Microscope-Assisted Periodontal and Peri-implant Plastic Surgery

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Contents

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Abstract

The use of microsurgical principles and procedures provides clinically relevant advantages over conventional macrosurgical concepts for plastic esthetic periodontal surgery. The term "periodontal microsurgery" proposed by Shanelec refers to a procedure that has advantages in periodontal surgery. The combination of an improved visual precision with the use of microsurgical tools specifically designed for this procedure allows more precise and less damaging manipulation of both soft and hard tissues and more capacity to properly debride the defect and the root surface, which increases the chances of healing by primary intention. Microsurgical procedures from incision to the final closure of the surgical wound have less extensive flap designs and enhanced vision fields that facilitate identification of defects and anatomical landmarks. Visual acuity is enhanced by both magnification and illumination when performing periodontal surgical procedures with the aid of an operating microscope (OM). Current evidence supports the benefits of OM and outcome superiority of periodontal surgical therapy with the use of OM for root coverage. It is not easy to move out of the comfort zone, especially when significant changes to the daily practice need to be implemented. This is one of the main reasons for limited use of microscopes in the periodontal field. Great determination, effort, and dedication are required to incorporate microscopy into practice; however, after it is accomplished, there is no turning back. Moreover, it takes clinical performance to a new level. The purpose of this chapter was to present the clinical experience with the use of the microscope in periodontal and peri-implant surgery.

Keywords

Periodontal microsurgery · Gingival recessions · Incisions · Sutures · Microsurgical tools

1 Introduction

Magnification and illumination translate into controlled manipulation of soft and hard tissue structures that make up the periodontium. Microsurgical procedures from incision to the final closure of the surgical wound have less extensive flap designs and enhanced vision fields that facilitate identification of defects and anatomical landmarks such as furcations, cementoenamel projections, anatomical grooves, and others (such as accretions, defective restorative margins, and caries lesions).

Mucogingival surgery has been a prevalent focus of interventions and studies looking at the advantages of utilizing the operating microscope (OM) to enhance surgical outcomes and patient experiences. This chapter will cover foundational aspects in microsurgical plastic therapy such as phenotype definitions, recession classification systems employed to enhance communication, technical applications such as incision and flap design, suture techniques, followed by therapy execution around natural teeth and dental implants.

2 Historical Background of Periodontal Microsurgery Compared with Conventional Mucogingival Interventions

Surgical procedures for correcting or eliminating anatomical, developmental, or traumatic deformities in the gingiva or alveolar mucosa benefit from the OM, which provides magnification and illumination and thus improves visual acuity and enhances precise and delicate tissue manipulation. Tissue trauma may be reduced by choosing finer suture diameters, because thinner (6–0, 7–0) sutures lead to thread breakage rather than tissue breakage [1], 7–0 sutures clearly represent a category of sutures that requires visual (OM improved visual precision) rather than tactile control in handling [1].

Therefore, it is not surprising that the field of mucogingival therapy has been an objective of various clinical studies. Burkhardt and Lang [2] conducted a 12-month randomized controlled trial to compare wound healing following mucogingival surgical interventions performed using micro- and macrosurgical approaches. According to Miller's classification, ten patients had bilateral Miller's class I and class II recession lesions [3]. In this split-mouth design, defects were randomly selected for recession coverage using either a microsurgical (test) or macrosurgical (control) approach. Fluorescent angiograms were performed to evaluate graft vascularization immediately after surgical intervention and 3 and 7 days of healing. Clinical parameters such as gingival inflammation, supragingival plaque presence, periodontal probing depth (PD), gingival recession, and clinical attachment level (CAL) were assessed prior to surgery and at 1, 3, 6, and 12 months postoperatively. All differences in vascularization and recession coverage were statistically significant. The percentage of root coverage for the test and control sites remained stable during the first 12 months at 98% and 90%, respectively. An OM (for recipient site) and prism loupes-5×− (for donor site) together with microsurgical instruments and 7–0 and 9–0 sutures were used in the test group. Conventional instruments and 4–0 sutures were used in the control group.

Francetti et al. [4]. performed a controlled clinical study and reported the treatment of 24 patients with Miller class I and II gingival recession defects (≥2 mm) were treated. Twelve patients were treated with the aid of OM (test group) and 12 patients were treated without the aid of OM (control group). Clinical parameters such as recession depth, PD, clinical attachment loss, and keratinized gingival tissue were evaluated and the measurements were recorded before surgery and after 12 months of surgery. After 12 months, the mean defect coverage in the test and control groups was 86% and 78%, respectively, and complete root coverage in the test and control groups was 58.3% and 33.4%, respectively. Qualitative esthetic assessment showed significantly less scarring and better marginal profile in the test group and no significant difference in papilla appearance between the groups.

In a case series, Andrade et al. [5] aimed to compare macro- and microsurgical techniques for root coverage using a coronally advanced flap (CAF) in combination with enamel matrix derivative (EMD). Thirty patients participated in this study. An equal number of patients were randomly assigned to the test group (TG) and the control group (CG). The microsurgical approach was used in TG, and the conventional macrosurgical approach was used in CG. Clinical parameters (gingival recession, PD, CAL, width, and thickness of keratinized tissue) were assessed before and 6 months after surgery. The discomfort level evaluation was performed 1 week after surgical intervention. At 6 months after surgery, the root coverage was 92% and 83% in TG and CG, respectively. A statistically significant increase in the width and thickness of keratinized tissue was found in TG only. All patients reported minimal postoperative discomfort. Microsurgical instruments with an OM and 5–0 and 8–0 sutures were used in TG. Conventional instruments and 5–0 sutures were used in CG.

In a randomized controlled trial, Bittencourt et al. [6] compared root coverage, postoperative morbidity, and esthetic outcomes of subepithelial connective tissue graft with and without the use of a surgical microscope for the treatment of Miller class I and II gingival recession (≥2 mm). Twenty-four patients were enrolled in this split-mouth study. Parameters such as depth and width of the gingival defect, width and thickness of keratinized tissue, PD, and CAL were recorded. In addition, postoperative morbidity and patient satisfaction were evaluated. At 12 months after surgery, root coverage in TG and CG was 98% and 88.3%, respectively, and complete root coverage in TG and CG was 87.5% and 58.3%, respectively. All (100%) TG patients and 79.1% CG patients were satisfied with the outcome. Patients of both the groups were treated using the same instruments and 8–0 sutures, except for the use of an OM.

It is evident that the scientific literature on the use of OM in periodontal surgical procedures mainly constitutes opinion papers, anecdotal case descriptors, and technical essays illustrating operational procedures. These types of publications are meritorious and form an important segment of the tiers of publications and clinical expertise that guide clinical care [7]. Although cohort studies and randomized controlled trials are limited (Table 1), the evidence put forth by these studies consistently suggests the outcomes of periodontal surgical procedures are superior with the use of OM. When it comes to mucogingival surgical applications and the execution of these procedures using an OM, the test groups (OM aided) consistently showed higher root coverage and superior complete root coverage compared with procedures performed without the assistance of the OM [2–4, 6]. These results are corroborated by recent meta-analysis [8], in comparison to macrosurgery, microsurgery yields an additional 6% of mean root coverage and 28% of probability for complete root coverage. Patient-reported outcomes also favored microsurgery with improved esthetics, patient's satisfaction, and reduced pain.

3 Periodontal Phenotype

The determination and classification of the periodontal phenotype [9] are essential for the planning of periodontal, restoring, implantological, and orthodontic treatments. The type of phenotype is based on anatomical characteristics such as:

- Thickness of the gingiva
- Width of the keratinized gingiva
- Osseous morphotype
- Tooth dimensions

Based on these parameters, the phenotype can be classified into the following three categories:

Thin scalloped phenotype: A phenotype characterized by a slender triangular crown, slight cervical convexity, interproximal contacts next to the incisal border, tight zone of keratinized tissue (KT) a high gingival scallop, and relatively slim alveolar bone (Fig. 1).

Table 1 Microscope-assisted periodontal surgical procedures studies

Reference	Patient group	Study type	Methods	Key results	Comments
Francetti et al. [4]	*N* = 24; single Miller's I or II	Prospective RTC	Root coverage with OM (T) and conventional (C) 12 m follow up	Defect coverage: 86% (T),78% (C) complete coverage: 58.3% (T),33.3% (C)	OM: Better results: Success and predictability
Burkhardt and Lang [2]	*N* = 10; Bilateral Miller's class I or II in maxillary canines	Prospective RTC/Split mouth	Root coverage with OM (T) and conventional (C) Fluorescent angiograms 0, 3, 7d. 12 m follow up	Vascularization: 0d 8.9 ± 1.9% (T) 7.95 ± 1.8% (C) 3d 53.3 ± 10.5% (T) 4.5 ± 5.7% (C) 7d 84.8 ± 13.5% (T) 64.0 ± 12.3% (C) Mean recession coverage 98% (T) and 90% (C)	Microsurgery improves vascularization and percentages of root coverage
Andrade et al. [5]	*N* = 15 single Miller's class I or III	Prospective RTC	Root coverage with OM (T) and conventional (C) 6 m follow up	Defect coverage: 92% (T),83% (C) complete coverage: 73% (T),46% (C)	No statistically significant differences between groups. Short duration, mix of recession (I and III) and tooth groups
Bittencourt et al. [6]	*N* = 24 single Miller's class I or II	Prospective RTC/Split mouth	With OM (T) and conventional (C) 12 m follow up	Defect coverage: 98% (T),88.3% (C) complete coverage: 87.5% (T), 58.3% (C) esthetics: 100% patients satisfied (T), 79.1% patients satisfied (C)	Although both approaches produce root coverage, OM: Yields better results

CAL clinical attachment level, *PD* probing depth, *OM* operating microscope, *T* test, *C* control, *m* month, *d* day, *RTC* randomized controlled trial

Fig. 1 Thin scalloped phenotype

Fig. 2 Thick flat phenotype

Fig. 3 Thick scalloped phenotype

Thick flat phenotype: A phenotype characterized by more square-shaped dental crowns, pronounced cervical convexity, large interproximal contact at the apex, wide zone of KT, thick and fibrotic gingiva, and relatively thick alveolar bone (Fig. 2).

Thick scalloped phenotype: A phenotype characterized by a thick fibrotic gingiva, slim teeth, tight zone of KT, and pronounced gingival sinuation (Fig. 3).

4 Gingival Recessions

In the last few decades, the treatment of gingival recessions has gathered much interest from both surgeons and researchers, which has led to this field of periodontics to rapidly evolve, and thus, the predictability of the techniques has increased.

Generally, different approaches and techniques are available for the treatment of recessions, such as isolation or multiple, to achieve root covering. These techniques can be grouped based on the source of the donor tissue for root covering (Table 2). Thus, the techniques are grouped into pedunculated soft tissue grafting, free soft tissue grafting, and additive treatment in which biomaterials are used to replace the connective tissue.

