

ORIGINAL ARTICLE

Impact of a Bioadhesive Oral Wound Dressing Combined With Flowable Resin on Patient-Reported Outcomes After Palatal Graft Harvesting: A Randomized Clinical Trial

Sergio García-Moreno¹ | Rosa María López-Pintor²  | Isabel Leco-Berrocal² | Jesús Torres² | José González-Serrano² 

¹Private Practice in Madrid, Spain | ²ORALMED Research Group, Department of Dental Clinical Specialties, School of Dentistry, Complutense University of Madrid, Spain

Correspondence: Rosa María López-Pintor (rmlopezp@ucm.es) | José González-Serrano (josego09@ucm.es)

Received: 23 June 2025 | **Revised:** 8 September 2025 | **Accepted:** 18 October 2025

Funding: This work was supported by Nueva Galimplant, S.L.U and Sanhigia S.L.

Keywords: flowable resin | gingival graft harvesting | oral wound dressing | patient-reported outcomes | postoperative pain

ABSTRACT

Objective: To evaluate the effect of a cellulose-based oral wound dressing (OWD) stabilized with flowable resin (FR), in combination with hemostatic sponges, on patient-reported outcomes (PROMs) after palatal graft harvesting.

Materials and Methods: This randomized clinical trial included patients requiring soft tissue augmentation with dental implants. Participants were allocated to three groups: OWD and FR (OWDFR), cyanoacrylate (CY), or palatal plate (PP). The primary outcome was postoperative pain, assessed with a 10-cm visual analog scale (VAS) over 14 days. Secondary outcomes were analgesic consumption, oral health-related quality of life (OHIP-14), postoperative bleeding, and willingness to repeat the procedure.

Results: Sixty-one patients were enrolled. The OWDFR group reported lower VAS values on Days 1, 2, 3, and 7 compared with CY and PP ($p < 0.05$). On Day 2, VAS scores were significantly lower in OWDFR, with mean differences of -1.94 versus CY and -2.12 versus PP ($p < 0.01$). Analgesic intake differed significantly on Days 3 and 5; on Day 3, OWDFR consumed -0.89 tablets compared to PP and CY consumed -0.95 tablets compared to PP (both $p < 0.05$). OHIP-14 scores were similar across groups, but OWDFR patients reported greater early postoperative comfort. No bleeding or adverse events occurred. All OWDFR patients were willing to repeat the procedure, compared with 90% in CY and 85% in PP.

Conclusions: The combination of a bioadhesive OWD with FR appears to be a safe and minimally invasive method for protecting palatal donor sites. It reduces postoperative pain and analgesic use while enhancing comfort, supporting its incorporation into routine clinical protocols.

Trial Registration: Protocol registered at clinicaltrials.gov (NCT06408792)

1 | Introduction

Soft tissue grafting is a widely utilized procedure for the management of gingival recessions and lack of keratinized mucosa around dental implants (Tavelli, Ravidà, Lin, et al. 2019). In cases where an increase in the width and thickness of keratinized

mucosa is required, the palatal graft remains the gold standard (Tavelli, Barootchi, Avila-Ortiz, et al. 2021; Zucchelli et al. 2010). The connective tissue obtained from a gingival graft is predominantly composed of lamina propria, with minor components of glandular and adipose tissue (Bertl et al. 2015). The harvesting technique is straightforward, and the favorable availability

of keratinized tissue in the palatal mucosa has contributed to its frequent use (Tavelli, Ravidà, Saleh, et al. 2019; Zucchelli et al. 2010). Nevertheless, the primary disadvantages and concerns associated with palatal gingival grafts include postoperative pain, discomfort, and bleeding (Rossmann and Rees 1999; Wang et al. 2001).

Evidence indicates that healing by secondary intention following palatal graft harvesting is associated with greater postoperative pain and morbidity compared to alternative techniques (Chambrone et al. 2018; Wessel and Tatakis 2008). Moreover, patients' previous experiences with autogenous soft tissue grafts can significantly influence their willingness to undergo subsequent procedures, particularly among those who have experienced considerable postoperative discomfort (Tavelli, Barootchi, Di Gianfilippo, et al. 2021). To minimize postoperative bleeding and pain at the palatal donor site, various protective measures have been employed including palatal acrylic plates (Yussif et al. 2021), cellulose sponges (Patarapongsanti et al. 2019), absorbable sponges (Rossmann and Rees 1999), platelet-rich fibrin (Meza-Mauricio et al. 2021), cyanoacrylate (CY) (Escobar et al. 2021), propylene meshes (Yussif et al. 2021), Alvogyl, and absorbable gelatin sponges as palatal wound dressings (Alghriany et al. 2024; Ehab et al. 2020). These interventions aim to protect the surgical site and reduce morbidity. Among them, hemostatic sponges are the most used due to their biocompatibility, nontoxicity, and low cost (Chattopadhyay and Raines 2014; Guralnick 1946). Hemostatic sponges offer mechanical protection, support clot formation (Guralnick and Berg 1948; Rossmann and Rees 1999), accelerate hemostasis (Rossmann and Rees 1999), and promote early healing at donor sites (Schinini et al. 2021). Recent studies have evaluated the combination of hemostatic sponges with adjunctive materials, such as CY tissue adhesive, to optimize outcomes (Escobar et al. 2021; Tavelli et al. 2018; Tavelli, Ravidà, Saleh, et al. 2019). This combination has been associated with a reduction in postoperative pain, discomfort, and analgesic consumption compared to the use of hemostatic sponges alone (Escobar et al. 2021; Tavelli et al. 2018; Tavelli, Ravidà, Saleh, et al. 2019). However, the tendency of CY to detach prematurely from the donor site has prompted the exploration of alternative strategies.

Clinical trials have investigated the application of composite resins in periodontal plastic surgery to manage combined defects, such as gingival recession associated with noncarious cervical lesions (Santamaria et al. 2016, 2018). In these cases, soft tissue coverage of approximately 50%–80% of the cervical restoration is achieved following healing, contributing to defect reduction without compromising periodontal health (Santamaria et al. 2009, 2014). Flowable resin (FR) is also widely used following dental implant placement to fabricate customized provisional prostheses that closely adapt to the surrounding soft tissues, thereby replicating the contours of the definitive prosthesis (Studenikin and Niftaliev 2021). In such clinical scenarios, the FR remains in direct contact with the gingival tissue, and studies have demonstrated complete epithelialization without signs of inflammation (Studenikin and Niftaliev 2021). Furthermore, recent studies have evaluated the application of FR to coat hemostatic sponges following palatal graft harvesting, reporting promising outcomes.

The additional sealing effect provided by FR appears to further reduce postoperative pain compared to the use of hemostatic sponges alone (Laguna-Martos et al. 2025; Meza-Mauricio et al. 2023).

On the other hand, a recently developed bioadhesive cellulose film has demonstrated efficacy in reducing postoperative pain, bleeding, and discomfort in patients undergoing mucogingival surgery (Min et al. 2020). This material (Ora-Aid; TBM Co., Gwangju, South Korea) has also proven effective in decreasing biofilm formation (Bozkurt et al. 2020), alleviating pain from traumatic ulcers caused by orthodontic appliances (Bozkurt and Buyukbasaran 2024) and serving as a minimally invasive solution for the closure of oroantral communications (Kaba et al. 2023). However, its clinical application is limited by a short adhesion time, typically lasting only a few hours.

