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ORIGINAL ARTICLE

Root coverage of gingival recessions with non-carious cervical lesions: a controlled clinical trial

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Abstract

Objective The non-carious cervical lesion (NCCL) is commonly produced by improper toothbrushing techniques, occlusion trauma, anatomic mal-positioned teeth, and acid erosion, thus sharing the same etiology of gingival recession (GR). The association of a graft to the coronally advanced flap had demonstrated the best long-term outcome for root coverage (RC). However, substitutes for the autogenous graft must be studied. This split-mouth clinical trial investigates the RC and the increase in keratinized tissue (KT) when comparing RC of NCCLs associated with GR with intact roots using an extended coronally advanced flap (ECAF) associated with the acellular dermal matrix graft (ADMG), a connective tissue replacement graft.

Material and methods Seventeen individuals with bilateral GR were included in the study. One side had a NCCL (TG) and the opposite root was intact (CG). All patients were treated with the ECDF associated with ADMG. All clinical parameters were assessed at baseline and 6 months postoperative.

Results Root coverage means (CG, 69.5 ± 19 and TG. 72.2 ± 16.5; p value = 0.849570) were not significantly different between control and test groups. In addition, the KT had an increase in the follow-up period for both groups.

Conclusion GR associated with NCCLs can be successfully treated with the ECDF and ADMG.

Clinical relevance Patients frequently search for GR treatment due to cervical wear, root sensitivity, and compromising aesthetics. The NCCL participates with the same issues. The present study contributes to the literature that GR associated with NCCLs can be successfully treated with the ECAF and the ADMG.

Keywords Allograft · Gingival recession · Acellular dermal matrix graft · Non-carious cervical lesion · Mucogingival surgery

Introduction

Irrespective of oral hygiene indexes, gingival recession (GR) is a common finding in the world population [1]. The apical migration of the gingival margin beyond the cementoenamel junction (CEJ) leads to root exposure, favoring cervical wear, root sensitivity, and compromising aesthetics [2, 3]. Patients with high standards of oral hygiene frequently seek for gingival recession treatment due to these issues [2].

After examining 1010 GR defects, Pini-Prato [4] reported that only 46% of the considered root surfaces were intact, with an identifiable CEJ and absence of cervical wear. In accordance with that, it has been reported that cervical abrasion was observed in about 50% of the examined teeth with gingival recessions [5]. Multiple factors can be associated with this process, such as stress (abfraction: parafunction and traumatic occlusion), friction and wear (improper tooth brushing techniques [6] and dentifrice abrasion), and biocorrosion (chemical, biochemical, and electrochemical degradation: extrinsic and intrinsic acids) [7–9]. A recent systematic review by Chambrone and Tatakis [1] entrenched the association of GR and trauma (e.g., traumatic toothbrushing) and also that the presence and quality of marginal keratinized tissue influence the odds of increasing or developing new GRs.

Frequently, as a misdiagnosis, restorative procedures are adopted as the only treatment of these cervical lesions [10].

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However, subgingival restorations were strongly associated with marginal bleeding, attachment loss, and gingival recession [11] due to an increasing amount of bacterial biofilm and changes in its composition [12]. Therefore, cases in which the NCCL is apical to the CEJ, and when it is possible to remove caries or existing restoration and achieve a relatively flat root surface, without endangering the pulp, a periodontal surgical approach should be considered [7, 9].

Over the decades, many different surgical approaches have been described in order to establish the best and predictable treatment for root coverage [13]. Gingival recessions, Cairo RT1 [14], have been successfully treated with the coronally advanced flap (CAF). However, it has also been recognized that for a long-term outcome, the addition of a connective tissue graft (CTG) to the CAF provides better root coverage (RC), increase of keratinized tissue (KT), and outcome stability than CAF alone. In cervical lesions, some authors suggest that the CTG beneath the flap might prevent the collapse of the flap inside the dead space created by the cervical lesion [15], providing better stability [15, 16]. In spite of being the gold standard graft [16], the CTG demands a second surgical area increasing postoperative discomfort as well as having a limited amount of available graft [17]. In order to reduce the morbidity, the use of an acellular dermal matrix graft (ADMG) has been extensively described in the literature as a substitute for a CTG with similar results [17–21].