This section will focus on the two most used techniques for the treatment of recessions: the coronal advanced flaps (CAF) and the envelope and tunneling assisted by microscope techniques. The use of a microscope allows us to perform

Table 2 Techniques based on the source of the donor tissue for root covering

Pedunculated soft tissue grafts	**Rotated** Double papilla pedicle graft **Coronal advanced** Coronal Advanced Flap (1965) Coronal advanced flap modified (De Sanctis and Zucchelli 2000, 2007) Semilunar Flap (1907)	*Treatments additives*	Biomaterials periodontal surgery Biological (allograft xenograft) Bioactive molecules (enamel matrix proteins) Tissue engineering
Free soft tissue grafts	**Non-submerged grafts** Free gingival graft (1966) **Submerged grafts** Connective tissue graft subepithelial Coronal advanced flap + connective tissue graft Lateral moved coronal advanced flap + connective tissue graft Envelope Flap Raeztke (1985), Allen, Bruno (1994) Tunnel Azi Etienne (1998), Zuhr		

precise and minimally invasive interventions. Shannelec [10] reported the benefits of plastic periodontal microsurgery, which are as follows:

1. Enhanced motor skills, thus perfecting surgical capabilities
2. Primary wound closure with emphasis on passive flaps
3. Use of micro-tools and micro-sutures, thus reducing tissue trauma

The microsurgical technique causes minimal trauma in the tissue, both during incision and micro-suturing. Moreover, if the first intention closure is performed, the healing time, inflammation time, and the risk of necrosis are lower compared with those after macrosurgery [11]. Two additional factors that are advantageous to the microsurgery technique are postoperative patient satisfaction and the long-term esthetic satisfaction of patients. A correlation was reported between the invasiveness and duration of the surgical technique and postoperative complications and pain [12]. Patient satisfaction and postoperative pain experience are reduced by 55% when microsurgery techniques are used [4].

Usually, the effectiveness of the root coverage procedure is measured in relation to the final position of the gingival margin with respect to the cementoenamel junction (CEJ). This provides an objective view of the result in terms of the percentage of root coverage, but not of the actual esthetic result. Macrosurgical techniques can achieve good root coverage. Cairo et al. [13] proposed the use of root coverage esthetic score (RES) that measures other clinical variables such as texture, color, and soft tissue contour in addition to the percentage of coverage achieved. The current perception of the outcomes of patients with high esthetic demand requires the

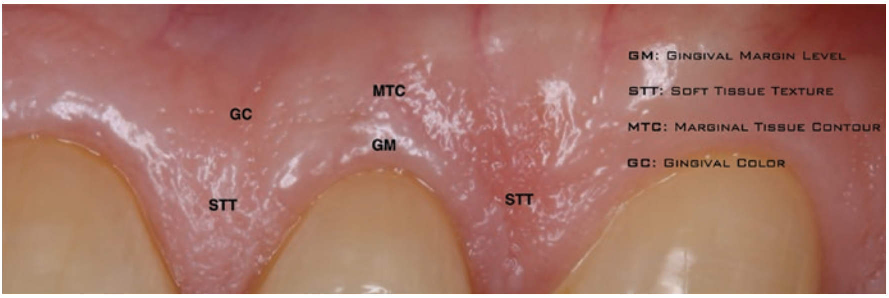


Fig. 4 Root coverage esthetic score (RES) clinical variables

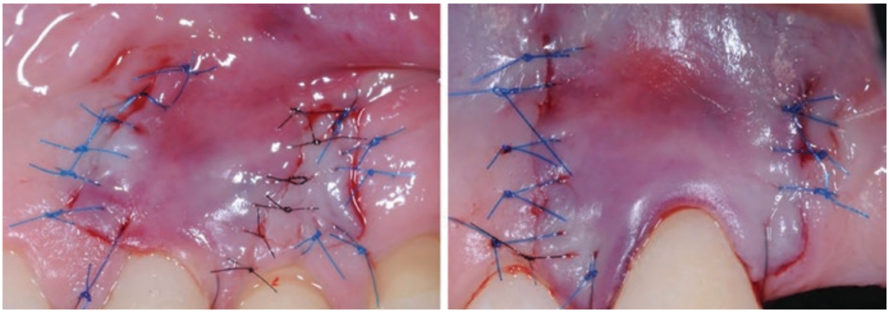


Fig. 5 Suture technique and materials in microsurgery

use of surgical techniques that do not leave scars or sequelae and are less invasive characteristics that fit perfectly with the concept of microsurgery (Fig. 4).

In mucogingival surgery, an optimal esthetic outcome can be achieved with microsurgical techniques when numerous parameters are upheld: many hours of practice for the training and mastery of the microsurgical technique of the microsurgeon, suture technique (the most important parameter), and necessary visual aids, tools, and materials [14] (Fig. 5).

Independent of the technique, various factors can affect root coverage [15], which are as follows:

- Type of recession and the risk of the interdental tissue
- Dimension, symmetry, height, and shape of the interdental papilla
- Postsurgical position of the gingival margin (ideally 1 mm in the coronal CEJ direction)
- Degree of passivity of the flap
- Tissue phenotype
- Presence of carious and non-carious cervical lesions
- Absence of the CEJ
- Flap design
- Biomodification of the root surface

- Dimension, thickness, and quality of the connective tissue graft (CTG)
- Tooth position (extrusion and buccal/lingual inclination)

5 Recession Classification

Miller [5] proposed four types of gingival recession based on the level of the gingival margin with regard to the mucogingival line and interproximal osseous tissue. The important aspect of this classification system is that it associates the type of recession with its therapeutic outcome success (Fig. 6). Most recently, Cairo et al. [16] proposed a classification system that identifies three types of gingival recession: type RT-1, does not include loss of interproximal insertion; type RT-2, the loss of interproximal insertion that is less than or equal to the buccal recession; and type RT-3, the loss of interproximal insertion is greater than that of the buccal recession (Fig. 7).

6 Incisions

The term "periodontal microsurgery" proposed by Shanelec [10, 14] refers to a procedure that has advantages in periodontal surgery. The combination of an improved visual precision with the use of microsurgical tools specifically designed for this procedure allows more precise and less damaging manipulation of both soft and hard tissues and more capacity to properly debride the defect and the root surface, which increases the chances of healing by primary intention. Based on the type of intervention, magnifications of 8× to 20× are considered ideal depending on periodontal microsurgery (Table 3). The depth of field and field of view decreases with an increase in magnification, and therefore, the maximum magnification for a

Fig. 6 Miller classification system

Fig. 7 Cairo classification system

Table 3 Magnification recommended for surgical periodontal procedures

Magnification recommended	Surgical interventions
6×–8×	Clinical inspections, anesthesia, entire quadrant is under operation
12×–15×	Coverage of single of a single tooth tissue recession, interdental wound closure
15×–25×	Clinical details, anatomical papillae, de-epithelized

Table 4 Field of view Vs. depth of field

Magnification (×)	Field of view (mm.)	Depth of field (cm.)
3×	64 mm	Up to 10 cm
5×	41 mm	Up to 5 cm
8×	25 mm	Up to 3.5 cm
13×	16 mm	Up to 1 cm
21×	10 mm	Up to 0.3 cm

surgical intervention is limited to approximately 12× to 20× (Video 1) for localized problems such as the coverage of a single soft tissue recession (Table 4; Figs. 8a, b, 9, and 10).

A correct incision means preservation of an adequate amount of vascularization in the flap, allowing access to the area being treated by moving the flap, preservation of the attached gingiva and making the suturing process easier. The type of incision and the angle of the blade in relation to the surface of the tissue are used to determine the thickness of the flap. Moreover, the marginal edges of the flap and its thickness should be consistent and ideally close to 1 mm [17]. The blood flow in the gingiva is mainly derived from the supraperiosteal blood vessels, which anastomize with the blood vessels of the alveolar bone and periodontal ligament in the free gingiva [18]. During incision, the blade of the scalpel should be perpendicular to the surface of the tissue regardless of any anatomic restriction that may exist. This is the only way to achieve 90° angles in the flap margins or adequate thickness on both the sides of the incision line. Bevels should be avoided, especially in thin phenotypes. Furthermore, initial incisions that cross one another should be slightly over-extended to achieve clearly defined margins and corners of consistent thickness [19].

The use of microscope greatly benefits these procedures, as it allows us to see in detail the flap thickness and incision limits, especially when dealing with fragile tissues with a limited vascular network, such as the interdental mucosa. The use of a microscope greatly improves the surgical access to the interdental or interimplant spaces. These delicate and narrow soft tissues can be sharply dissected using microblades (Keydent microblade tunnel ADSystem Munich, Germany) with the aid of clear magnified vision and preserved, thus reducing trauma and facilitating accurate wound closure (Video 2).

Based on direction, the types of incision are of two types: horizontal and vertical.

Fig. 8 (**a**) 3.4×–5.1× Magnification. (**b**) 8.5×–13.6× Magnification ideal in periodontal microsurgery

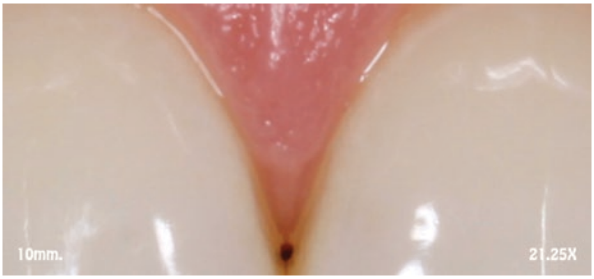


Fig. 9 21.25× Magnification in periodontal microsurgery

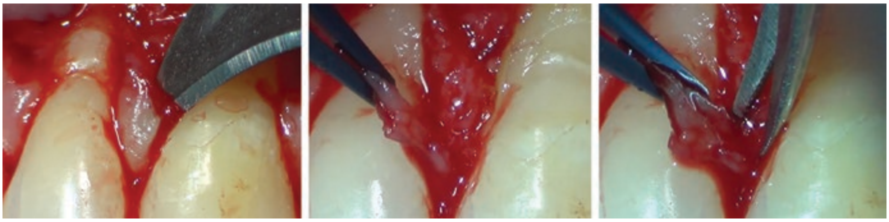


Fig. 10 Controlled manipulation of soft tissue structures that make up the periodontium

6.1 Horizontal

Sulcular incision: This type of incision maintains the marginal tissue completely intact. The blade of the scalpel is inserted through the gingival sulcus and is apically directed to the osseous tissue, maintaining contact with the dental and root surface. The whole gingival margin is incorporated into the flap and preserved in its entirety.