In this context, the incorporation of FR into the cellulose film may enhance its stability and prolong its protective effect, thereby improving patient comfort. Notably, an FR with enhanced translucency has recently been developed, enabling effective light curing even at greater thicknesses and offering superior structural rigidity compared to conventional FRs, along with a vivid yellow color that facilitates its removal (Galisoft, Galimplant S.L., Sarria, Spain).

To the best of our knowledge, there are no randomized clinical trials (RCT) that have evaluated the Patient Reported Outcomes (PROMs) of combining a cellulose-based adhesive oral wound dressing (OWD) with FR in the context of mucogingival surgery. Therefore, the main objective of this RCT is to assess whether combining the use of hemostatic sponges with an OWD and FR as a protective strategy for palatal donor sites after autologous gingival graft harvesting reduces patients' post-treatment pain compared to two other common treatments, such as the use of hemostatic sponges and CY and the use of hemostatic sponges and palatal plates (PP). The null hypothesis is that there are no differences in postoperative pain levels among palatal donor sites treated with OWDFR, CY, or PP.

2 | Materials and Methods

2.1 | Study Design

This study was designed as an RCT and was conducted in accordance with the CONSORT (Consolidated Standards of Reporting Trials) guidelines (<http://www.consort-statement.org/>). The protocol received approval from the Ethics Committee of Hospital Clínico San Carlos (24/175-EC_X) and adhered to the principles outlined in the Declaration of Helsinki for research involving human participants. The trial was registered at <http://clinicaltrials.gov> (NCT06408792).

2.2 | Patients

Patients were recruited from two private dental clinics in the Community of Madrid (Spain) between May 2024 and December 2024. Prior to inclusion, all participants received

detailed information regarding the study and provided written informed consent.

The inclusion criteria were as follows: (a) age ≥ 18 years; (b) indication for soft tissue augmentation in an edentulous area to increase soft tissue volume concurrently with dental implant placement, or in a postextraction socket where an immediate implant was placed; (c) palatal thickness of at least 4 mm, determined by superimposing DICOM files from CBCT with STL files from intraoral scans (Shining 3D Tech. Co. Ltd., Hangzhou, China), measured in the area between the maxillary second premolar and first molar, 5 mm from the gingival margin; (d) patients in whom a 12 \times 5 mm de-epithelialized palatal graft with a thickness of 1.5–2 mm could be harvested, verified with a digital caliper after de-epithelialization; (e) patients with no history of prior palatal graft harvesting; (f) patients with the ability to comply with study procedures, including maintaining adequate oral hygiene, completing questionnaires, and attending follow-up appointments; and (g) full understanding of the surgical procedure and capacity to provide informed consent.

Exclusion criteria were as follows: (a) presence of vertical bone dehiscence > 3 mm on the vestibular aspect of the edentulous site, as assessed during surgery, which would require guided bone regeneration; (b) smoking > 10 cigarettes/day; (c) untreated periodontitis; (d) patients suffering from diabetes mellitus; (e) patients undergoing treatment with oral anticoagulants or antiplatelet agents; (f) patients with a history of malignant tumors, head and neck radiotherapy, chemotherapy, or immunotherapy within the past 5 years; (g) current or previous use of medications known to impair wound healing or increase infection risk (e.g., corticosteroids, immunosuppressants, immunomodulators); (h) systemic conditions affecting connective tissue metabolism, autoimmune or chronic inflammatory diseases with oral involvement (e.g., oral lichen planus, mucous pemphigoid, pemphigus vulgaris), vascular alterations at the donor or recipient site, metabolic bone diseases, or alcohol abuse; (i) use of antiresorptive agents (e.g., bisphosphonates, denosumab, romosozumab) or other medications related to osteonecrosis of the jaws (e.g., mTOR inhibitors, bevacizumab, sunitinib); (j) pregnancy or breastfeeding; (k) presence of palatal lesions such as recurrent herpes simplex virus infections; (l) use of removable dental prostheses covering the palate; and (m) known hypersensitivity to any of the materials employed in the study.

2.3 | Interventions: Treatment Protocol

At the first visit, eligible participants underwent CBCT imaging and intraoral scanning (Shining 3D Tech. Co. Ltd., Hangzhou, China). Subsequently, supragingival mechanical debridement was performed, and subgingival debridement was carried out when necessary. Participants also received standardized oral hygiene instructions, including training in the modified Bass brushing technique.

At the second visit and prior to surgery, the patients rinsed with a 0.2% solution of chlorhexidine digluconate for 60 s. All surgical procedures were performed under local anesthesia

using 4% articaine with 1:100,000 epinephrine. The same surgical protocol was followed for all patients, and all procedures were conducted by the same surgeon (SGM). All participants received a single IPX dental implant (Galimplant S.L., Sarria, Spain), accompanied by the placement of a de-epithelialized gingival graft in the vestibular region of the alveolar ridge to augment soft tissue volume. Implant placement was performed either immediately after tooth extraction or in a fully healed edentulous ridge, depending on the clinical indication. Firstly, a sulcular incision around the neighboring teeth and a mesiodistal crestal incision were made. A full-thickness flap was elevated on the palatal/lingual side and on the buccal side. Then, a dental implant was placed according to the manufacturer's indications. On the palate, an 815-turbine bur under irrigation was used to de-epithelialize the gingival graft in the area between the maxillary second premolar and first molar, 5 mm from the gingival margin, achieving dimensions of 12 \times 5 mm. Subsequently, two parallel vertical incisions (5 mm in length) extending to the bone were made, followed by two horizontal incisions (12 mm in length) to connect the vertical incisions. Once the outlined area was defined, a scalpel blade was utilized to harvest the palatal tissue at a deeper plane. Thereafter, the grafts were placed in the vestibular area of the dental implant, immobilized, and stabilized in the desired position using a nonresorbable 5–0 suture (Supramid SMI, Sanhigia S.L., Zaragoza, Spain). One horizontal mattress suture was applied through the buccal flap to position the graft without tension. Single interrupted sutures were used to adapt the wound margins and to achieve primary closure of the augmented site.

At this time point, allocation concealment was maintained using sealed, opaque, and consecutively numbered envelopes prepared by an independent researcher not involved in the study. The envelopes were opened immediately after implant placement and graft harvesting to assign participants to their respective groups: OWDFR, CY, or PP. In all groups, hemostatic sponges (Curaspon, CuraMedical B.V., Assendelft, The Netherlands) were placed in the palatal wound prior to the application of the allocated protective measure. The palatal wound was then managed according to the assigned protocol.

2.3.1 | PP group

The sponges were secured with a nonresorbable 4–0 suture (Supramid SMI, Sanhigia S.L., Zaragoza, Spain), followed by coverage with a custom-made PP fabricated immediately postoperatively (Figure 1a,b). Intraoral scans obtained at the first visit were used to produce 3D-printed maxillary models. On these models, custom-made vacuum-formed shells of 0.5-mm thickness were fabricated (Basma et al. 2023). Chairside adjustments were performed as required.