Therefore, the aim of this controlled split-mouth clinical trial is to investigate the root coverage and the increase in KT when comparing root coverage of non-cervical lesions with recession with intact roots using an extended coronally advanced flap associated with a connective tissue replacement graft.

Materials and methods

Study population

This split-mouth, controlled clinical trial included a group of 17 patients (three males and 15 females, aged 24–65 years old; mean age 40.9 ± 10.7 years). The sample size was determined to provide 80% power to recognize a significant difference of 1 mm (d) between the groups with a 95% confidence interval (a = 0.05) and standard deviation (s) of 1.0 mm [22]. Considering the changes in mean clinical attachment level (CAL) as the primary outcome variable and $(Z\alpha + Z\beta)^2$ = 7.84 ($Z\alpha$ = 1.96 for two-tailed 0.05 hypothesis test: $Z\beta$ = 0.842 for power = 0.8), the sample size was calculated using the following formula: $n = \{2[(SD)^2/(d)^2]\} \times (Z\alpha + Z\beta)^2$. Therefore, a total of at least 16 patients were required [20–23].

After the approval of the Research Ethics Committee of the School of Dentistry of Ribeirão Preto, University of São Paulo, (CAAE: 0002.0.138.000.-11; Process: 20111.176.58.1) and subscribed at ClinicalTrials.gov (NCT03615092), the patients were selected from the periodontal clinic of the same institution. The entry criteria were (1) non-compromised systemic health and no contraindications for periodontal surgery; (2) non-smokers; (3) no previous periodontal surgical treatment on the involved sites; (4) non-pregnant or lactating; (5) CEJ without significant damage; and (6) bilateral RT1 [17] gingival recession ≥ 3 mm in the same arch, in which one had a non-carious cervical lesion (NCCL) type 2 [7], and the opposite root was intact. All patients received detailed information about the study (goals, benefits, risks, and discomforts) and signed with a consent form.

All patients included in the study received a session of prophylaxis including instructions in oral hygiene to eliminate habits related to the etiology of the recession, scaling and root planning, professional tooth cleaning with the use of a rubber cup and a low abrasive polishing paste, and occlusal adjustment if indicated [17, 19, 21]. The surgeries were only performed if the plaque index (PI) [24] and bleeding on probing (BP) were less than 20%.

Clinical assessments

Firstly, the examiner (C.M.R.M.) was calibrated to reduce intra-examiner error ($k > 0.75$) to establish reliability and consistency in clinical assessment. Ten individuals with GR were selected for calibration. Each patient was examined twice by a universal North Carolina-15 periodontal probe†, at a 48-h interval between the first and second assessments. Then, 1 week before surgery, this same examiner recorded the clinical parameters using a universal North Carolina-15 periodontal probe† and an acrylic stent with reference marks at the mid-facial aspect of the study teeth to determine the exact measurement site at baseline and 6 months after surgery.

The following clinical parameters were evaluated: (1) probing depth (PD); (2) clinical attachment level (CAL); (3) gingival recession (GR); (4) gingival recession width (GRW); (5) keratinized tissue height (KT); (6) keratinized tissue thickness (KTT). The PD and CAL were assessed using a universal North Carolina-15 periodontal probe† and were rounded up to the nearest millimeter. The KT height was measured with the same probe but by the movement of the mucogingival junction. The GR was screened with a digital caliper with 0.01-mm resolution for a more accurate measurement, and for the teeth with NCCL type 2 [7], the maximum root coverage [25] was located at the level of the coronal step of the NCCL, which should be the CEJ. The KTT was assessed with an anesthesia needle attached to a silicone disc stop. The needle was placed 1-mm distant from the gingival margin and perpendicular to the mucosa surface through the soft tissue with light pressure until a hard surface was felt. After carefully

