higher values of DCP were mainly associated with the class(es) relative to lower RCs (Figure 1a). The RC at 1 year appeared to slightly decrease with an increase in DCP (Figure 1a). In opposite, the CAL at baseline did not have any impact on the RC: similar distributions whatever the classes of RC (Figure 1b).

S. Similar distributions were observed according to the group (test or control) and tooth position (maxilla or mandible), as illustrated in Figure 2. The distribution of different percentages of RC

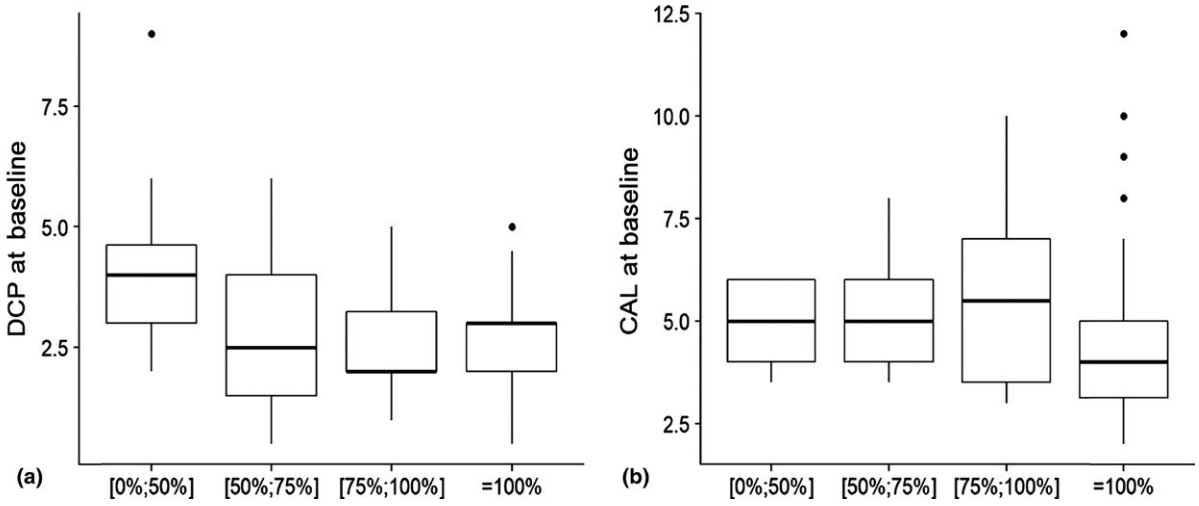

FIGURE 1 Distributions of DCP at baseline (a) and CAL at baseline (b) with respect to the four ordinal classes of RC