2.3.2 | CY group

The sponges were secured with a nonresorbable 4–0 suture (Supramid SMI, Sanhigia S.L., Zaragoza, Spain), followed by coverage with cyanoacrylate tissue adhesive (PeriAcryl 90 HV; Glustitch, Delta, Canada) (Figure 1c–e).



FIGURE 1 | (a) Hemostatic sponges secured in place using a single suture, (b) palatal plate placement, (c) de-epithelialization of the palatal graft, (d) stabilization of hemostatic sponges using a single suture; (e) application of cyanoacrylate, (f) application of the oral wound dressing over the hemostatic sponges at the palatal wound site without suture fixation, (g) etching of the palatal surfaces of the adjacent teeth, (h) application of light-cured flowable resin for stabilization.

2.3.3 | OWDFR group

After sponge placement, no sutures were applied at the palatal donor site. Instead, a bioadhesive cellulose OWD (Ora-Aid; TBM Co., Gwangju, South Korea) was subsequently stabilized with FR (Galisoft, Galimplant S.L., Sarria, Spain), bonded to the palatal surfaces of the adjacent teeth (Figure 1f-h). Figure 2 provides a comprehensive, step-by-step depiction of the employed technique.

Postoperative pharmacological management included amoxicillin 750 mg every 8 h for 7 days, and ibuprofen 600 mg every 8 h as needed for pain management (Monje et al. 2022). Patients were instructed to rinse twice daily with a 0.2% solution of chlorhexidine for 10 days. Follow-up visits occurred 14 days postoperatively for suture removal and, when applicable, removal of the palatal protection device.

2.4 | Study Variables

The following demographic variables were recorded for each participant: Age, sex, and daily cigarette consumption (cigarettes per day).

2.5 | Patient-Reported Outcome Measures (PROMs)

2.5.1 | Pain Assessment

Postoperative pain was evaluated using a 10-cm visual analog scale (VAS), where 0 indicated no pain and 10 represented the worst imaginable pain. Patients recorded their pain levels on Days 1, 2, 3, 4, 5, 6, 7, and 14 after surgery. Analgesic consumption (ibuprofen 600 mg every 8 h as needed) was also documented by each patient.

To standardize data collection, all questionnaires were completed at 9:00 p.m.

2.5.2 | Oral Health-Related Quality of Life

The Oral Health Impact Profile-14 (OHIP-14) was used to assess the impact of the procedure on patients' quality of life. Participants rated each of the 14 items on a 5-point Likert scale ranging from 0 (never) to 4 (very frequently). The OHIP-14 questionnaire was completed at baseline (Day 0) and on Days 3, 7, and 14 after treatment.

2.5.3 | Other Outcomes

Patients documented the occurrence of immediate (<24h) or delayed (>24h) postoperative bleeding from the palatal site. On Day 14, participants were also asked whether they would be willing to undergo a similar mucogingival surgical procedure in the future.

Additionally, any adverse events or complications were recorded throughout the study period.

2.6 | Sample Size

The primary outcome was postoperative pain. Sample size estimation was based on Tavelli, Ravidà, Saleh, et al. 2019, who evaluated postoperative pain after palatal graft harvesting using CY plus collagen sponges versus collagen sponge alone. In that study, the collagen + CY group reported VAS scores of 0.58 ± 0.92 at Day 3, whereas the collagen sponge group showed a VAS score of 2, corresponding to a mean difference of 1.4 VAS points. For our calculation, we assumed a standard deviation of 0.92 and powered the study to detect a 1.5-point difference using a two-sample independent *t*-test with $\alpha = 0.05$ and 95% power, without correction for multiplicity, yielding a minimum of 10 participants per group; to account for potential dropouts, 11 per group were planned. Because this trial involved three groups, the primary analysis used the



FIGURE 2 | Step-by-step sequence of the surgical technique for palatal donor site protection using a bioadhesive oral wound dressing stabilized with flowable resin: (a) palatal wound immediately after graft harvesting; (b) placement of hemostatic sponges over the wound site; (c) positioning of the oral wound dressing over the sponges and etching of the palatal surfaces of the adjacent teeth; (d) stabilization of the dressing with light-cured flowable resin bonded to the etched surfaces.

Kruskal–Wallis test followed, if significant, by Bonferroni-adjusted pairwise comparisons.

2.7 | Randomization and Blinding

Randomization was conducted by an independent researcher using a random number generator. The treatment assignment communication was offered in identical opaque envelopes and assigned sequentially according to the order of patient inclusion. Due to the visible differences between the interventions, neither clinicians nor participants could be blinded to group allocation.

2.8 | Statistical Analysis

Statistical analyses were performed using SPSS version 29.0 (SPSS Inc., New York, NY, USA). Descriptive statistics were conducted. Categorical variables are shown as numbers and percentages, and continuous variables are reported as both median with interquartile range (IQR) and mean with standard deviation (SD). The Shapiro–Wilk test was used to assess whether the quantitative variables had a normal distribution. Differences in continuous variables among groups were analyzed using the Kruskal–Wallis test with Bonferroni post hoc correction. Categorical variables were analyzed using the chi-square test. In addition, linear regression models were performed for postoperative pain (VAS on Days 1, 2, 3, and 7) and analgesic intake (Days 3 and 5). The covariates considered were study group, age, smoking status (yes/no), and smoking intensity (cigarettes/day). These tests were performed to assess the possible influence of these covariates on the results. Statistically significant associations were considered at $p \leq 0.05$.

3 | Results

A total of 61 patients were enrolled in this study. All enrolled participants were successfully randomized into one of the three

study groups (OWDFR: 21 patients; CY: 20 patients; PP: 20 patients), and all completed the study protocol without deviations. The CONSORT Flowchart is shown in Figure 3. Baseline demographic characteristics of the study population are presented in Table 1. No significant differences were observed among the groups with respect to gender, age, smoking status and intensity, and implant timing (immediate vs. conventional).

3.1 | Patient-Reported Outcome Measures (PROMs)

3.1.1 | Pain Assessment (VAS)

Postoperative pain scores, as measured on the VAS (0–10 scale), peaked on Day 1 in the OWDFR and PP groups, whereas the CY group exhibited maximal pain on Day 2. Thereafter, a progressive reduction in pain was observed across all groups, with significant decreases noted through Day 14 (Figure 4).

The OWDFR group demonstrated a statistically significant reduction in pain perception compared with the CY and PP groups on Days 1, 2, 3, and 7 (Figure 4 and Table S1). It is worth noting that the OWDFR group reported near-zero pain levels throughout the postoperative period.

In linear regression analyses age, smoking status and smoking intensity were not significant predictors of VAS on Days 1, 2, 3, and 7. Only the group of treatment was a significant predictor of the outcomes (see Table S2).