Table 1 Clinical parameters (mean ± SD) intragroup

	Control			Test		
Parameters	Baseline	6 months	*p*	Baseline	6 months	*p*
PD (mm)	1.5 ± 0.6	1.5 ± 0.5	> 0.999	1.5 ± 0.6	1.5 ± 0.6	> 0.999
CAL (mm)	4.4 ± 1.1	2.5 ± 0.7	< 0.0004*	4.8 ± 1.3	2.6 ± 0.9	< 0.0001*
GR (mm)	3.1 ± 0.2	0.9 ± 0.6	< 0.0001*	3.3 ± 0.4	0.9 ± 0.6	< 0.0001*
GRW (mm)	4.1 ± 0.4	2.9 ± 1.2	< 0.0001*	4.4 ± 0.4	2.8 ± 1.3	< 0.0001*
KT (mm)	2.8 ± 0.6	3.4 ± 1.2	0.0274†	2.6 ± 0.8	3.3 ± 1.2	0.0008†
KTT (mm)	1.0 ± 0.5	1.5 ± 0.4	0.0026*	1.0 ± 0.4	1.5 ± 0.5	0.0001†

*Statistically significant difference at $p \leq 0.05$ (Wilcoxon test)

† Statistically significant difference at $p \leq 0.05$ (*t* test)

removing the needle, the penetration depth was measured with the digital caliper.

Surgical procedures and post-surgical cares

This study was initially planned to be performed by one operator (C.D.F.D.); however, the Ph.D. student finished her work and left the Program. The mentor considered this study significant enough to be continued; therefore, another operator (M.B.L.R) was calibrated the same way as the previous one. Calibration consisted of operating similar cases in the Periodontal Program until the mentor considered the training complete, with consistent results.

The bilateral gingival recessions were both treated in the same session with the extended flap technique associated with the ADMG. This technique was shown to be better to use with connective tissue substitutes [17, 21, 26]. An interesting observation is that because of the NCCLs, all of the patients that seek for mucogingival treatment had a restoration covering the NCCLs, which was removed during the surgery. Following local anesthesia, two releasing incisions were performed to the mesial and distal line angles of the adjacent tooth with a gingival recession. Sulcular incisions were made uniting the releasing vertical incisions, and the papillae were included in the flap. A partial-thickness flap was then raised up as close to the periosteum as possible by apical and mesiodistal sharp dissection and extended beyond the mucogingival junction. The anatomic papillae of the adjacent teeth were carefully de-epithelialized, and any muscular tension was relieved so that the flaps could be coronally advanced without tension [26]. Then, with the root surfaces exposed, the roots (including the NCCL and restorations if present) were gently mechanically treated (with hand and/or rotating instruments) to obtain a hard, smooth, and regularly concave surface, a 24% EDTA gel was applied for 2 min to eliminate the smear layer. The patients who did not have an intact CEJ were excluded from the study. The ADM was placed 1 mm apical to CEJ or apical to the coronal step of the NCCL [7] to avoid exposure and increase the graft nutrition. The grafts were sutured over the defects with periosteal 5-0 bioabsorbable sutures. At the end of the surgery, the flap was coronally advanced 1 mm over the CEJ or over the coronal step of the NCCL [7] of the involved teeth. In both groups, sling sutures were done followed by interrupted sutures in the releasing incisions. No periodontal dressing was applied.