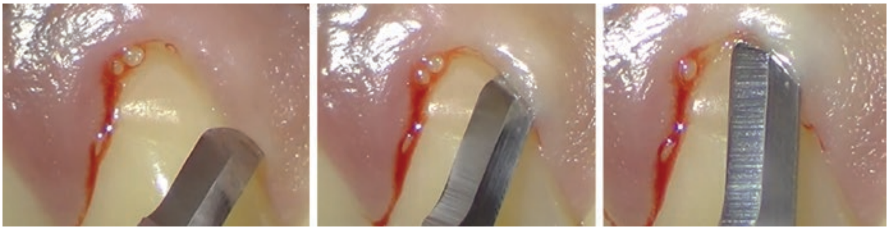
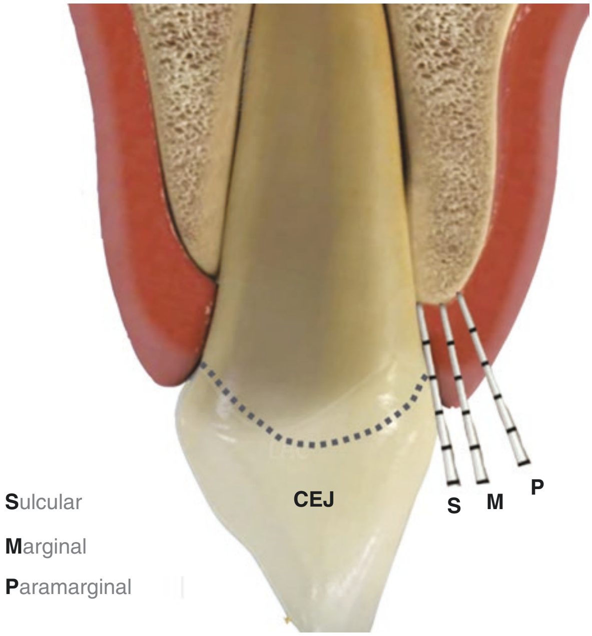


Fig. 11 Sulcular incision microblades (Swann-Morton SM67 Sheffield, England)

Fig. 12 Sulcular, marginal, and paramarginal incision



To make this process easier, the use of microblades (Swann-Morton SM67 Sheffield, England), instead of scalpel, combined with microscope for magnification provides absolute control and precision in the procedure (Fig. 11).

Paramarginal incision: This type of incision is located parallel or slightly apical to the gingival margin. The coronal tissue in the line of the paramarginal incision can be removed or de-epithelized depending on the procedure being performed [19] (Fig. 12).

6.2 Vertical

A vertical incision can be part of the design or act as a releasing incision. It is used to increase the accessibility or change the position of the flap. A vertical incision should be performed in the inter-root concavities and should have a slight

Fig. 13 Incorrect location of vertical incision

Fig. 14 (**a**) Correct location of vertical triangular incision. (**b**) Correct location of vertical trapezoidal incision

divergence (Video 3). The exact location of this incision depends on the type of procedure being performed (only coronal or apical access or displacement of the margin). The idea is to prevent flawed scarring at the interdental papilla level. Hence, an incision should be made where the papilla base meets the gingival margin and not in the middle of the papilla, dividing it into two (Fig. 13). The largest possible volume of papilla should be preserved. Therefore, the incision should not be made at the level of the gingival zenith because it increases the possibility of a future gingival recession in that area. The procedure of relocation of the gingival margin involves flap design (trapezoidal, triangular) (see treatment of gingival recession) (Fig. 14a, b).

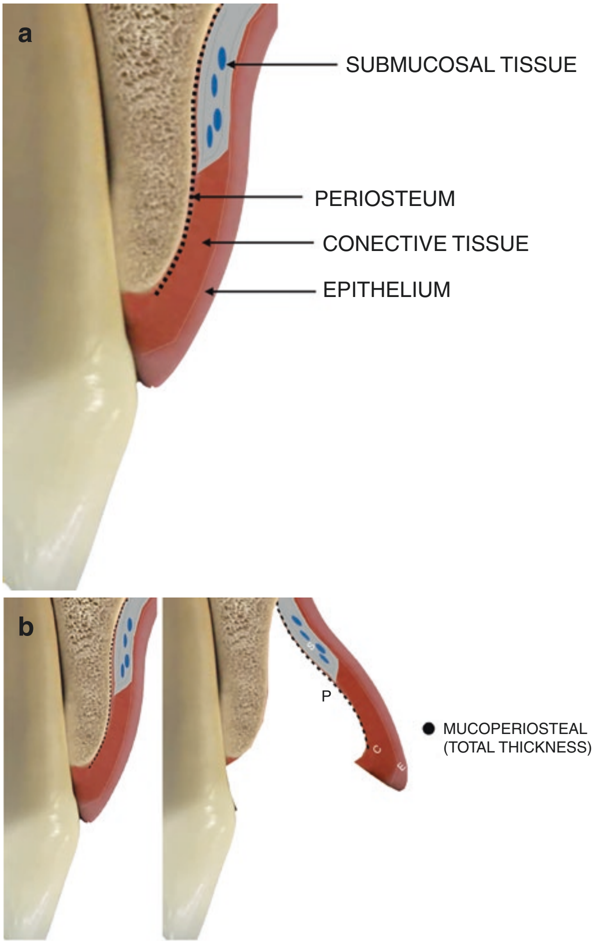


Fig. 15 (**a**) Depending on whether the periosteum is included in the flap. (**b**) Mucoperiosteal flap (total thickness)

7 Flap Designs

Depending on whether the periosteum is included in the flap (Fig. 15a), flaps are classified as follows:

- Mucoperiosteal flap (total thickness)
- Mucosal flap (partial thickness)
- Combined flap (partial/total/partial thickness)

7.1 Mucoperiosteal Flap (Total Thickness)

This type of flap design includes the epithelium, connective tissue, and periosteum. The incision reaches the osseous tissue. This flap design has the following characteristics (Figs. 15b and 16):

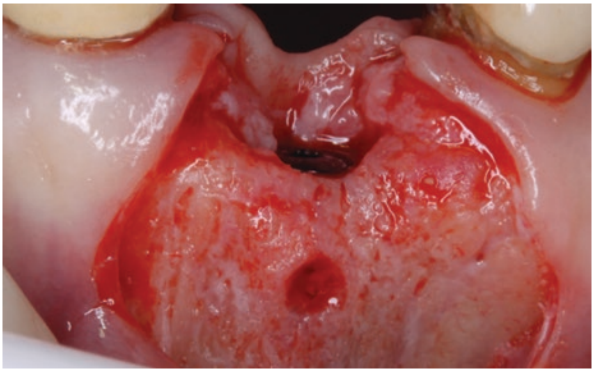


Fig. 16 Mucoperiosteal flap (total thickness)

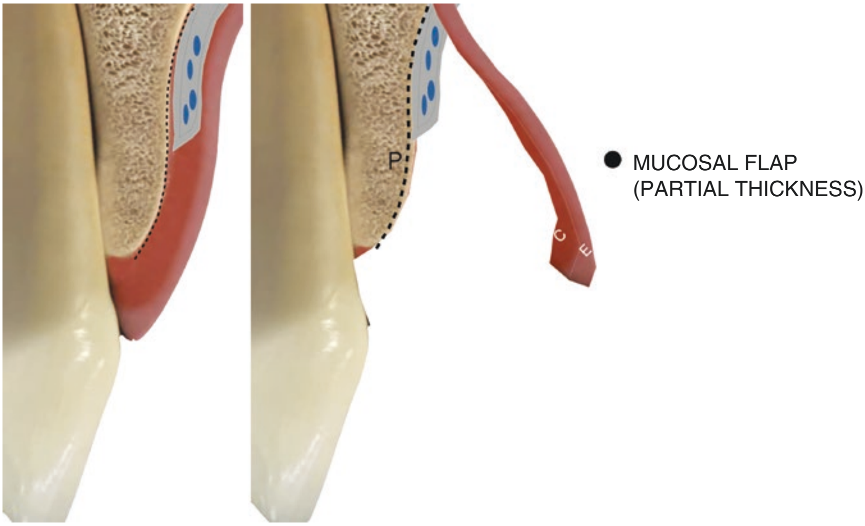


Fig. 17 Mucosal flap (partial thickness)

- First intention healing
- Relatively easy to design and perform
- Adequate blood support, as the entire plexus of the periosteum is present
- Limited mobility
- Minor bleeding

7.2 Mucosal Flap (Partial Thickness)

This type of flap design includes the epithelium, subepithelial connective tissue, and periosteum layer over the osseous tissue (Fig. 17). The microsurgeon should be very attentive when performing this incision and observe the external part of the flap because the blade of the scalpel runs parallel to the mucosal tissue and a high risk

Fig. 18 Mucosal flap (partial thickness)

of perforation is present. The main advantage of this type of flap is its mobility, which allows its relocation in any direction without tension. This flap design has the following characteristics (Fig. 18):

- Difficult to design and carry out
- Reduced blood support due to maximized design or extension
- More bleeding
- Moderate postoperative complications such as slightly more edema

7.3 Combined Flap (Partial/Total/Partial Thickness)

This flap design was introduced by Zucchelli and De Sanctis in 2000 [20]. The concept involved moderating the flap thickness (partial/total/partial). In the most coronal part at the level of the papilla, a partial incision is made (only epithelium and connective tissue), which allows better adaptation and healing of the flap. In the middle part, complete lifting is performed, including the periosteum, with the objective of increasing the flap thickness and improving vascularization. Finally, in the most apical part, two incisions are made. One incision is made deep and parallel to the osseous tissue to release the mucosal of the periosteum and another incision is made superficial and parallel to the alveolar mucosa to release the flap from the muscular insertions and the submucosal tissue (Fig. 19). This type of flap design has been proven to be superior in the long term with regard to the stability of the percentage of root covering in the treatment of isolated maxillary recessions compared with the mucosal flap or partial thickness [21]. This flap design has the following characteristics (Fig. 20):

- Easy to perform using the proposed protocol
- Good blood flow support
- Moderate inflammation postoperatively

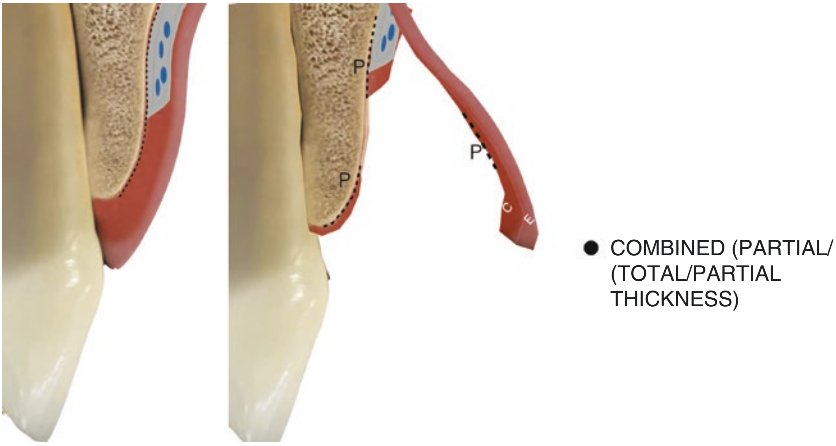


Fig. 19 Combined flap (partial/total/partial thickness)