3.1.2 | Analgesic Consumption

Analgesic intake was monitored for the first 14 postoperative days. Ibuprofen consumption was lowest in the OWDFR group, followed by the CY group, and reached the highest levels in the PP group. Intergroup differences were observed on

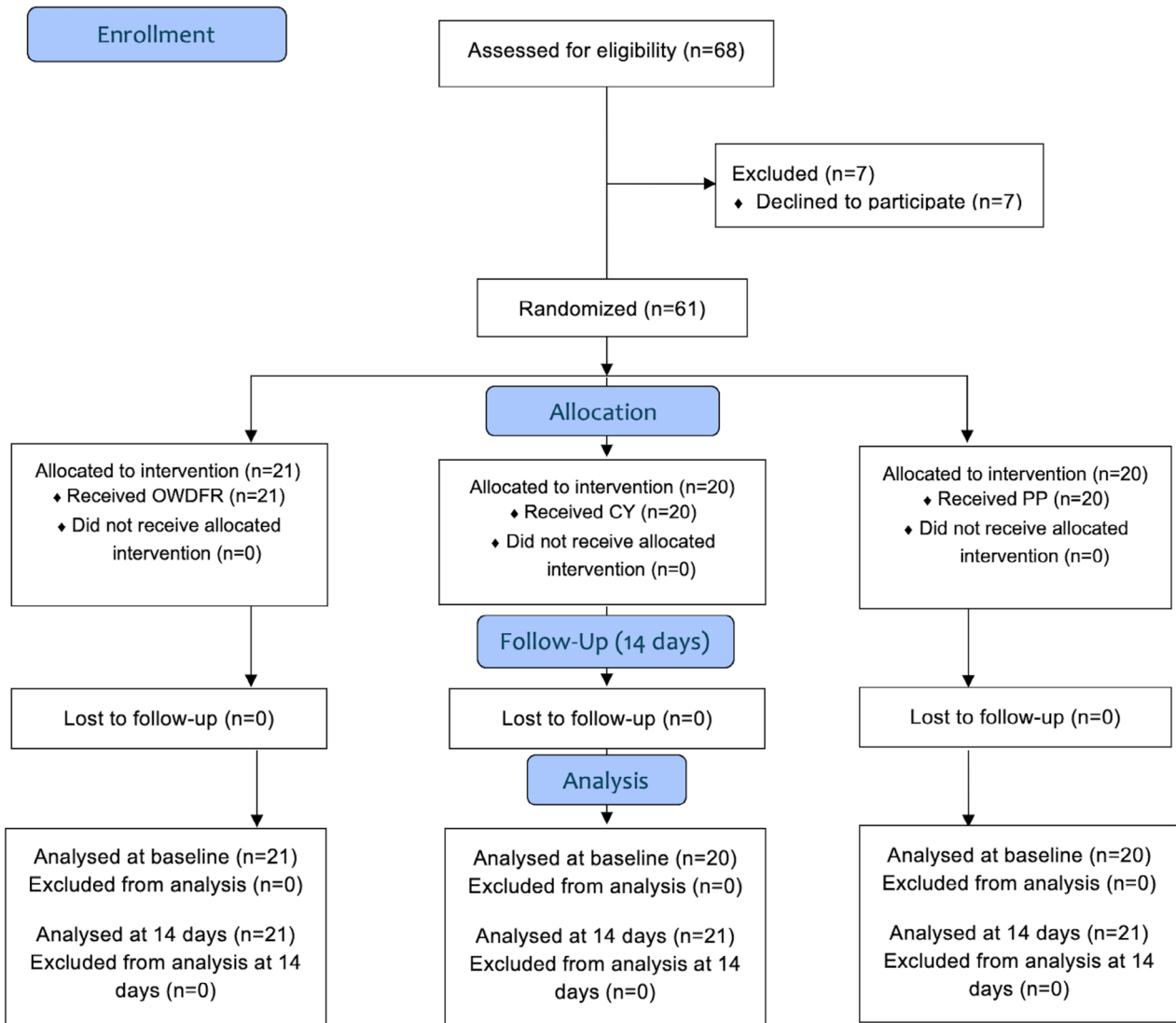


FIGURE 3 | CONSORT Flowchart.

TABLE 1 | Patients' characteristics.

		OWDFR ^a (n = 21)	CY ^b (n = 20)	PP ^c (n = 20)	p
Gender	Male	8	7	7	0.97
	Female	13	13	13	
Age	Mean (SD) ^d	50.67 (13.52)	53.11 (9.24)	47.9 (11.43)	0.18
	Median (IQR) ^e	49.50 (42.00–63.00)	56.50 (53.00–59.50)	46.00 (39.00–52.00)	
Cigarettes/day	Mean (SD)	3.05 (6.61)	0.5 (2.24)	1.7 (4.82)	0.24
	Median (IQR)	0.00 (0.00–2.25)	0.00 (0.00–0.00)	0.00 (0.00–0.00)	
Smokers		6/21 (28.57%)	1/20 (5%)	3/20 (15%)	0.12
Implant procedure	Immediate	11 (52.38%)	10 (50%)	9 (45%)	0.89
	Edentulous site	10 (47.62%)	10 (50%)	11 (55%)	

^aOral wound dressing and flowable resin.

^bCyanoacrylate.

^cPalatal plate.

^dStandard deviation.

^eInterquartile range (Q1–Q3).