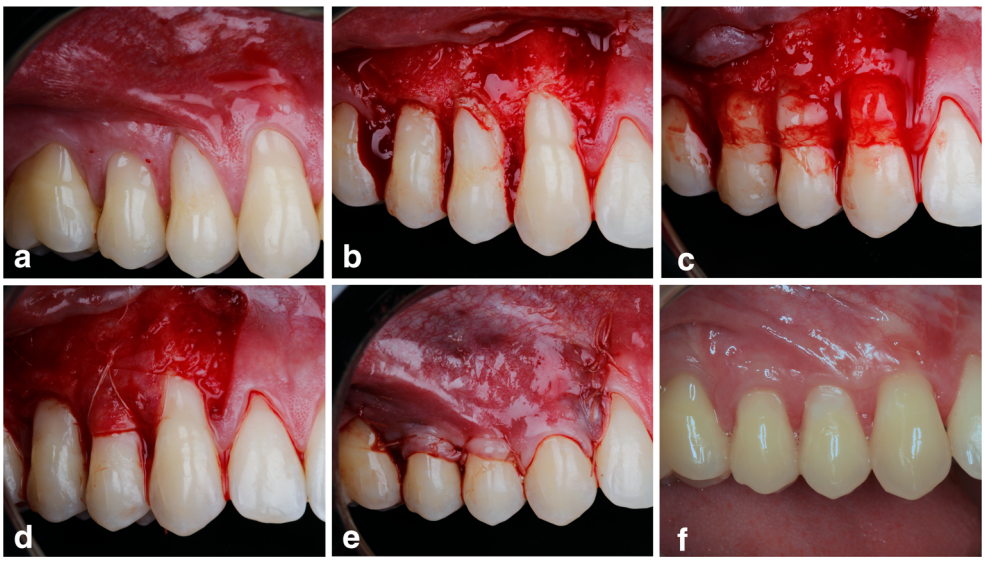

Fig. 1 Test groups: **a** baseline, **b** partial-thickness flap elevated, **c** the restoration was removed and the NCCL was exposed, **d** root conditioning using EDTA 24% followed by intense irrigation and the ADMG sutured 1 mm apically to the CEJ, **e** the flap sutured 1 mm coronally to the CEJ, and **f** 6-month follow-up

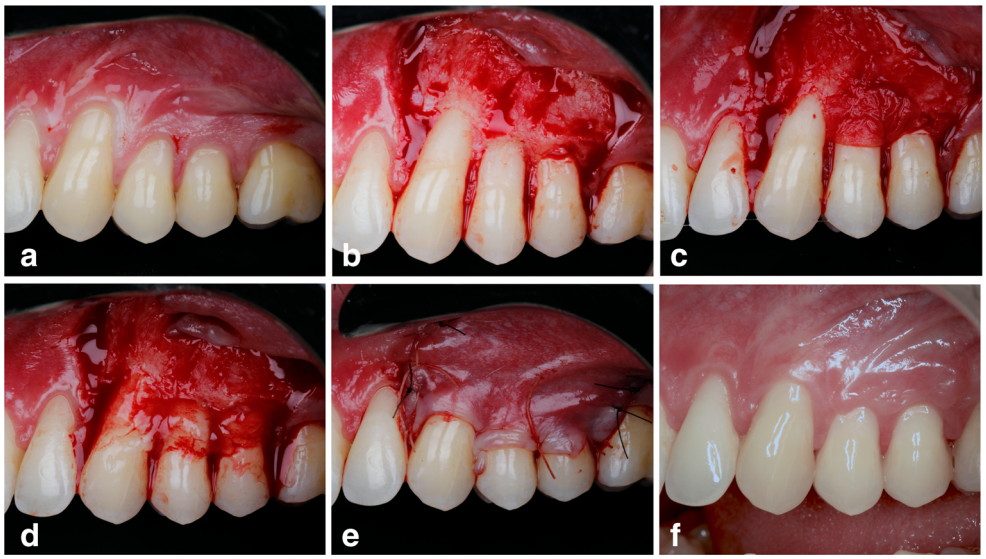

Fig. 2 Control groups: **a** baseline, **b** partial-thickness flap elevated, **c** root conditioning using EDTA 24%, **d** the ADMG sutured 1 mm apically to the CEJ, **e** the flap sutured 1 mm coronally to the CEJ, and **f** 6-months follow-up

One day before surgery, the patients started taking amoxicillin (500 mg) three times a day for 7 days, in order to prevent or minimize the risk of infections [24, 27, 28]. For postoperative pain and edema, ibuprofen was prescribed: four times a day for 2 days. The patients were instructed not to brush the treated area but to rinse with a 0.12% chlorhexidine solution two times a day for 1 min for the first 14 days [17, 26, 27]. Fourteen days after the surgical treatment, the sutures were removed. The patients were again instructed in mechanical tooth cleaning of the treated teeth using a soaked swab in a 0.12% chlorhexidine digluconate solution twice a day for 15 days. All patients were recalled for prophylaxis 2 and 4 weeks after suture removal and, subsequently, once every month until the 6 months evaluation.

Statistical analyses

Statistical analysis was performed on software‡ using two-tailed tests and a significance level of 5%. The Shapiro-Wilk test was used to assess the normality of the data. Parametric and non-parametric tests were performed for intra- and inter-group comparisons, according to data distribution. The root coverage parameter was dichotomized as complete/incomplete, and the chi-square test was applied to determine its association with the presence of NCCL defects.

The percentage of root coverage (RC) was calculated after 6 months as follows: baseline − 6 months GR/baseline GR × 100 [22]. Complete root coverage (CRC) was determined by the number of sites with 100% root coverage.