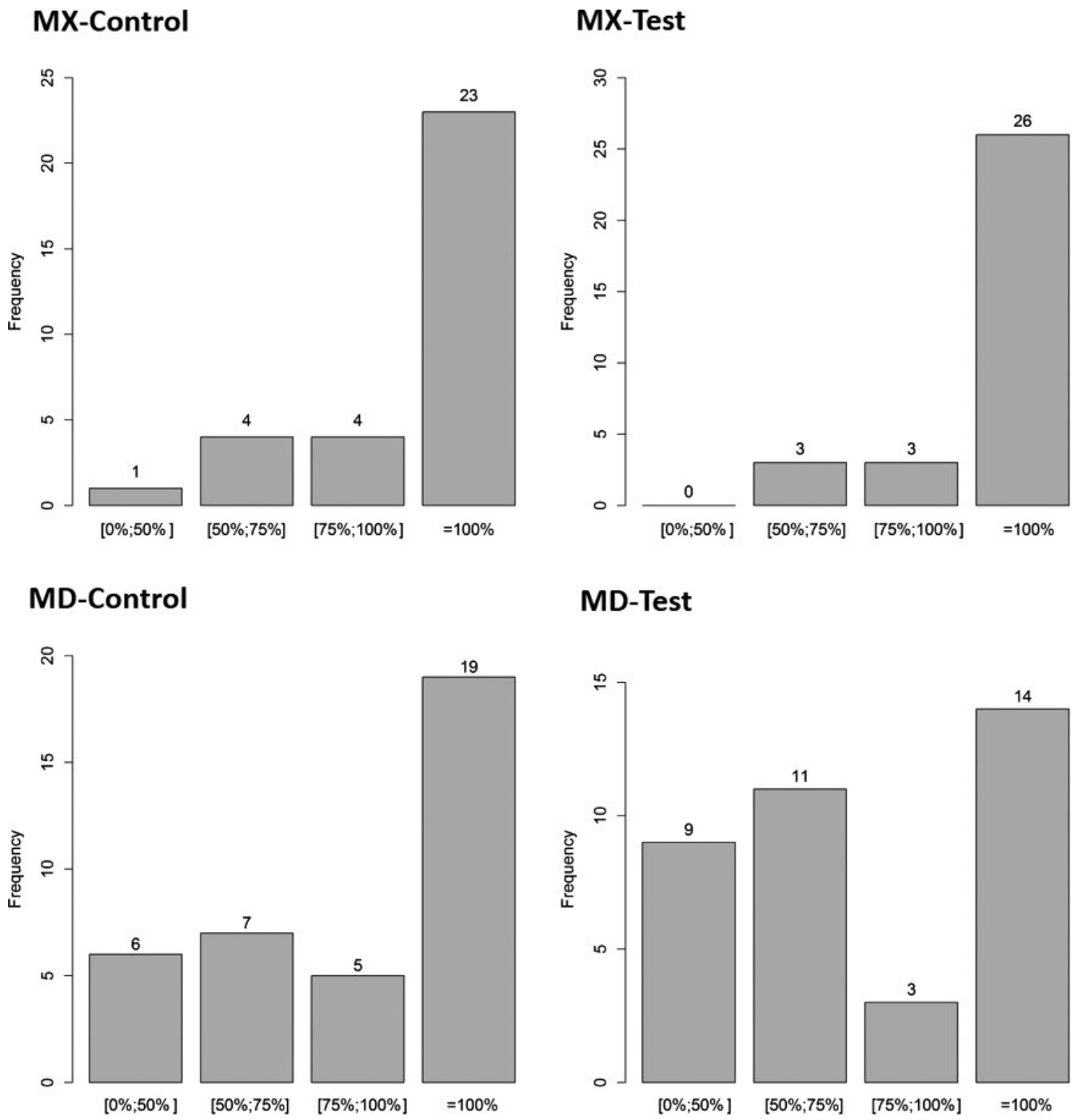

FIGURE 2 Bar plots of the distributions of different categories for root coverage at 1 year (*x*-axis) given the group membership (control group on the left and test group on the right) and the tooth type (maxillary at the top and mandibular at the bottom)

(0%–50%, 50%–75%, 75%–99%, 100%) appeared to be similar between both control and test groups, but it differed among the type of teeth. Indeed, maxillary teeth seemed to get a better root coverage than mandibular teeth (Figure 2).

Regarding the estimation of model defined in equation (1), the group membership (control vs. test) and the CAL at baseline did not influence the RC (p-value = 0.68 and p-value = 0.92, respectively), whereas the effects of DCP and the type of tooth were statistically significant (p-value = 0.01 and p-value < .001, respectively) to explain the RC at 1 year (Table 2). The estimation of the parameter associated with DCP was negative: the probability to have higher percentages of RC decreased when the DCP at baseline increased. Moreover, there was a significant difference between maxillary and mandibular teeth, as the RC resulted better for maxillary teeth than for mandibular teeth (Table 2).

The probability to observe a CRC decreased when the DCP increased whatever the tooth position (solid line in Figure 3). However, given an identical DCP value, the probability to obtain a CRC was

TABLE 2 Estimation of regression model parameters associated with the group covariate (β_{group}), the type of teeth covariate (β_{type}), the distance CP at baseline (β_{DCP}) and the CAL at baseline (β_{CAL}), with the standard error (*SE*) and *p*-value associated with the Wald's test

	Coefficients	*SE*	*p*-value
β_{group}	−0.09	0.23	0.68
β_{type}	−1.66	0.43	<.001**
β_{DCP}	−0.29	0.12	0.01*
β_{CAL}	0.01	0.09	0.92

*p-value < 0.05; **p-value < 0.001.

greater for maxillary teeth (Figure 3, MX) than for mandibular teeth (Figure 3, MD).

4 | DISCUSSION

Data from the previous article (Aroca et al., 2010) indicate that both treatments of CAMT were able to significantly decrease recession depth (from 3.5 ± 1.5 mm to 0.8 ± 1.1 mm for test group; from 3.2 ± 1.4 to 0.6 ± 0.9 mm for control group), resulting in a remarkable CAL gain (3.11 and 2.86 mm for test and control groups, respectively). Moreover, a CRC was obtained, irrespective of the treatment group, in all the recessions present in eight of 20 patients.