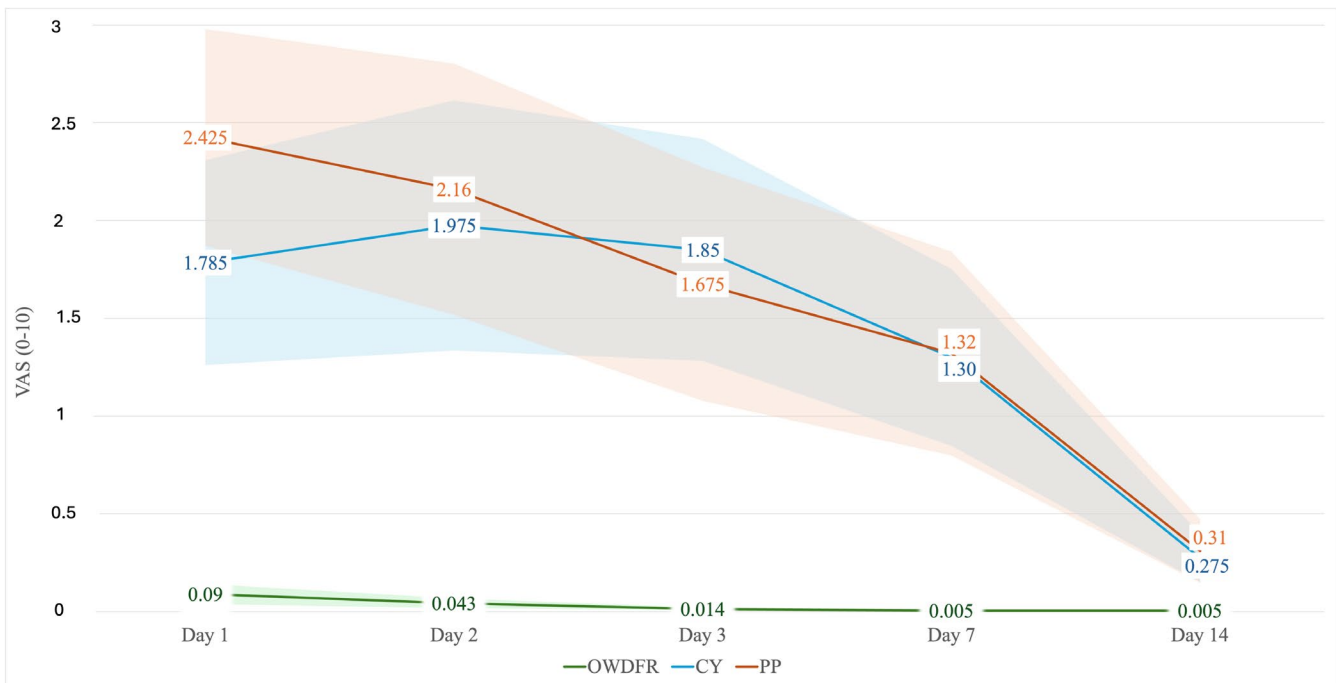


FIGURE 4 | Pain perception using VAS. Line plot showing the reported pain perception (VAS 0–10) in the three treatment groups. Shading indicates standard error. Patients randomized to OWDFR reported significantly less pain ($p < 0.05$) compared to the CY and PP groups on Days 1, 2, 3, and 7. OWDFR: Oral wound dressing and flowable resin, CY: Cyanoacrylate, PP: Palatal plate.

Days 3 and 5 ($p = 0.05$); however, these differences did not remain significant after Bonferroni correction for multiple comparisons (Table 2).

In linear regression analyses age, smoking status and smoking intensity were not significant predictors of analgesic intake on Days 3 and 5. Only the group of treatment was a significant predictor of these outcomes (see Table S3).

3.1.3 | Oral Health–Related Quality of Life (OHIP-14)

At baseline, OHIP-14 scores were comparable among groups ($p = 0.74$). The most notable intergroup differences were observed on Day 3, when the OWDFR group reported the lowest scores, although these did not reach statistical significance between groups ($p = 0.093$). Detailed data regarding the evolution of OHIP-14 scores throughout the follow-up period are provided in Table 3.

3.2 | Additional Findings

No cases of immediate (< 24 h) or delayed (> 24 h) postoperative bleeding from the palatal donor site were reported in any of the three groups.

Regarding patient willingness to undergo a similar surgical procedure in the future, 100% of participants in the OWDFR group (21/21), 90% in the CY group (18/20), and 85% in the PP group (17/20) responded affirmatively. However, these differences did not reach statistical significance ($p = 0.20$).

No adverse events or complications were observed in any participant throughout the study period.

4 | Discussion

This RCT evaluated the clinical performance of combining hemostatic sponges with an OWD covered with FR to protect palatal donor sites after autologous gingival graft harvesting. The results demonstrated a significant reduction in postoperative pain compared to conventional methods such as hemostatic sponges with CY or PP, suggesting that the OWDFR combination may represent a novel, patient-friendly alternative for donor site management.

These findings align with previous studies indicating that applying CY over collagen sponges significantly reduces postoperative pain and analgesic consumption (Tavelli, Ravidà, Saleh, et al. 2019). Similarly, Meza-Mauricio et al. (2023) reported improved wound protection and reduced discomfort when sponges were coated with FR. However, other materials such as bioadhesive cellulose films have limitations due to their short adhesion time and need for mechanical retention.

Pain is a key determinant of recovery after mucogingival surgery. In this study, patients treated with the OWDFR combination reported consistently lower pain scores, particularly during the first postoperative week. This supports prior evidence that stabilizing the wound and providing mechanical protection significantly reduces nociceptive stimulation and improves comfort (Meza-Mauricio et al. 2023; Silva et al. 2023). Preclinical studies have shown that bioadhesive films promote epithelial proliferation, accelerate wound closure, and enhance collagen deposition (Kang et al. 2022), effects likely contributing to the favorable clinical outcomes observed. The addition of FR improves dressing retention, resulting in minimal pain perception.

TABLE 2 | Total analgesics consumed during the postoperative period.

	Groups	n	Median (IQR^a)	Mean (SD^b)	p	Bonferroni correction
Day 1	OWDFR ^c	21	1.50 (0.00–3.00)	1.43 (1.24)	0.48	
	CY ^d	20	1.00 (0.00–2.50)	1.25 (1.33)		
	PP ^e	20	2.00 (0.00–3.00)	1.75 (1.33)		
Day 2	OWDFR	21	0.50 (0.00–2.50)	1.05 (1.28)	0.21	
	CY	20	1.00 (0.00–2.00)	1.15 (1.22)		
	PP	20	1.00 (0.00–3.00)	1.75 (1.41)		
Day 3	OWDFR	21	0.00 (0.00–1.50)	0.81 (1.12)	0.05*	Not significant
	CY	20	0.00 (0.00–1.00)	0.75 (1.20)		
	PP	20	1.00 (0.00–3.00)	1.70 (1.38)		
Day 4	OWDFR	21	0.50 (0.00–2.00)	0.90 (1.13)	0.13	
	CY	20	0.00 (0.00–2.00)	0.85 (1.30)		
	PP	20	1.00 (0.00–3.00)	1.60 (1.35)		
Day 5	OWDFR	21	0.00 (0.00–1.00)	0.62 (1.02)	0.05*	Not significant
	CY	20	0.00 (0.00–2.00)	0.85 (1.26)		
	PP	20	1.00 (0.00–3.00)	1.45 (1.27)		
Day 6	OWDFR	21	0.00 (0.00–1.00)	0.48 (0.92)	0.14	
	CY	20	0.00 (0.00–2.00)	0.80 (1.32)		
	PP	20	0.00 (0.00–2.00)	1.25 (1.33)		
Day 7	OWDFR	21	0.00 (0.00–0.00)	0.33 (0.73)	0.2	
	CY	20	0.00 (0.00–1.00)	0.75 (1.25)		
	PP	20	0.00 (0.00–1.00)	1.05 (1.31)		
Total	OWDFR	21	3.00 (0.00–10.50)	6.05 (7.79)	0.19	
	CY	20	3.00 (0.00–10.00)	7.55 (10.22)		
	PP	20	7.00 (0.00–18.00)	11.90 (10.43)		

^aInterquartile range (Q1–Q3).

^bStandard deviation.

^cOral wound dressing and flowable resin.

^dCyanoacrylate.

^ePalatal plate.

*Statistically significant results.

While OHIP-14 is a widely used tool for assessing oral health-related quality of life, it may lack sensitivity to detect early healing differences. In this trial, no significant differences in OHIP-14 scores were found among the groups, despite the reported reduction in pain in the OWDFR group. This may be due to confounding factors, including the presence of dual surgical sites or functional limitations related to missing teeth, which can affect perceived oral health (Petsos et al. 2020). Interestingly, Baroudi and Othman (2024) did not employ OHIP-14 but still supported the use of patient-centered outcomes like postoperative pain and willingness to repeat the procedure. Similarly, a systematic review by Stefanini et al. (2021) emphasized the importance of integrating PROMs such as pain perception, analgesic use, and willingness to undergo treatment again into the evaluation of soft tissue grafting procedures.