Results

All patients completed the entire length of the study. Thirty-four RT1 [14] gingival recessions (N = 17 patients, 17 CG sites, and 17 TG sites) were treated with extended coronally advanced flap associated with an ADMG. The test group was represented by seventeen gingival recessions presenting a non-carious cervical lesion type 2 [7]. In the contralateral arch, all of the patients presented gingival recessions with no cervical lesions, as the control group. Only one patient reported dental hypersensitivity after the first month, and it lasted until

Table 2. Clinical parameters (mean ± SD) inter-groups and variation between 6 months and baseline

	Baseline			6 months			Δ Baseline - 6 months		
Parameters	*C*	*T*	*p*	*C*	*T*	*p*	*C*	*T*	*p*
PD (mm)	1.5 ± 0.6	1.5 ± 0.6	0.8981	1.5 ± 0.5	1.5 ± 0.6	> 0.999	0 ± 0.7	0 ± 0.9	0.9528
CAL (mm)	4.4 ± 1.1	4.8 ± 1.3	0.6736	2.5 ± 0.7	2.6 ± 0.9	0.6742	− 1.9 ± 1.3	− 2.1 ± 1.2	0.9293
GR (mm)	3.1 ± 0.2	3.3 ± 0.4	0.2821	1.0 ± 0.6	0.9 ± 0.6	0.9066	− 2.2 ± 0.5	− 2.4 ± 0.5	0.2368
GRW (mm)	4.2 ± 0.4	4.4 ± 0.4	0.057	2.8 + 1.2	2.8 ± 1.3	0.7789	− 1.3 ± 1.1	− 1.7 ± 1.4	0.3990
KT (mm)	2.8 ± 0.7	2.6 ± 0.7	0.3393	3.4 ± 1.2	3.3 ± 1.2	0.8765	0.6 ± 1	0.8 ± 0.8	0.5948
KTT (mm)	1 ± 0.5	1 ± 0.5	0.9932	1.4 ± 0.4	1.5 ± 0.5	0.6238	0.4 ± 0.4	0.5 ± 0.4	0.4181

The Mann-Whitney and *t* tests were performed

the third month of follow-up. All other patients expressed complete satisfaction with the results and no discomfort or hypersensitivity after the first month.

Table 1 shows the clinical parameters at baseline and 6 months for each group. The GR mean was 3.1 ± 0.2 mm for the CG and 3.3 ± 0.4 mm for the TG, and the defects were located on 7 canines (four maxillary and 3 mandibular) and 27 premolars (14 maxillary and 13 mandibular). Both groups had similar clinical parameters at baseline, with no statistically significant differences between them.

At the 6 months postoperative visit, in both test and control groups with the exception of the PD, all of the parameters were significantly different from baseline. The KT height and KTT presented a significant gain, and a reduction was expressed in GR, GRW, and CAL for both groups (Figs. 1 and 2).

The inter-group analysis showed no statistically significant differences in clinical parameters at baseline and 6 months (Table 1). The PD remained unchanged at this period of evaluation for both groups. The differences in RC means (CG, 69.5 ± 19 and TG, 72.2 ± 16.5; p value = 0.849570) were also not significant between control and test groups. When the analysis was weighted by KTT (0.8 > KTT > 0.8), by maxillary/mandibular teeth and by the operator, there was still no statistical difference in RC between groups (Table 2). Finally, there was a mean reduction in GR of 2.2 mm (± 0.5), 2.4 mm (± 0.5), in CAL of 1.9 mm (± 1.3) and 2.1 mm (±1.2), for CG and TG, respectively. In addition, the KT height and KTT presented an increase in the follow-up period, as seen in Table 3.

Discussion

The primary purpose of the study was to investigate the root coverage and the increase in KT when comparing root coverage of recessions with intact roots to recessions with NCCLs using an extended coronally advanced flap associated with a connective replacement graft. Although knowing that the NCCLs have a negative influence in complete root coverage [28], a decision-making process for treating NCCLs associated with gingival recession defects was published by Zucchelli [7] in 2011, categorizing 5 types of NCCLs. According to this paper, NCCL type 2 has a radicular defect associated with a gingival recession RT1 [14], in which the CEJ was located over the coronal step of the NCCL. Differently from the other NCCLs types, the treatment remains exclusively periodontal, as described in the present study. The cervical defect promotes a dead space in which the flap might collapse, albeit having a CTG beneath the flap might provide adequate support to the flap, and as a consequence, better stability [7, 15, 16] and stable outcomes [29].