This study measured also the distance from the tip of the papilla and the contact point. This distance decreased by 58.6% (test) and 59.2% (control), showing a vertical gain of the papillae of 41.3% (test) and 40.7% (control) in both groups. In a recent case series treating 68 gingival recessions in nine patients with a MCAT (Yaman, Demirel, Aksu, & Basegmez, 2015), a statistically significant difference between baseline and 12-month DCP values was found, with an inter-dental tissue gain of 73%. The role of the CTG in this type of surgical procedure, aiming to treat multiple recessions with inter-dental hard and soft tissue loss, is not only to support the gingival margin but also to be a determining factor in supporting post-surgical papilla position.

Measurement of DCP allowed to investigate the relationship between this clinical parameter and the root coverage. From the estimation obtained on the observed data, more precisely was studied the evolution of the cumulative probabilities that, at 1 year, the RC was at least 0%, 50%, 75% higher or equal to 100%, given different values of DCP at baseline (Table 3). When the DCP at baseline was 3 mm, the probability to obtain a CRC was 0.89 for a maxillary tooth, whereas it was equal to 0.34 for a mandibular tooth. Moreover, the estimated probabilities to obtain a RC greater than, or equal to 75% for maxillary teeth were 0.99, 0.98 and 0.92 for DCP of 0.0, 0.2 and 4 mm, respectively, while these probabilities were equal to 0.82, 0.63 and 0.40 for mandibular teeth.

Similar methodology was utilized by Cairo et al. (2012), who reported that ICAL is a strong predictor of root coverage outcomes for both RecRed and CRC. The statistical analysis used in this study showed that when ICAL was less than 3 mm at baseline, the probability to obtain CRC was greater than 80% using CAF + CTG. However, as a predictor for RC the authors did not use the DCP, that is the integrity of inter-dental soft tissue. Furthermore, the study was conducted in single recession defects.

On the other hand, no influence was evidenced on RC when CAL gain was evaluated.

This finding is not in accordance with results from the previously mentioned study (Cairo et al.,2012). This difference may be due to