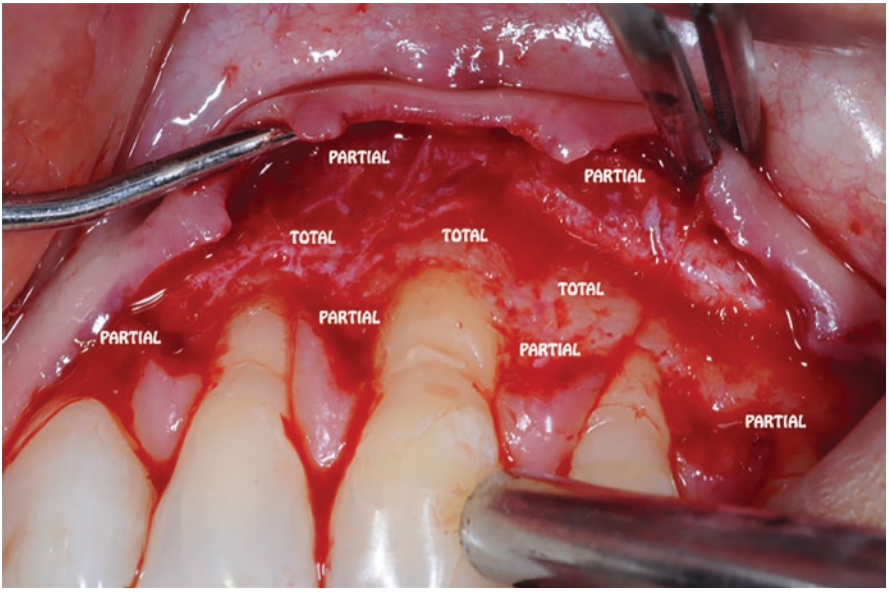


Fig. 20 Combined flap (partial/total/partial thickness)

8 Suture Techniques

The suture technique should be focused on at the surgical borders, especially in the case of a flap that has been correctly, completely, and passively executed, to avoid creating tension.

The selection of the suture material, technique, and manner of knotting plays a fundamental role in the initial stages of healing and in resistance to mechanical stress in the stages of greater inflammation [22]. As a rule, the mobile tissue should be sutured toward the immobile tissue, and to do this, it is recommended to slightly lift the immobile border with a micro-elevator (Mamadent Micro 005 papilla elevator ADS system Munich, Germany) and to permanently irrigate the tissue, which makes the manipulation and stitching of the soft tissues easier (Fig. 21a, b).

In the management of micro-sutures, the biomechanics and technique of knotting, choice of materials, and suture strength are fundamental (Fig. 22a, b).

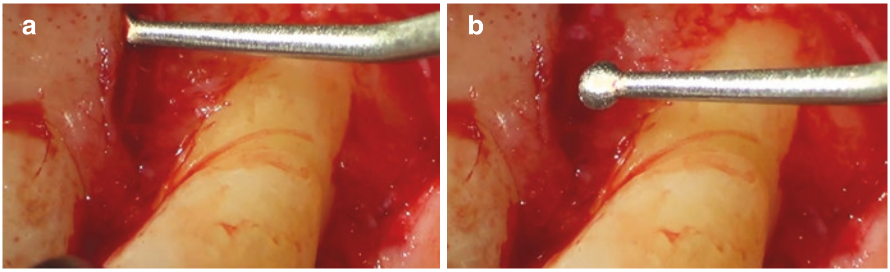


Fig. 21 (**a**, **b**) It is recommended to slightly lift the immobile border with a micro-elevator (Mamadent Micro 005 papilla elevator ADS system Munich, Germany)

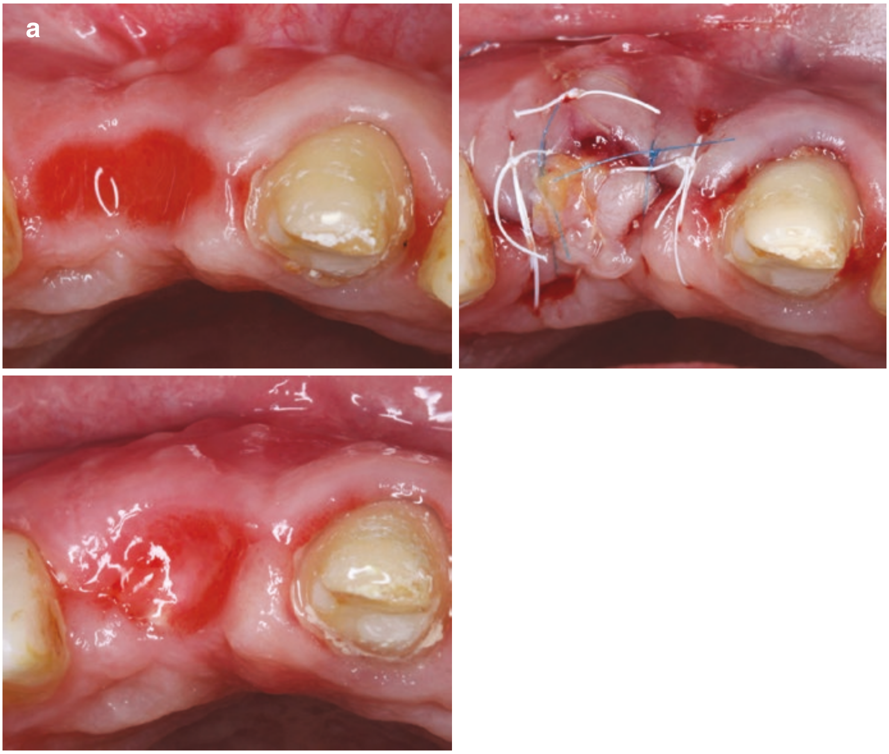


Fig. 22 (**a**, **b**) In the management of micro-sutures, the biomechanics and technique of knotting, choice of materials, and suture strength are fundamental

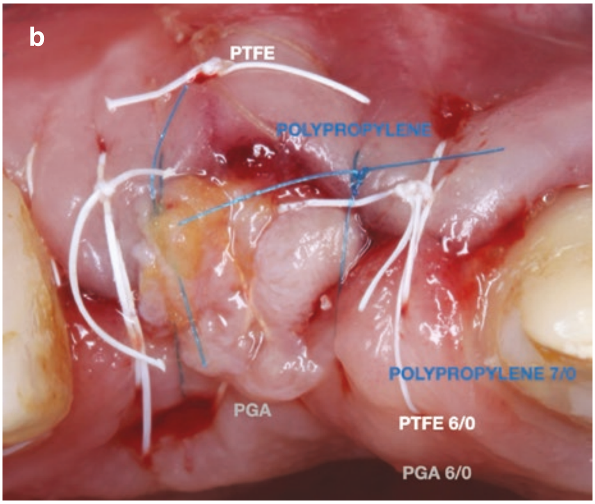


Fig. 7 (continued)

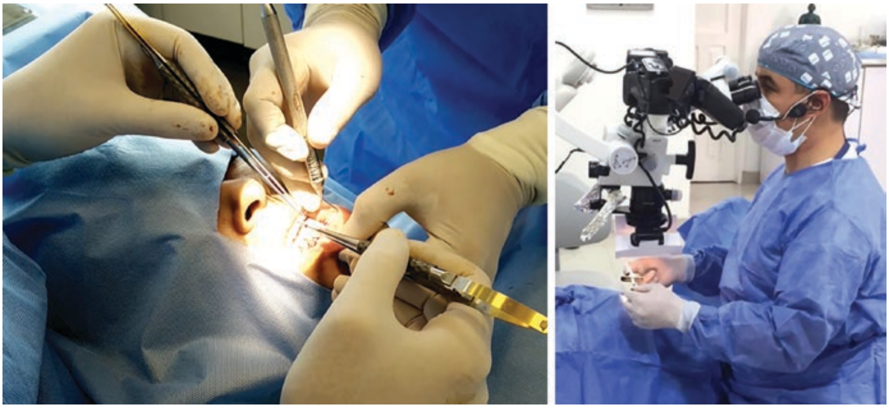


Fig. 23 The use of bimanual technique allows to work comfortably from outside the mouth in any small area, facilitating the manipulation of micro-sutures and preventing sharp injuries

The use of bimanual technique is highly recommended with instruments that are 18 cm long for suturing. This technique allows to work comfortably from outside the mouth in any small area, facilitating the manipulation of micro-sutures and preventing sharp injuries (Fig. 23). Very small needles should be inserted in the gingiva close to the area where knots will be tied (Fig. 24) (Video 4).

Table 5 Sutures and micro-sutures used in periodontal and peri-implant surgeries.

Generally, based on the function, sutures are classified as follows [19]:

- *Closing sutures*
- *Tension-relieving sutures*

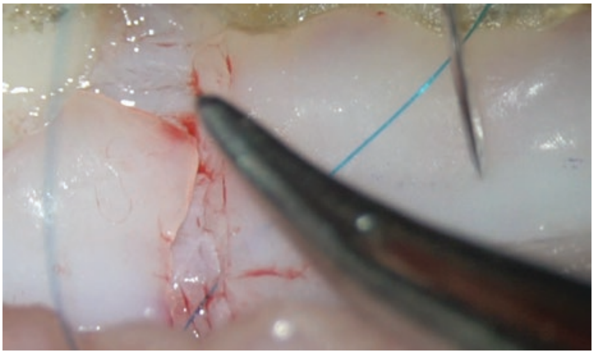


Fig. 24 Very small needles should be inserted in the gingiva close to the area where knots will be tied

- *Combined sutures (closed and tension-relieving)*
- *Suspension sutures*
- *Fixation sutures*
- *Insertion and position sutures*

8.1 Closing Sutures

Closing sutures are used to close the gap between the surgical borders to achieve primary wound healing. It is fundamental that the manipulation of the flap is performed correctly and that no tension exists whatsoever. This ensures that the tension generated at the surgical border during the initial stages of the scarring process is minor and that the sutures do not rip the tissue or break the stitching material. The most common technique used for closure sutures is the simple interrupted suture technique. Although the simple interrupted suture technique seems to be simple, executing it in a reproducible and systematic manner with consistent and symmetrical bite size is challenging (Fig. 25) (Video 5).

Another closure suture technique is the continuous suture technique. As the name implies, sutures are not interrupted or knotted independently. The main disadvantage and the reason for limited use of the continuous suture technique are that it depends on a single knot and is generally used in large surgical borders (Fig. 26).