The findings also align with a broader interest in developing materials and protocols that reduce morbidity at donor sites. Hemostatic sponges are widely used for clot stabilization and biocompatibility, yet their lack of inherent adhesion can compromise protection. CY has demonstrated hemostatic and analgesic benefits, but its adhesion can be unstable and prone to premature detachment, which may limit its protective function over time. Parlak et al. (2023) reported that combining CY with hyaluronic acid promoted epithelialization and minimized bleeding, offering additional benefits for donor site management. The current study suggests that OWD combined with FR may offer superior adhesion and stability.

FR, in particular, has shown benefits in enhancing wound coverage and healing. Meza-Mauricio et al. (2023) demonstrated that sponges coated with FR significantly lowered pain and

TABLE 3 | Total OHIP-14 values during the postoperative periods and differences between those days.

	Groups	n	Median (IQR^a)	Mean (SD^b)	p
Baseline	OWDFR ^c	21	6.00 (3.00–17.25)	8.05 (7.39)	0.74
	CY ^d	20	7.00 (3.00–12.00)	8.30 (5.79)	
	PP ^e	20	11.00 (2.00–12.00)	8.40 (4.83)	
3 days—Bl ^f	OWDFR	21	4.00 (2.00–17.25)	8.57 (9.50)	0.093
	CY	20	11.00 (3.50–16.75)	12.45 (10.88)	
	PP	20	19.00 (3.00–24.00)	16.35 (12.43)	
7 days—Bl	OWDFR	21	2.50 (0.00–12.00)	5.90 (6.91)	0.263
	CY	20	5.00 (1.50–12.00)	8.95 (10.82)	
	PP	20	7.00 (2.00–23.00)	12.70 (15.59)	
14 days—Bl	OWDFR	21	0.00 (0.00–2.00)	2.24 (5.39)	0.33
	CY	20	0.00 (0.00–5.00)	3.20 (5.50)	
	PP	20	1.50 (0.00–6.00)	5.85 (10.26)	
7 days–3 days	OWDFR	21	–4.00 (–6.00–0.00)	–2.67 (5.97)	0.92
	CY	20	–2.00 (–9.25–1.00)	–3.50 (5.52)	
	PP	20	–6.00 (–12.00–0.00)	–3.65 (8.35)	
14 days–7 days	OWDFR	21	0.00 (–9.75–0.00)	–3.67 (7.27)	0.19
	CY	20	–4.00 (–8.75–(–0.25))	–5.75 (7.00)	
	PP	20	–4.00 (–13.00–(–1.00))	–6.85 (7.64)	

^aInterquartile range (Q1–Q3).^bStandard deviation.^cOral wound dressing and flowable resin.^dCyanoacrylate.^ePalatal plate.^fBaseline.

reduced analgesic use compared to controls. Isler et al. (2018) also showed that effective pain control achieved through topical flurbiprofen reduced analgesic intake and improved patient comfort, reinforcing the clinical relevance of PROMs in evaluating postoperative management. The present findings are consistent with this, supporting the idea that FR contributes to mechanical stabilization while improving patient comfort and reducing early exposure risk.

Bioadhesive cellulose films have also been explored for palatal wound care. A recent scoping review identified cellulose-based dressings as promising tools for improving PROMs and reducing healing-related morbidity (Silva et al. 2023). However, their clinical performance is limited by a short adhesion time—typically lasting only a few hours—as observed in a preclinical study (Kang et al. 2022). Incorporating FR into the cellulose base may enhance retention and extend protection. Notably, the FR used in this study was translucent enough for effective light curing through thicker layers and included a yellow dye that facilitated clinical removal.

Although procedural time was not formally recorded, it is noteworthy that no sutures were required in the OWDFR group. At the 14-day follow-up, removal of the FR layer required slightly more time; however, its yellow coloration

facilitated identification and handling. In contrast, palatal plate (PP) fabrication involves greater cost and chairside time, as it requires individualized clinical and laboratory procedures. Overall, the OWDFR approach represents a cost-effective, straightforward, and well-tolerated alternative for routine clinical application.

Some limitations should be acknowledged. First, the relatively small sample size may limit the generalizability of the findings. Second, the follow-up period was restricted to 14 days, which is sufficient to evaluate postoperative pain, but not long-term outcomes such as complete tissue healing or patient satisfaction over time. Third, a double-blind design was not feasible due to the inherent differences among the three interventions being compared. Additionally, the patients included in the study underwent two types of procedures: Immediate postextraction implant placement or implant placement in an edentulous area. Therefore, postoperative pain may have been influenced by the type of intervention performed in the recipient site rather than by the palatal donor site protection. However, all patients underwent the same surgical procedure on the buccal aspect, which provides some consistency across groups. Moreover, no cost analysis was conducted for the different treatment modalities, which may also affect the clinical applicability of the findings. In addition, because this trial involved three groups, pairwise

comparisons require multiplicity control. Our original sample-size estimate did not incorporate this penalty and targeted 95% power, whereas the post hoc power calculation indicated 89% ($\beta=0.11$) (see file S4). Although lower than initially planned, this level still exceeds the conventional 80% threshold typically accepted in clinical trials. Finally, no formal multiplicity correction was applied across the different time points, which could increase the risk of Type I error.

Overall, the results support integrating FR-stabilized dressings into clinical protocols aimed at reducing donor site morbidity and enhancing patient experience in mucogingival procedures. As Thoma et al. (2023) emphasized, PROMs play a pivotal role in evaluating soft tissue augmentation techniques and guiding the adoption of minimally invasive approaches, by incorporating patients' perspectives into clinical decision-making.

5 | Conclusions

The OWDFR combination represents a practical and minimally invasive alternative for protecting palatal donor sites. Its capacity to reduce postoperative pain and analgesic needs may improve patient satisfaction and encourage acceptance of autologous soft tissue grafting. Moreover, this technique requires no specialized equipment and can be easily implemented into daily practice.

Author Contributions

Sergio García-Moreno: funding acquisition, conceptualization, investigation. **Rosa María López-Pintor:** conceptualization, writing – review and editing, software, formal analysis, methodology. **Isabel Leco-Berrocal:** writing – review and editing, supervision, validation. **Jesús Torres:** supervision, writing – review and editing, validation. **José González-Serrano:** conceptualization, investigation, writing – original draft, methodology.

Acknowledgments

The authors have nothing to report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

References

Alghriany, A. A., A. U. Ali, I. S. A. Khallaf, A. S. Hassan, M. A. Sayed, and A. M. Fikry. 2024. "Clinical Effectiveness of Orange Peel Polymethoxy-Flavonoids Rich Fraction as a Palatal Dressing Material Compared to Alveogyl: Randomized Clinical Trial." *Scientific Reports* 14: 3067. <https://doi.org/10.1038/s41598-024-53511-4>.

Baroudi, M., and M. Othman. 2024. "Clinical and Patient-Reported Outcome Measures of Palatal Donor Site Healing Using Polyvinylpyrrolidone–Sodium Hyaluronate Gel as a Dressing Material Following Free Gingival Graft Harvesting: A Randomized Controlled Clinical Trial." *Clinical and Experimental Dental Research* 10: e70026. <https://doi.org/10.1002/cre2.70026>.