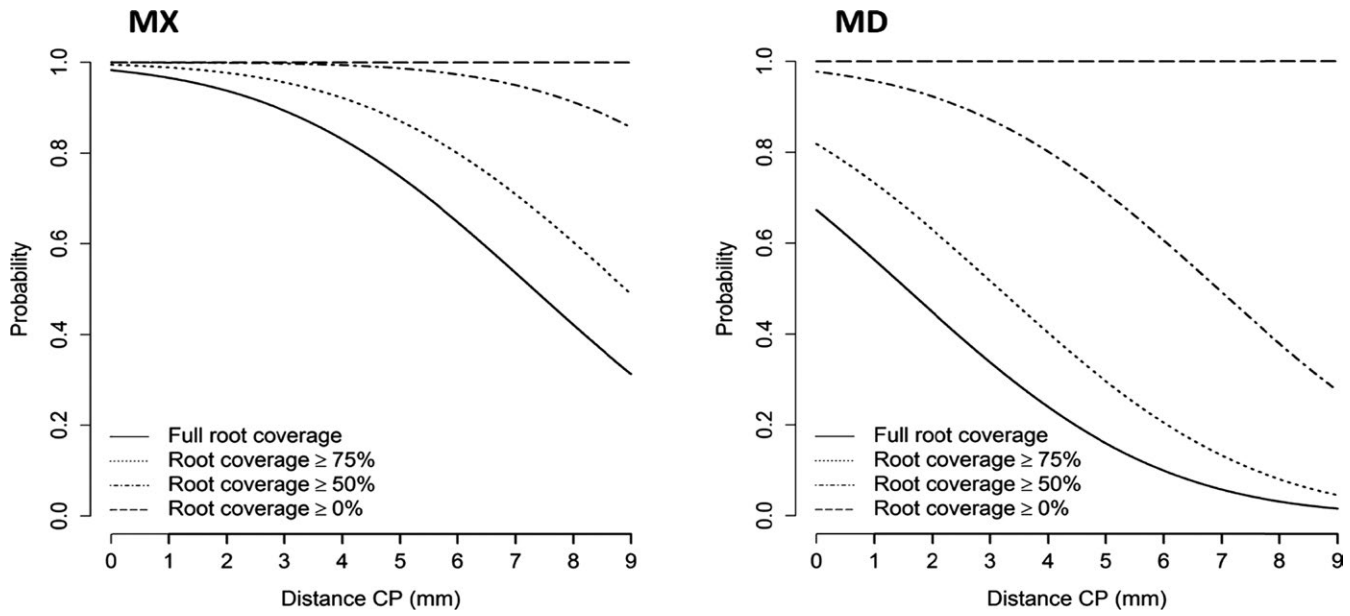

FIGURE 3 Average evolution of the cumulative probability of root coverage (*y*-axis) according to the Distance CP at baseline (*x*-axis) for the two tooth types (MX: maxillary on left; MD: mandibular on right), given the model estimation without group covariate

TABLE 3 Estimations of cumulative probabilities relative to root coverage given different distance arbitrary values CP

	Distance CP (mm)									
	0	1	2	3	4	5	6	7	8	9
Maxillary teeth										
Pr (Root coverage = 100%)	0.98	0.97	0.94	0.89	0.83	0.75	0.65	0.54	0.42	0.31
Pr (Root coverage ≥ 75%)	0.99	0.99	0.98	0.96	0.92	0.87	0.80	0.71	0.60	0.49
Pr (Root coverage ≥ 50%)	1.00	1.00	1.00	1.00	0.99	0.99	0.97	0.95	0.91	0.86
Pr (Root coverage ≥ 0%)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Mandibular teeth										
Pr (Root coverage = 100%)	0.67	0.56	0.45	0.34	0.24	0.16	0.10	0.06	0.03	0.02
Pr (Root coverage ≥ 75%)	0.82	0.73	0.63	0.52	0.40	0.30	0.20	0.13	0.08	0.05
Pr (Root coverage ≥ 50%)	0.98	0.96	0.92	0.87	0.80	0.71	0.61	0.49	0.38	0.28
Pr (Root coverage ≥ 0%)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

the different types of the defects treated: multiple vs. single recessions, this difference implies a different flap dimension that is larger when treating multiple recessions.

Also while tunnel technique maintains an intact papilla, the coronally advanced flap is designed to separate the buccal part of the papilla from its body. This difference can in fact have an influence on vascularization of the marginal aspect of the flap at least in the early healing phases (McLean, Smith, Morrison, Nasjleti, & Caffesse,1995).

Moreover, papillae are coronally translocated in the tunnel technique maintaining their integrity, this may allow for improved coronal blood supply when compared with coronally advanced flap where the papillae remain in their original position.

Our data were able to highlight the impact of tooth position on the achievement of a CRC. In fact, maxillary teeth achieved a higher percentage of root coverage than mandibular teeth. From a biological standpoint, differences in CRC between maxillary and mandibular teeth could be explained by the different anatomical situation of the inter-dental spaces, that is: bigger papillae (papilla width) in the upper arch and this anatomical situation may influence the amount of vascularization and dimensional stability. Another explanation could be the presence in the lower jaw of lip muscles and a minor vestibular depth, which could result in difficulty to coronally mobilize tissues and in a lower percentage of root coverage.

From a clinical standpoint, the results of this study support the key role of the evaluation of the distance between the tip of the papilla and the inter-dental contact point in order to anticipate root coverage which can be obtained with a CAMT in the treatment of multiple class III recession defects while they do not support the importance of CAL as a predictor for CRC in multiple recessions.

5 | CONCLUSIONS

At 1 year, the percentage of RC is statistically dependent on the DCP at baseline and on the tooth position. Indeed, the probability to obtain higher percentage of RC decreases when the DCP at baseline increases. Moreover, maxillary teeth are more likely to have a better RC at 1 year than mandibular teeth. As for the study groups, there is no significant difference between the CAMT with EMD and CAMT without EMD to explain the RC.

CONFLICT OF INTEREST

The authors report no conflict of interests related to the study.

ORCID

Marco Clementini http://orcid.org/0000-0002-1827-5200

REFERENCES

Agresti, A. (2010). *Analysis of Ordinal Categorical Data*. New York, NY: John Wiley & Sons. https://doi.org/10.1002/9780470594001

Allen, A. L. (1994). Use of the supra periosteal envelope in soft tissue grafting for root coverage. I rationale and technique. *Int J Periodontics Restorative Dent*, *14*, 216–227.