8.2 Tension-Relieving Sutures

The tension-relieving suture technique is used in combination with the closing suture technique to release the tension generated by postoperative inflammation and edema at the surgical border. This helps closure sutures to have better mechanical stability because closure sutures are applied after stitching and knotting tension-relieving sutures in the deeper layers of the tissue. One type of tension releasing/relieving suture technique is the mattress suture technique (vertical and horizontal variants) (Figs. 27 and 28). The mattress suture technique allows an eversion to occur at the surgical border, which should be supported by interrupted closing sutures.

Table 5 Micro-sutures

Brand name®	Material	Thread type	Suture strength	Needle	Needle	Indications	Absorbable
AD surgical	Polypropylene	Monof	6/0	12 mm	3/8	Papillary sutures anterior, periosteal sutures	No
AD surgical	Polypropylene	Monof	7/0	11 mm	3/8	Buccal releasing incision	No
Seralene	Polyvinylidene fluoride	Monof	6/0	12 mm	3/8	Standard sutures	No
Vicryl	Polyglactin 910	Braided	7/0	6.4 mm	3/8	Fixation sutures CTG	Yes
PGA	Acid polyglycolic	Monof	6/0	13 mm	3/8	Fixation sutures CTG	Yes
Monotex	Polytetrafluoroethylene	Monof	6/0	13 mm	3/8	Papillary sutures posterior	No
Prolene	Polypropylene	Monof	8/0	6.4 mm	1/2	Buccal releasing incision	No
AD surgical	Polyamide	Monof	9/0	5 mm	3/8	Buccal releasing incision, papilla base incision	No
AD surgical	Polyamide	Monof	10/0	4 mm	3/8	Buccal releasing incision, papilla base incision	No

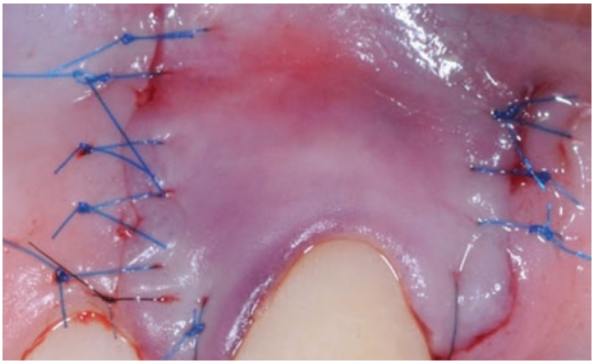
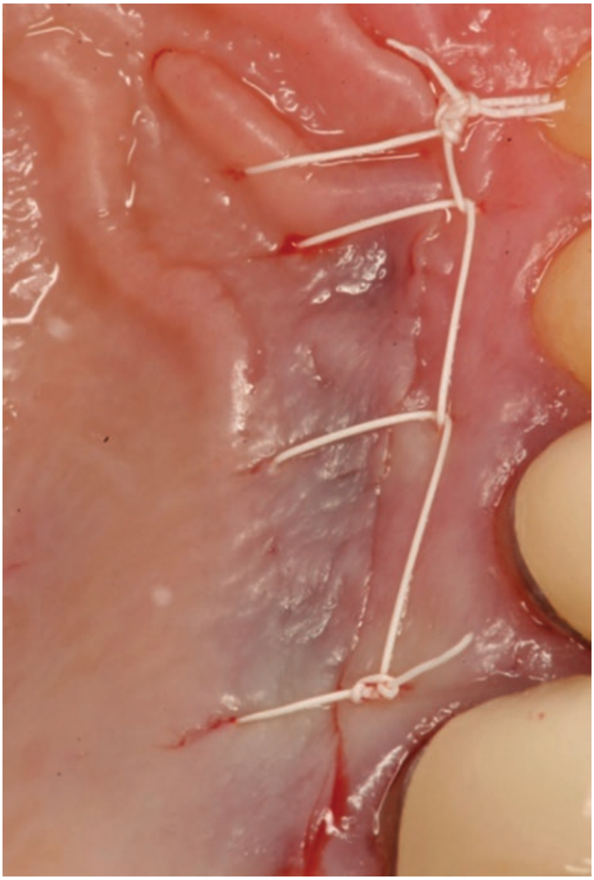
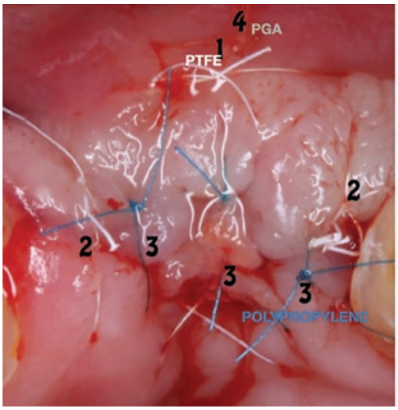


Fig. 25 Symmetrical bite size

Fig. 26 Continuous suture technique





- 1-Tension-relieving sutures (PTFE 6/0)
- 2-Double Sling (Combined sutures) (PTFE 6/0)
- 3-Closing sutures (Polypropylene 7/0)
- 4-Fixation sutures (PGA 6/0)

Fig. 27 The mattress suture technique (vertical and horizontal variants)

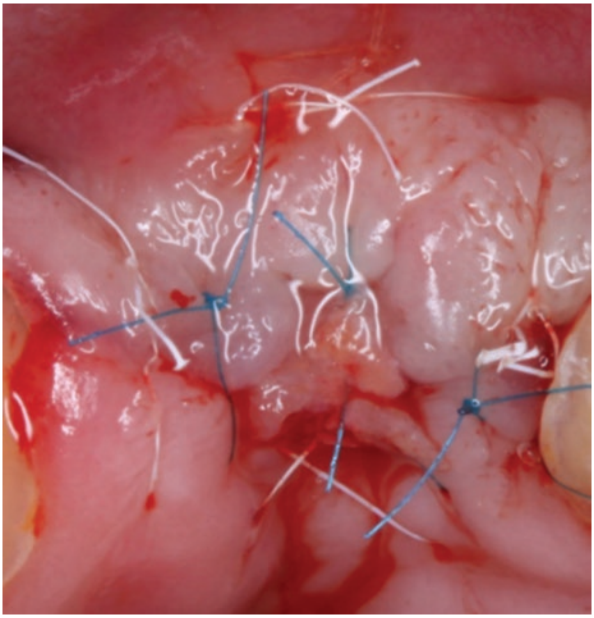


Fig. 28 Tension-relieving sutures

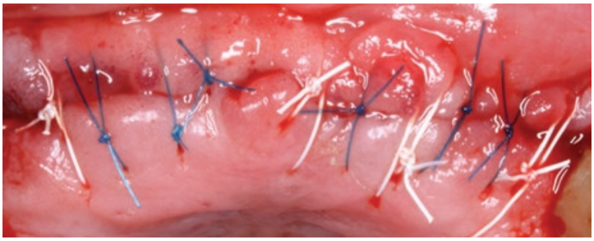


Fig. 29 The double sling technique combines two interrupted closing sutures of different bite sizes in different tissue layers

8.3 Combined Sutures (Closing and Tension-Relieving Sutures)

Combined sutures relieve tension and close the surgical border in an accurate and safe manner. The double sling technique [23] combines two interrupted closing sutures of different bite sizes in different tissue layers (Fig. 29). The suture with the largest bite size releases the tension and the suture with smaller bite size closes the surgical border and both the sutures are knotted in one place.

8.4 Suspension Sutures

Suspension sutures are used to fix the new positions of the flap, when it is moved (coronal, apical, or lateral). The anchoring zones of suspension sutures can be dental palatal zone, soft tissue palatal zone, and contact points (Fig. 30).

Fig. 30 Suspension sutures

8.5 Point-of-Contact Sling Sutures

Point-of-contact sling sutures are the most commonly used sutures in plastic microsurgeries for the treatment of gingival recession with a modified tunnel [24]. They are designed to displace the flap in the coronal and palatal directions to adapt and stabilize the soft tissue toward the root surface in its new position while avoiding dead spaces and zones of greater edema and clot formation. Many variations of this technique are used to achieve the goal. These sutures are generally attached to an interdental contact point created by a composite. Based on the severity of the recession, the sutures can be horizontal, oblique, or vertical. Once the design has been selected (horizontal, oblique, or vertical), suturing is initiated by inserting the needle from the apical to coronal part depending on the degree of displacement required, which could be at the level of the papilla base or apical to the last suture, and exiting almost from the vertex of the papilla. Thereafter, the needle is passed below the contact point and the short end is used to interweave it with the long end that goes in the palatal direction. The knot is tied at the coronal end toward the buccal or palatal area, taking care that the occlusion does not touch the knot and break it postoperatively (Fig. 31a, b) (Video 6).

8.6 Fixation Sutures

Fixation sutures are used to fix a membrane or CTG to a determined position for gingival recession treatment or gingival augmentation. These sutures unite the graft by anchoring to the periosteum, papilla, or the same flap in its internal area (Fig. 32).

8.7 Insertion Sutures

Insertion sutures are used in tunnel procedures for the placement of the CTGs inside them (Fig. 33).

Fig. 31 (**a**, **b**) Point-of-contact sling sutures

Fig. 32 Fixation sutures are used to fix CTG

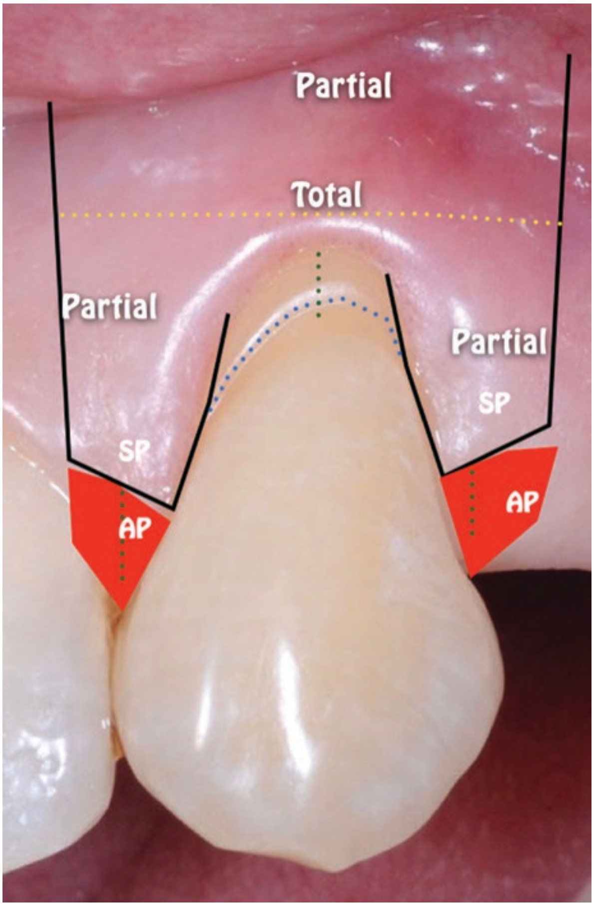
9 Treatment of Single Gingival Recessions

9.1 Trapezoidal Flap (CAF with Vertical Incisions)

The trapezoidal flap technique was described and modified by Zucchelli and De Sanctis in 2007 [25]. This design consists of two horizontal incisions of 3 mm in each papilla, and two slightly divergent vertical incisions in a trapezoidal shape (Fig. 34). An essential requirement for this technique is that the apical zone in relation to the recession should have at least 2 mm of keratinized gingiva.