A randomized clinical trial [16] compared two different treatments for gingival recessions associated with NCCLs, using only a coronally advanced flap (CAF) and a CTG, or a CAF + CTG in combination with a resin-modified glass ionomer restoration (CTG+R). Regardless of the conclusion that, after a 6-month follow-up, both procedures provided soft tissue coverage, it has been suggested that only the NCCL located specifically on the root could be predictably covered by soft tissue after the surgical procedure. This could be explained by the presence of the CTG beneath the flap as mentioned previously.

It is important to note that in the present study, the ADMG was used as a CTG substitute. This matrix has been shown by several studies to be a reliable substitute for autogenous tissue grafts [15–17, 30–33]. A meta-analysis done in 2005 by Gapski [31] concluded that there was no statistical difference between ADMG and CTG for RC and also that ADMG showed better short-term outcomes than CTG for CRC. Regarding the flap, the extended coronally advanced flap has been described as a suitable surgical technique when associated with an avascular graft as the ADMG [17, 21, 26, 30] and suitable for NCCLs treatment [7] because it provides better nutrition for the graft [17, 21].

The root coverage outcomes in the present study are consistent with Queiroz Côrtes [34] that reported mean root coverage of 76.18% ± 20.81 after 6-month follow-up for the ADMG group and 65.9% by Aichelmann-Reidy [19], although some studies show a different mean root coverage [33] (96.2% control vs 95.8% ADMG group) shows how difficult it is to compare studies because of the many different methodologies. Additionally, Zucchelli [7] found an overall mean root coverage of 2.07 ± 1.12 mm, similar to our test group results (2.4 ± 0.5 mm).

The success of the mucogingival treatment is complete root coverage, which varies depending on the width and height of the recession, phenotype of the gingival tissue and type of surgical technique, location of the teeth, root condition, and

Table 3 Root coverage (mean ± SD) inter-groups

		C	*T*	*p*
Root coverage %		− 69.5 ± 19	− 72.2 ± 16.5	0.8495
Weighted analysis by	Maxilar/mandibular	− 66.8 ± 19.6	− 70 ± 16.2	0.6339
	KTT > 0.8/<0.8	− 70.9 ± 17.9	− 72.9 ± 17.9	0.9328
	Operator	− 74.4 ± 17.7	− 70.7 ± 17.3	0.540

The Mann-Whitney test was performed

interproximal tissues [29, 35]. In the present study, maxillary and mandibular teeth were both treated, and the mean baseline height recession was 3.1 ± 0.2 and 3.3 ± 0.4 for control and test groups, respectively. In the literature, there is no uniformity in parameter size becoming impossible to compare different outcomes. Thus, Chambrone [36] recently described that the greater the baseline recession or deeper the recession depth, the smaller the chance of CRC (45% less chances). On the other hand, if root coverage is considered complete only when the gingival margin is coronal to and completely covering the CEJ, percentages of CRC are even lower than those reported in the literature [36], especially when it is written without accurate parameters as outcomes.

Finally, as there were no differences between the clinical parameters in both test and control groups at 6 months, it could be supposed that the allograft also has the potential to support the flap, preventing collapse and stabilizing the gingival margin even over the cervical lesions.

Conclusion

In conclusion, gingival recessions associated with NCCLs can be successfully treated with the extended flap technique associated with de ADMG. More studies should be performed in order to evaluate long-term outcomes.

[†]PCPUNC156, Hu-Friedy, Chicago, IL, USA.
[‡]Graphpad Prism 7 Software, La Jolla, CA, USA.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethics approval All procedures performed in studies involving human participants were in accordance with the 1964 Helsinki Declaration and its later amendments and with the ethical standards of the Research Ethics Committee of the School of Dentistry of Ribeirao Preto, University of Sao Paulo (CAAE: 0002.0.138.000.-11; Process: 20111.176.58.1) and subscribed at ClinicalTrials.gov (NCT03615092).

Informed consent Informed consent was obtained from all individual participants included in the study.

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