Aroca, S., Keglevitch, T., Nikolidakis, D., Gera, I., Nagy, K., Azzi, R., & Etienne, D. (2010). Treatment of class III multiple gingival recessions: A randomized-clinical trial. *Journal of Clinical Periodontology*, *37*, 88–97. https://doi.org/10.1111/j.1600-051X.2009.01492.x

Azzi, R., & Etienne, D. (1998). Recouvrement radiculaire et reconstruction papillaire par greffon conjonctif enfoui sous un lambeau vestibulaire tunnelise´ et tracte´ coronaire-ment. *J Parodontologie & d'Implantologie Orale*, *17*, 71–77.

Cairo, F., Carnevale, G., Buti, J., Nieri, M., Mervelt, J., Tonelli, P., … Tonetti, M. (2015). Soft-tissue regrowth following fibre retention osseous resection surgery or osseous resection surgery. A multilevel analysis. *Journal of Clinical Periodontology*, *42*, 373–379. https://doi.org/10.1111/jcpe.12383

Cairo, F., Cortellini, P., Tonetti, M., Nieri, M., Mervelt, J., Cincinelli, S., & Pini-Prato, G. (2012). Coronally advanced flap with and without connective tissue graft for the treatment of single maxillary gingival recession with loss of inter-dental attachment. A randomized controlled clinical trial. *Journal of Clinical Periodontology*, *39*, 760–768. https://doi.org/10.1111/j.1600-051X.2012.01903.x

Chambrone, L., & Tatakis, D. N. (2015). Periodontal soft tissue root coverage procedures: A systematic review from the AAP Regeneration Workshop. *Journal of Periodontology*, *86*(2 Suppl.), S8–S51. https://doi.org/10.1902/jop.2015.130674

Esteibar, J. R., Zorzano, L. A., Cundín, E. E., Blanco, J. D., & Medina, J. R. (2011). Complete root coverage of Miller Class III recessions. *Int J Periodontics Restorative Dent*, *31*, 1–7.

Graziani, F., Gennai, S., Roldan, S., Discepoli, N., Buti, J., Madianos, P., & Herrera, D. (2014). Efficacy of periodontal plastic procedures in the treatment of multiple gingival re-cessions. *Journal of Clinical Periodontology*, *41*(Suppl. 15), S63–S76. https://doi.org/10.1111/jcpe.12172

McLean, T. N., Smith, B. A., Morrison, E. C., Nasjleti, C. E., & Caffesse, R. G. (1995). Vascular changes following mucoperiosteal flap surgery: A fluorescein angiography study in dogs. *Journal of Periodontology*, *66*, 205–210. https://doi.org/10.1902/jop.1995.66.3.205

Miller, P. J. (1985). A classification of marginal tissue recession. *Int J Periodontics Restorative Dent*, *5*, 8–13.

O'Leary, T. J., Drake, R. B., & Naylor, J. E. (1972). The plaque control record. *Journal of Periodontology*, *43*, 38. https://doi.org/10.1902/jop.1972.43.1.38

Tozum, T. F., & Dini, F. M. (2003). Treatment of adjacent gingival recessions with subepithelial connective tissue grafts and the modified tunnel technique. *Quintessence International*, *34*, 7–13.

Yaman, D., Demirel, K., Aksu, S., & Basegmez, C. (2015). Treatment of multiple adjacent miller class III gingival recessions with a modified tunnel technique: A case series. *Int J Periodontics Restorative Dent*, *35*, 488–497.

Zabalegui, I., Sicilia, A., Cambra, J., Gil, J., & Sanz, M. (1999). Treatment of multiple adjacent gingival recessions with the tunnel sub- epithelial connective tissue graft: A clinical report. *Int J Periodontics Restorative Dent*, *19*, 199–206.

Zucchelli, G., & De Sanctis, M. (2000). Treatment of multiple recession-type defects in patients with esthetic demands. *Journal of Periodontology*, *71*, 1506–1514. https://doi.org/10.1902/jop.2000.71.9.1506

Zuhr, O., Fickl, S., Wachtel, H., Bolz, W., & Hürzeler, M. B. (2007). Covering of gingival re-cessions with a modified microsurgical tunnel technique: Case report. *Int J Periodontics Restorative Dent*, *27*, 457–463.

How to cite this article: Aroca S, Barbieri A, Clementini M, Renouard F, de Sanctis M. Treatment of class III multiple gingival recessions: Prognostic factors for achieving a complete root coverage. *J Clin Periodontol*. 2018;45:861–868. https://doi.org/10.1111/jcpe.12923