Fig. 33 Insertion sutures

Fig. 34 Trapezoidal flap (CAF with vertical incisions)



Horizontal incisions constitute the new surgical papilla (SP), and the position of these incisions depends on the degree of coronal displacement in relation to the depth of the recession being treated. The extension of coronal displacement is calculated and 1 mm is added in the coronal direction in relation to the CEJ to compensate for the postsurgical contraction of the gingival margin. Vertical incisions are made 3–4 mm along the mucogingival line. Thereafter, the SP should be removed from the underlying tissue as a partial thickness flap having consistent thickness, which is achieved by keeping the scalpel blade parallel to the osseous tissue. Once both the SP have been lifted, the apical part of the gingival margin is performed with a muco-periosteal elevator of complete thickness. The flap should be lifted approximately 3 mm apical to the residual bone crest. Thereafter, the vertical incisions are beveled toward the internal section of the flap, with the objective of leaving the periosteum on the surgical border and reducing the risk of scarring along the incision. To allow the flap to be passive and to be moved without tension, a deep incision parallel to the osseous tissue is made in the apical part of the flap to allow for the disinsertion of muscular and submucosal fibers of the periosteum. Further, a superficial incision is made parallel to the alveolar mucosa to detach the muscular insertions from the connective tissue of the alveolar mucosa (Fig. 35).

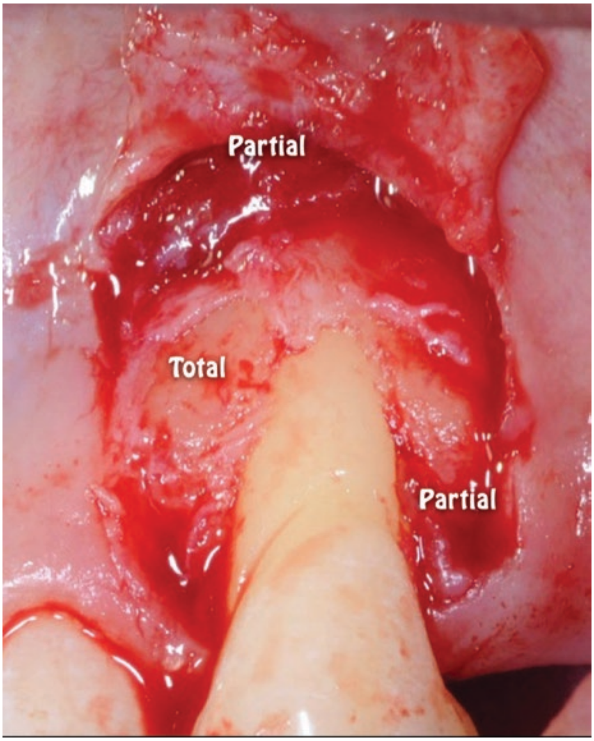


Fig. 35 Combined flap (partial/total/partial thickness)

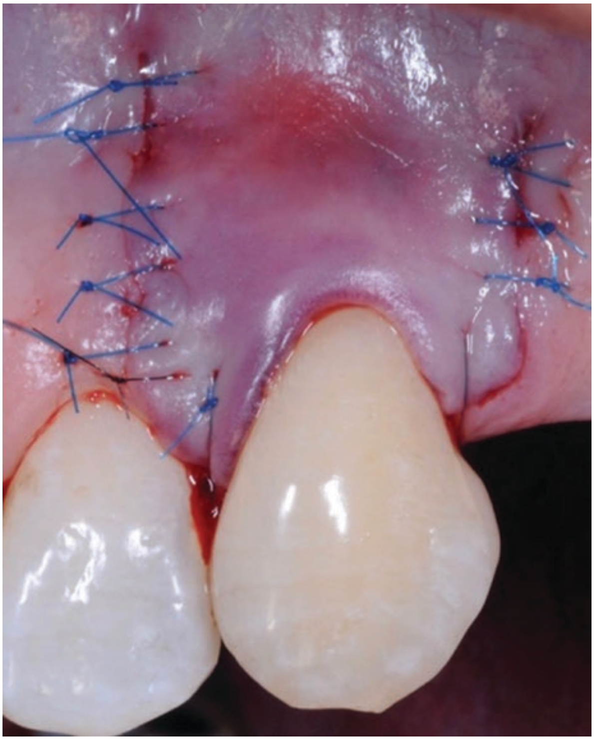


Fig. 36 Polypropylene 7/0 and 8/0 nylon sutures were used

The biomodification of the root surface is performed by root planning while avoiding contact between the root surface and osseous deficiency to preserve the connective tissue fibers that are in the root cementum. Additionally, the root surface can be conditioned with the local application of ethylenediaminetetraacetic acid (EDTA, 24%) followed by irrigation with the Enamel matrix derivative (Emdogain Straumann, Basel, Switzerland), after the removal of EDTA.

The anatomical papilla (AP) is de-epithelized to expose the connective tissue that receives the internal connective tissue of the coronally displaced SP. This procedure can be made easier by using microsurgical tools such as Castroviejo scissors and microblades (Morita Micro 15c Kyoto, Japan).

First, the vertical incisions are sutured with simple closing sutures using 7/0 or 8/0 non-absorbable monofilament threads (Polypropylene, Nylon, AD Surgical Sunnyvale CA, USA) while keeping the bite size symmetrical. It is important to use needles with a length shorter than 8 mm to suture vertical incisions easily. Finally, a suspension suture is placed in the papilla base anchored to the palatine (Fig. 36) (Video 7).

The sutures are removed after 2 weeks (Fig. 37). Postsurgical evaluations are performed at 2 weeks, 4 weeks, 12 weeks, 6 months, and 12 months after the surgery (Figs. 38 and 39).

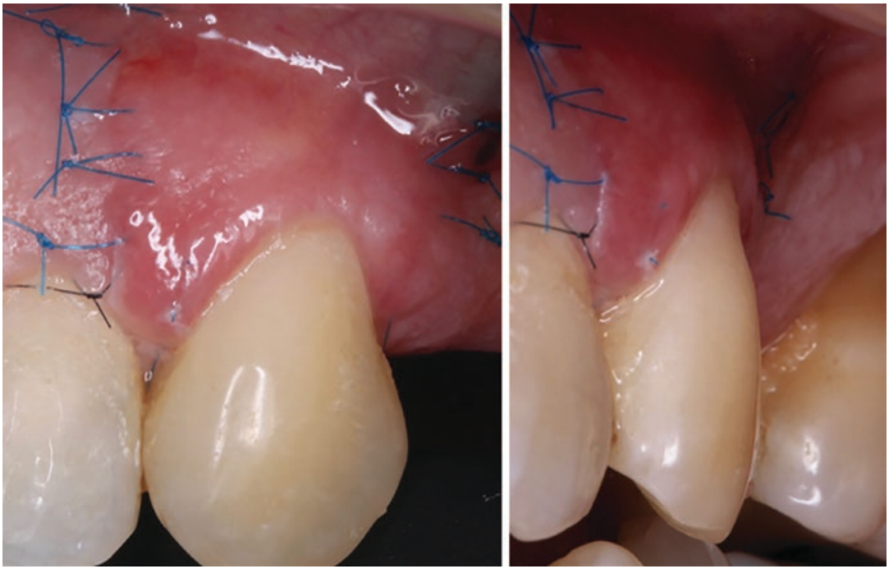


Fig. 37 The sutures are removed after 2 weeks

9.2 Laterally Moved CAF

The laterally moved CAF technique was described [26] and modified by Zucchelli and De Sanctis [27]. This flap design has many characteristics in common with the trapezoidal CAF. The main requirement of this technique is that the donor zone adjacent to the recession should have 3 mm of keratinized gingiva from the apical to coronal region and 6 mm in the meso-distal region plus the width of the recession being treated (Fig. 40). This technique is not recommended when the esthetic demands of the patient are high.

The approach to the flap is partial/total/partial. This creates the SP1 that is laterally advanced or in some cases is moved in the coronal direction. The mesial papilla AP1 is de-epithelized to expose the connective tissue and unite it with the internal area of the connective tissue of the pedicle. The suturing method is the same as in the trapezoidal flap technique, starting with the vertical incisions from apical to coronal region and ending with a suspension suture from the base of the SP1 to the base of the AP1 anchored to the palatal aspect of the tooth. Polypropylene 7/0 and 8/0 nylon sutures were used (Polypropylene, Nylon, AD Surgical Sunnyvale CA, USA) (Figs. 41, 42, 43, 44, 45, 46, 47, and 48) (Video 8).

Fig. 38 Postsurgical evaluations are performed at 6 months after the surgery

9.3 CAF in Envelope Without Vertical Incision

This approach is the modification of the CAF for multiple teeth described by Zucchelli and De Sanctis in 2000 [28]. Oblique incisions are made at the papilla level to create the SP, and a partial/total/partial thickness flap is created to achieve the displacement and passivity of the flap. In this case, a bilaminar technique with CTG is used (Fig. 49). Evaluation is performed at 3 months after surgery (Fig. 50).

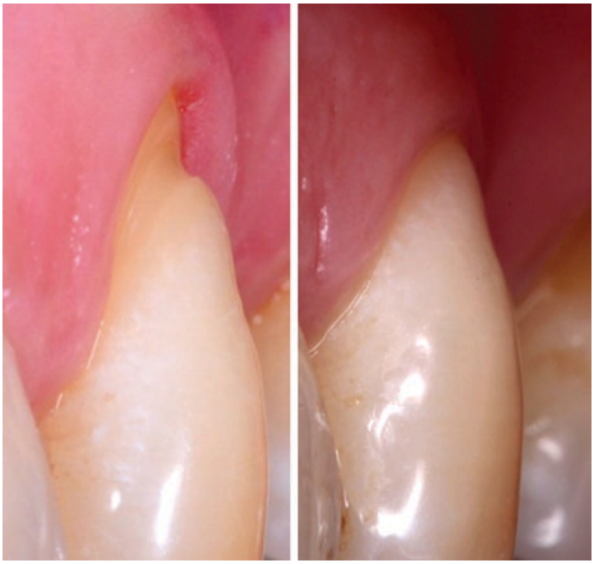


Fig. 39 Postsurgical evaluations are performed at 12 months after the surgery

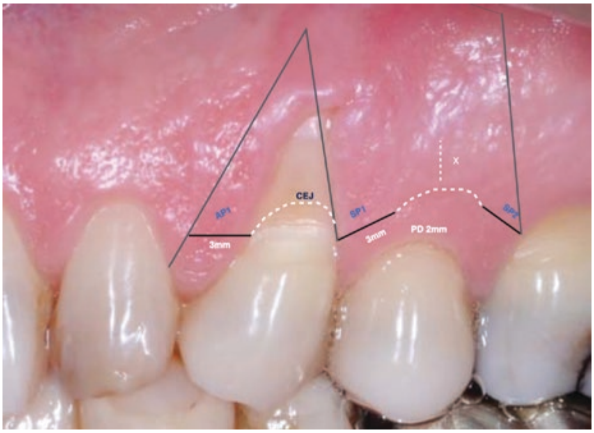


Fig. 40 Flap design laterally moved CAF

9.4 Envelope Without Incision

The envelope without incision technique was described by Raetzke in 1985 [29] and modified by Allen in 1994 [30], the first procedure without flap for root covering of single recessions. This technique was modified to increase flap mobility to displace it coronally and enhance the suture techniques at the same end. An incision-free procedure enhances the vascularization of the flap and graft and avoids scarring.