Basma, H. S., M. H. A. Saleh, R. V. Abou-Arraj, et al. 2023. "Patient-Reported Outcomes of Palatal Donor Site Healing Using Four Different Wound Dressing Modalities Following Free Epithelialized Mucosal Grafts: A Four-Arm Randomized Controlled Clinical Trial." *Journal of Periodontology* 94: 88–97. <https://doi.org/10.1002/JPER.22-0172>.

Bertl, K., M. Piffl, L. Hirtler, et al. 2015. "Relative Composition of Fibrous Connective and Fatty Glandular Tissue in Connective Tissue Grafts Depends on the Harvesting Technique but Not the Donor Site of the Hard Palate." *Journal of Periodontology* 86: 1331–1339. <https://doi.org/10.1902/jop.2015.150346>.

Bozkurt, A. P., and E. Buyukbasaran. 2024. "Effects of Orthodontic Wax and ora-Aid on Pain and Discomfort at the Beginning of Orthodontic Treatment." *Clinical Oral Investigations* 28: 636. <https://doi.org/10.1007/s00784-024-06020-7>.

Bozkurt, A. P., Ö. Ünlü, and M. Demirci. 2020. "Comparison of Microbial Adhesion and Biofilm Formation on Orthodontic Wax Materials: An In Vitro Study." *Journal of Dental Sciences* 15: 493–499. <https://doi.org/10.1016/j.jds.2020.04.011>.

Chambrone, L., M. A. Salinas Ortega, F. Sukekava, et al. 2018. "Root Coverage Procedures for Treating Localised and Multiple Recession-Type Defects." *Cochrane Database of Systematic Reviews* 10: CD007161. <https://doi.org/10.1002/14651858.CD007161.pub3>.

Chattopadhyay, S., and R. T. Raines. 2014. "Review: Collagen-Based Biomaterials for Wound Healing." *Biopolymers* 101: 821–833. <https://doi.org/10.1002/bip.22486>.

Ehab, K., O. Abouldahab, A. Hassan, and K. M. Fawzy El-Sayed. 2020. "Alvogyl and Absorbable Gelatin Sponge as Palatal Wound Dressings Following Epithelialized Free Gingival Graft Harvest: A Randomized Clinical Trial." *Clinical Oral Investigations* 24: 1517–1525. <https://doi.org/10.1007/s00784-020-03254-z>.

Escobar, M., P. Pauletto, C. A. M. Benfatti, A. C. C. Cruz, C. Flores-Mir, and B. A. P. C. Henriques. 2021. "Effect of Cyanoacrylate Tissue Adhesive in Postoperative Palatal Pain Management: A Systematic Review." *Clinical Oral Investigations* 25: 3609–3622. <https://doi.org/10.1007/s00784-020-03683-w>.

Guralnick, W. C. 1946. "Absorbable Gelatin Sponge and Thrombin in Oral Surgery." *American Journal of Orthodontics* 32: 792–794. [https://doi.org/10.1016/0096-6347\(46\)90041-5](https://doi.org/10.1016/0096-6347(46)90041-5).

Guralnick, W. C., and L. Berg. 1948. "Gelfoam in Oral Surgery: A Report of 250 Cases." *Oral Surgery, Oral Medicine, and Oral Pathology* 1: 632–639. [https://doi.org/10.1016/0030-4220\(48\)90337-5](https://doi.org/10.1016/0030-4220(48)90337-5).

Isler, S. C., N. Eraydin, H. Akkale, and B. Ozdemir. 2018. "Oral Flurbiprofen Spray for Mucosal Graft Harvesting at the Palatal Area: A Randomized Controlled Clinical Trial." *Journal of Periodontology* 89: 166–172. <https://doi.org/10.1002/JPER.17-0381>.

Kaba, Y. N., E. Soyulu, A. E. Demirbas, and M. S. Kilavuz. 2023. "Is an Attachable Oral Wound Dressing Effective at Closing an Acute Oroantral Communication?" *Journal of Oral and Maxillofacial Surgery* 81: 1557–1568. <https://doi.org/10.1016/j.joms.2023.09.006>.

Kang, S., E. J. Jang, H. M. Jo, et al. 2022. "Effects of a Topically Applied Oral Wound Dressing Film on Intra-Oral Wound Healing in Rabbits." *In Vivo* 36, no. 4: 1745–1752. <https://doi.org/10.21873/invivo.12887>.

Laguna-Martos, M., R. Cascos, Ó. Iglesias-Velázquez, M. Gómez-Polo, S. Vasquez-Ramos, and A. Castro-Calderón. 2025. "Technique to Protect the Palatal Donor Area After Taking a Free Gingival Graft: Patchwork Technique." *Journal of Oral Implantology* 51: 142–146. <https://doi.org/10.1563/aaaid-joi-D-24-00125>. Epub ahead of print.

Meza-Mauricio, J., C. P. Furquim, A. Geldres, et al. 2021. "Is the Use of Platelet-Rich Fibrin Effective in the Healing, Control of Pain, and Postoperative Bleeding in the Palatal Area After Free Gingival Graft Harvesting? A Systematic Review of Randomized Clinical Studies." *Clinical Oral Investigations* 25: 4239–4249. <https://doi.org/10.1007/s00784-021-03933-5>.