Patient after RT1 Cairo orthodontic treatment with the modified envelope technique and CTG (Fig. 51a–c) (Video 9).

Fig. 41 Polypropylene 7/0 and 8/0 nylon sutures were used

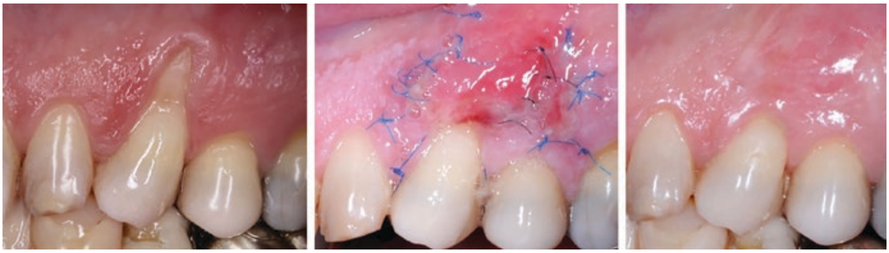


Fig. 42 Postsurgical evaluations at 7 days and 6 months after surgery

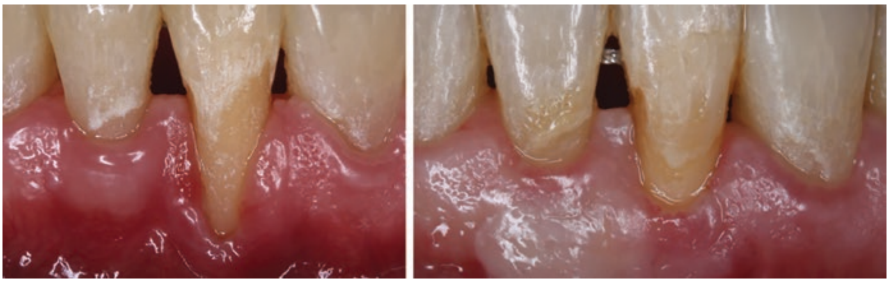


Fig. 43 Post-orthodontic treatment, type 2 Cairo recession, and a displaced lateral flap

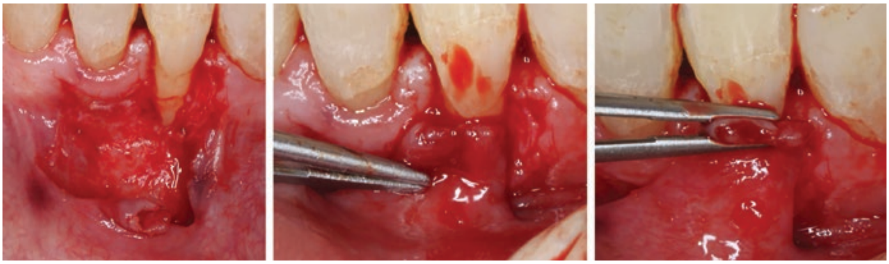


Fig. 44 De-epithelized grafting CTG with 7/0 sutures

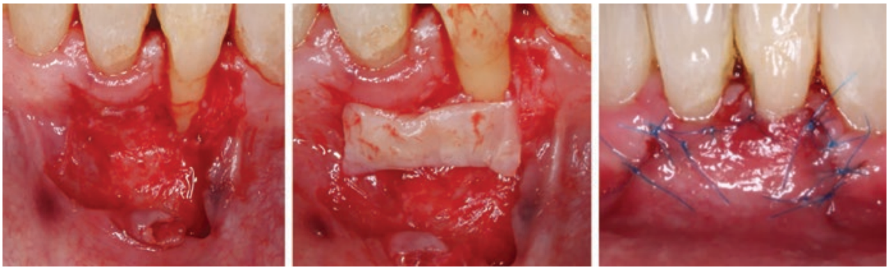


Fig. 45 7/0 polypropylene sutures

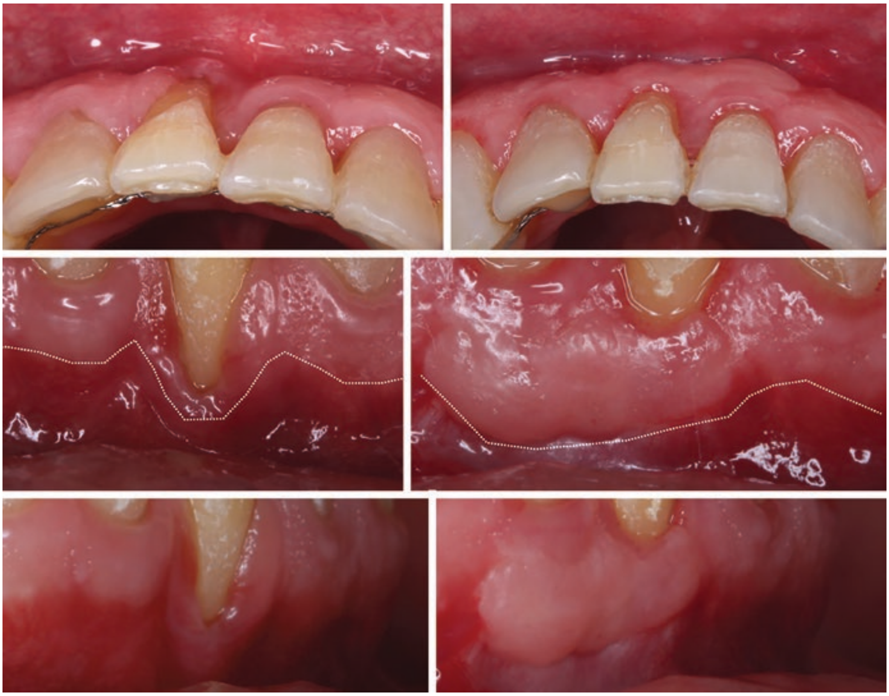


Fig. 46 Evaluation at 6 months after surgery

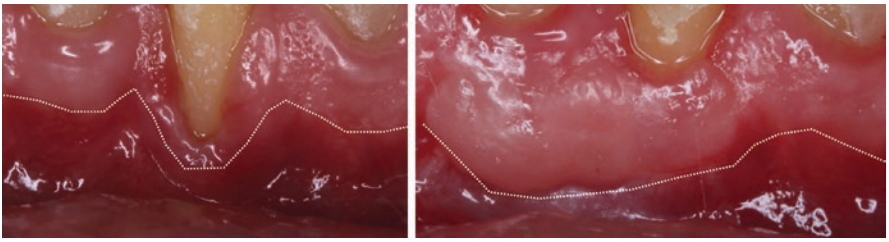


Fig. 47 Evaluation of a displaced lateral flap with a CTG at 5 years after surgery

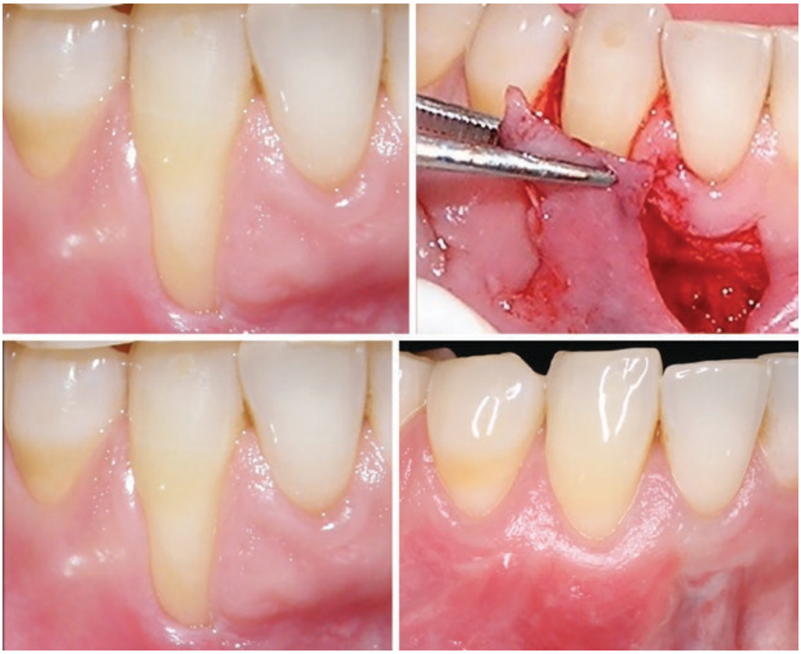


Fig. 48 Evaluation of the patient who received post-orthodontic treatment with displaced lateral flap and CTG at 5 years after surgery

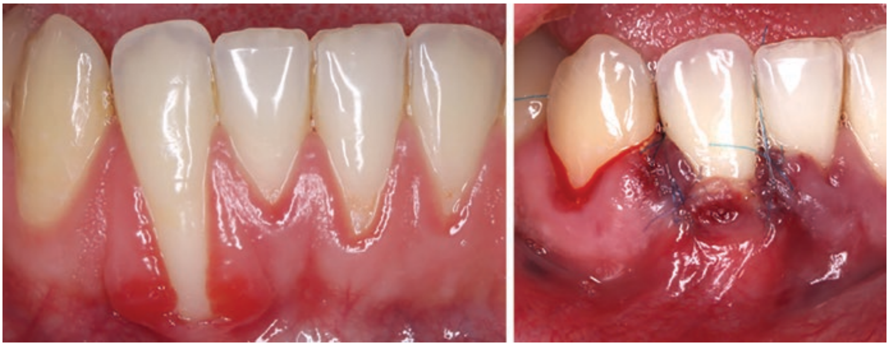


Fig. 49 In this case, a bilaminar technique with CTG is used

Fig. 50 Evaluation is performed at 3 months after surgery

9.5 Laterally Closed Tunnel for Isolated Mandibular Recession

The laterally closed tunnel for isolated mandibular recession technique was described by Sculean [31] and modified by Carranza [32]. It was specifically designed for deep and ideally narrow isolated recessions (RT1, 2) in mandibular incisors. It involves making of a supraperiosteal tunnel with microsurgical tools: a microscalpel microblade tunnel (Keydent ADS system Munich, Germany), micro papilla elevator, and microtunnelers. An incision parallel to the alveolar mucosa is made to free the submucosal tissue until a tensionless tissue has been obtained and the recession being treated can be closed laterally. A graft is obtained from the connective tissue of the palate and is inserted in the tunnel through 6/0 polyglycolic acid (PGA, AD Surgical Sunnyvale CA, USA) sutures in the mesial and distal directions, and the recession borders are sutured over the CTG with 7/0 polypropylene sutures (Polypropylene, AD Surgical Sunnyvale CA, USA) with simple stitches and border approximation knotting. Thus, the graft is submerged in the tunnel (Fig. 52).