- Meza-Mauricio, J., E. R. S. T. Mourão, K. Oliveira Marinho, et al. 2023. "Effect of Collagen Sponge and Flowable Resin Composite on Pain Management After Free Gingival Graft Harvesting: A Randomized Controlled Clinical Trial." *European Journal of Oral Sciences* 131, no. 3: e12935. <https://doi.org/10.1111/eos.12935>.
- Min, H. S., D. Y. Kang, S. J. Lee, S. Y. Yun, J. C. Park, and I. W. Cho. 2020. "A Clinical Study on the Effect of Attachable Periodontal Wound Dressing on Postoperative Pain and Healing." *Journal of Dental Rehabilitation and Applied Science* 36, no. 1: 21–28. <https://doi.org/10.14368/jdras.2020.36.1.21>.
- Monje, A., G. Blasi, E. Amerio, I. Sanz-Martin, and J. Nart. 2022. "Dimensional Changes in Free Epithelialized Gingival/Mucosal Grafts at Tooth and Implant Sites: A Prospective Cohort Study." *Journal of Periodontology* 93: 1014–1023. <https://doi.org/10.1002/JPER.21-0521>.
- Parlak, H. M., M. H. Durmaz, H. Bayrak, B. T. Yilmaz, and H. G. Keceli. 2023. "Cyanoacrylate and Hyaluronic Acid Combination on Palatal Donor Site Management After de-Epithelialized Graft Harvesting." *Journal of Periodontology* 94: 519–528. <https://doi.org/10.1002/JPER.22-0409>.
- Patarapongsanti, A., P. Bandhaya, B. Sirinirund, S. Khongkhunthian, and P. Khongkhunthian. 2019. "Comparison of Platelet-Rich Fibrin and Cellulose in Palatal Wounds After Graft Harvesting." *Journal of Investigative and Clinical Dentistry* 10: e12467. <https://doi.org/10.1111/jicd.12467>.
- Petsos, H., P. Eickholz, P. Raetzke, K. Nickles, B. Dannewitzl, and U. Hansmeier. 2020. "Clinical and Patient-Centred Long-Term Results of Root Coverage Using the Envelope Technique in a Private Practice Setting: 10-Year Results-A Case Series." *Journal of Clinical Periodontology* 47: 372–381. <https://doi.org/10.1111/jcpe.13242>.
- Rossmann, J. A., and T. D. Rees. 1999. "A Comparative Evaluation of Hemostatic Agents in the Management of Soft Tissue Graft Donor Site Bleeding." *Journal of Periodontology* 70: 1369–1375. <https://doi.org/10.1902/jop.1999.70.11.1369>.
- Santamaria, M. P., F. D. da Silva, F. J. Nociti, M. Z. Casati, A. W. Sallum, and E. A. Sallum. 2009. "Cervical Restoration and the Amount of Soft Tissue Coverage Achieved by Coronally Advanced Flap: A 2-Year Follow-Up Randomized-Controlled Clinical Trial." *Journal of Clinical Periodontology* 36: 434–441. <https://doi.org/10.1111/j.1600-051X.2009.01389.x>.
- Santamaria, M. P., I. F. Mathias, S. B. Dias, M. A. Jardini, M. S. Junior, and E. A. Sallum. 2014. "Esthetic Evaluation of Different Approaches to Treat Gingival Recession Associated With Non-Carious Cervical Lesion Treatment: A 2-Year Follow-Up." *American Journal of Dentistry* 27: 220–224.
- Santamaria, M. P., L. A. Queiroz, I. F. Mathias, et al. 2016. "Resin Composite Plus Connective Tissue Graft to Treat Single Maxillary Gingival Recession Associated With Non-Carious Cervical Lesion: Randomized Clinical Trial." *Journal of Clinical Periodontology* 43: 461–468. <https://doi.org/10.1111/jcpe.12524>.
- Santamaria, M. P., C. A. Silveira, I. F. Mathias, 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." *Journal of Clinical Periodontology* 45: 968–976. <https://doi.org/10.1111/jcpe.12907>.
- Schinini, G., D. Sales, M. V. Gómez, H. J. Romanelli, and L. Chambrone. 2021. "Healing of Donor Sites of Connective Tissue Grafts Harvested by the Single Incision Technique: A Randomized Clinical Trial Evaluating the Use of Collagen Hemostatic Sponge With or Without Sutures." *Journal of Periodontology* 92: 629–636. <https://doi.org/10.1002/JPER.20-0645>.
- Silva, A. L. M., J. A. C. de Souza, and T. E. Nogueira. 2023. "Postoperative Local Interventions for the Palate as a Gingival Graft Donor Area: A Scoping Review." *Clinical Oral Investigations* 27: 6971–7006. <https://doi.org/10.1007/s00784-023-054296-5>.
- Stefanini, M., L. Tavelli, S. Barootchi, M. Sangiorgi, and G. Zucchelli. 2021. "Patient-Reported Outcome Measures Following Soft-Tissue Grafting at Implant Sites: A Systematic Review." *Clinical Oral Implants Research* 32: 157–173. <https://doi.org/10.1111/clr.13767>.
- Studenikin, R., and S. Niftaliev. 2021. "Fabrication and Use of a Customized Provisional Composite Abutment in Dental Practice." *International Journal of Dentistry* 2021: 9929803. <https://doi.org/10.1155/2021/9929803>.
- Tavelli, L., F. Asa'ad, R. Acunzo, G. Pagni, D. Consonni, and G. Rasperini. 2018. "Minimizing Patient Morbidity Following Palatal Gingival Harvesting: A Randomized Controlled Clinical Study." *International Journal of Periodontics and Restorative Dentistry* 38: e127–e134. <https://doi.org/10.11607/prd.3581>.
- Tavelli, L., S. Barootchi, G. Avila-Ortiz, I. A. Urban, W. V. Giannobile, and H. L. Wang. 2021. "Peri-Implant Soft Tissue Phenotype Modification and Its Impact on Peri-Implant Health: A Systematic Review and Network meta-Analysis." *Journal of Periodontology* 92: 21–44. <https://doi.org/10.1002/JPER.19-0716>.
- Tavelli, L., S. Barootchi, R. Di Gianfilippo, et al. 2021. "Patient Experience of Autogenous Soft Tissue Grafting Has an Implication for Future Treatment: A 10- To 15-Year Cross-Sectional Study." *Journal of Periodontology* 92: 637–647. <https://doi.org/10.1002/JPER.20-0350>.
- Tavelli, L., A. Ravidà, G.-H. Lin, F. S. Del Amo, M. Tattan, and H. L. Wang. 2019. "Comparison Between Subepithelial Connective Tissue Graft and de-Epithelialized Gingival Graft: A Systematic Review and meta-Analysis." *Journal of the International Academy of Periodontology* 21, no. 2: 82–96.
- Tavelli, L., A. Ravidà, M. H. A. Saleh, et al. 2019. "Pain Perception Following Epithelialized Gingival Graft Harvesting: A Randomized Clinical Trial." *Clinical Oral Investigations* 23: 459–468. <https://doi.org/10.1007/s00784-018-2455-5>.
- Thoma, D. S., F. J. Strauss, L. Mancini, T. J. W. Gasser, and R. E. Jung. 2023. "Minimal Invasiveness in Soft Tissue Augmentation at Dental Implants: A Systematic Review and meta-Analysis of Patient-Reported Outcome Measures." *Periodontology* 2000 91: 182–198. <https://doi.org/10.1111/prd.12465>.
- Wang, H. L., P. Bunyaratavej, M. Labadie, Y. Shyr, and R. L. MacNeil. 2001. "Comparison of Two Clinical Techniques for Treatment of Gingival Recession." *Journal of Periodontology* 72: 1301–1311. <https://doi.org/10.1902/jop.2001.72.10.1301>.
- Wessel, J. R., and D. N. Tatakis. 2008. "Patient Outcomes Following Subepithelial Connective Tissue Graft and Free Gingival Graft Procedures." *Journal of Periodontology* 79: 425–430. <https://doi.org/10.1902/jop.2008.070325>.
- Yussif, N., R. Wagih, and K. Selim. 2021. "Propylene Mesh Versus Acrylic Resin Stent for Palatal Wound Protection Following Free Gingival Graft Harvesting: A Short-Term Pilot Randomized Clinical Trial." *BMC Oral Health* 21: 1–10. <https://doi.org/10.1186/s12903-021-01541-z>.
- Zucchelli, G., M. Mele, M. Stefanini, et al. 2010. "Patient Morbidity and Root Coverage Outcome After Subepithelial Connective Tissue and de-Epithelialized Grafts: A Comparative Randomized-Controlled Clinical Trial." *Journal of Clinical Periodontology* 37: 728–738. <https://doi.org/10.1111/j.1600-051X.2010.01550.x>.

Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** Supporting Information. **Data S2:** Supporting Information. **Table S1:** VAS values during the postoperative period. **Table S2:** Linear regression models were performed for VAS at Days 1, 2, 3, and 7. The covariates considered were study group, age, smoking status, and cigarettes per day. **Table S3:** Linear regression models were performed for analgesic intake at Days 3 and 5. The covariates considered were study group, age, smoking status, and cigarettes per day.