10 Treatment of Multiple Gingival Recessions

There are two types of approaches for the treatment of multiple recessions: the CAF in the envelope [28] and the modified tunneling [24, 33, 34].

10.1 CAF in Envelope

The design of the displaced coronal flap is based on oblique incisions made in the papilla from the base of the papilla to the vertex, taking the point of greater recession as a reference as the axis of greater rotation of the flap. In this case, it is the lateral one. Each oblique incision created a SP [28] (Fig. 53). A partial/total/partial thickness flap was made, using the same protocol described in the trapezoidal flap, to achieve coronal displacement and passivity. Before suturing, the anatomical

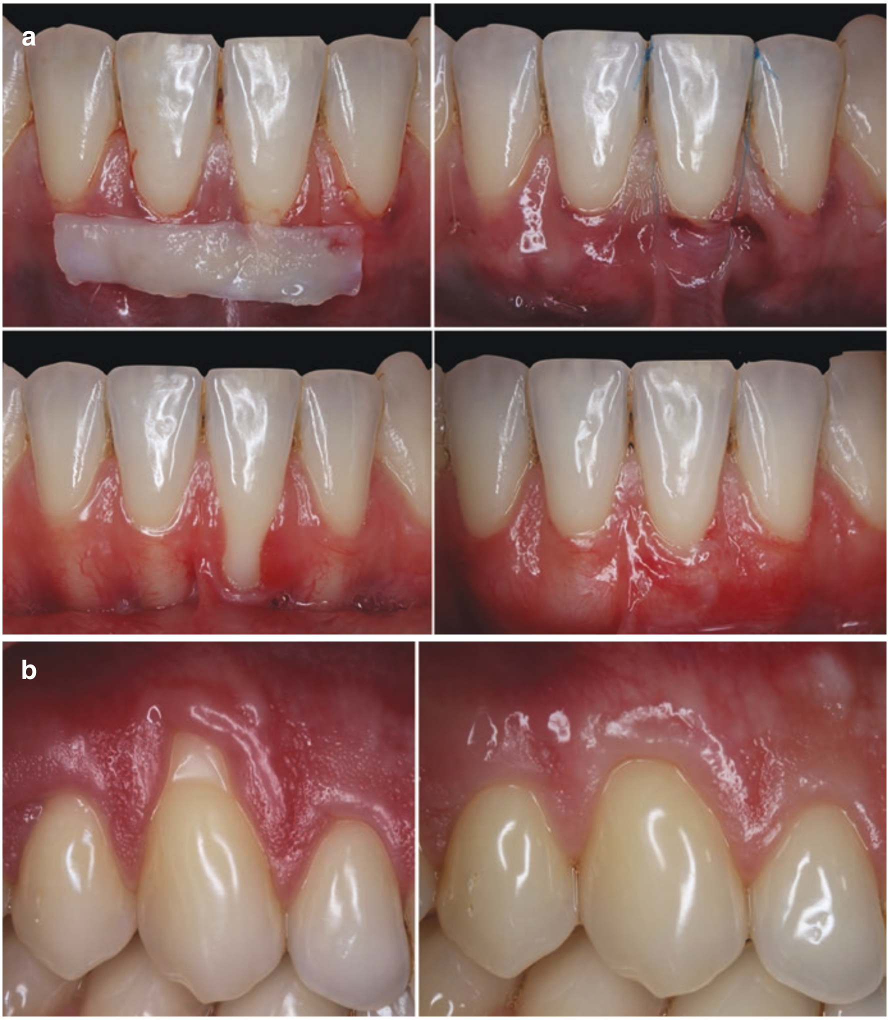


Fig. 51 (**a**) Patient after RT1 Cairo orthodontic treatment with the modified envelope technique and CTG. (**b**, **c**) Postsurgical evaluations at 5 years after surgery

Fig. 7 (continued)

Fig. 52 Laterally closed tunnel for isolated mandibular recession

Fig. 53 Flap design CAF in envelope

Fig. 54 Immediate postsurgical

Fig. 55 Evaluation performed at 6 months after surgery

papilla was de-epithelized to receive the connective tissue of the SP and sutured with suspension sutures (7/0 polypropylene sutures) (Polypropylene, AD Surgical Sunnyvale CA, USA) to palatine from the base of the SP to the base of the anatomical papilla (Figs. 54, 55, 56, and 57; Video 10).

10.2 Modified Tunnel

Modified tunnelling technique was described by Azzi and Etienne [24] in 1998, popularized by Zabalegui [33] in 1999 and modified by Zuhr [34] in 2007. It consists of making a tunnel through intrasulcular, continuing with a mucosal partial thickness flap (supraperiosteal technique), encompassing the entire adhered gingiva. At the mucogingival line, a dissection is made to free the submucosal and muscular tissues and to achieve the necessary mobility to displace the flap in the coronal direction. Another important aspect is the freedom of the base of the papillae, which should be created in a delicate and careful manner (micro papilla elevator Mamadent Micro 005 papilla elevator ADS system Munich, Germany), without touching the tip, palatinal, or lingual part of the papilla. A greater flap mobility is achieved in this manner.

The use of micro-tools specially designed for this purpose (microtunnelers, microelevators, micro papilla elevators, and microscalpels for tunneling Mamadent ADS system Munich, Germany) is essential because they ensure a clean, minimally invasive technique with a low risk of piercing the gingiva and mucosa (Figs. 58 and 59).

The suture technique should be based on immobilization of the flap, which has been displaced several millimeters in the coronal direction from its initial position.

Fig. 56 Evaluation performed at 1 year after surgery

Fig. 57 Evaluation before and after 1 year of surgery with coronal advanced flap

Suspension sutures are usually anchored to the contact point (intentionally or provisionally made with a flowable composite in the most incisal section close to the contact point). This suturing technique involves introduction of the needle from the base of the recession toward the papilla as close as possible to the vertex, where the needle exits the vestibular site. Thereafter, the needle is grabbed at its base, weaved underneath the contact point, and knotted in the incisal section close to the contact point. Before knotting, it is important to ensure that the short end of the suture is underneath the long end and that the suture applies a strength vector toward the coronal and palatine zones. In addition, 7/0 polypropylene sutures are used (Polypropylene, AD Surgical Sunnyvale CA, USA) (Fig. 60).

The orientation of the suture at the level of the papilla can be vertical, horizontal, or oblique depending on the depth of the recession (Fig. 61). Oblique orientation is recommended for deeper recessions, whereas vertical and horizontal orientations

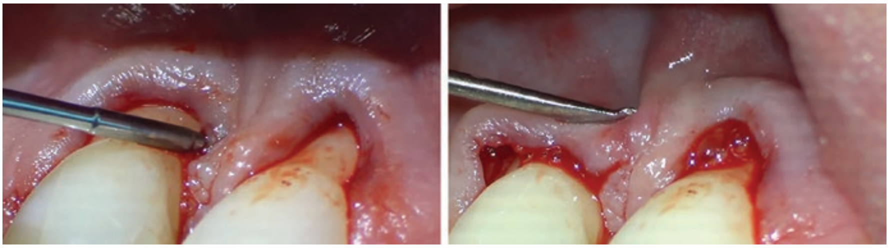


Fig. 58 Microtunnelers, micro papilla elevators, Mamadent Micro 005 papilla elevator ADS system Munich, Germany for tunneling

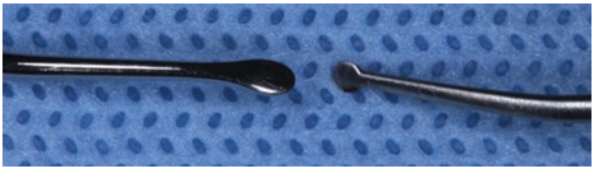


Fig. 59 Microtunnelers, micro papilla elevators, Mamadent Micro 005 papilla elevator ADS system Munich, Germany for tunneling

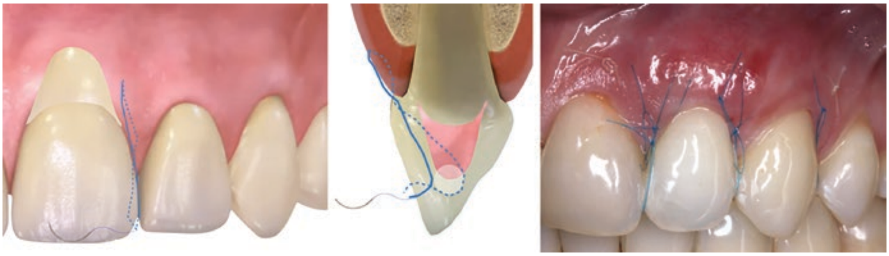


Fig. 60 Point-of-contact sling sutures, 7/0 polypropylene sutures are used

Fig. 61 The orientation of the suture at the level of the papilla can be vertical, horizontal, or oblique depending on the depth of the recession

are recommended for not so deep recessions. (Figs. 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, and 75; Videos 11 and 12).

Fig. 62 Female patient with multiple type I recessions and darkening of the central 2.1

Fig. 63 Tunneling with connective tissue grafting in the lateral zone 2.2

Fig. 64 Evaluation performed at 1 year after surgery

Fig. 65 Lateral view at 1 year after surgery

Fig. 66 Female patient with multiple type I recessions and non-carious cervical lesions treated with a displaced coronal flap and ceramic veneers. Evaluation after 5 years of treatment

Fig. 67 Male patient with multiple type I recessions treated with tunneling and connective tissue graft post-orthodontic treatment. Evaluation after 1 year of treatment

Fig. 68 Female patient with multiple type I recession treated with tunneling and connective tissue graft

Fig. 69 Evaluation at 6 months after treatment

Fig. 70 Female patients with multiple type I recessions treated with tunneling and connective tissue graft

Fig. 71 Evaluation after 6 months of treatment

Fig. 72 Evaluation after 6 months of treatment

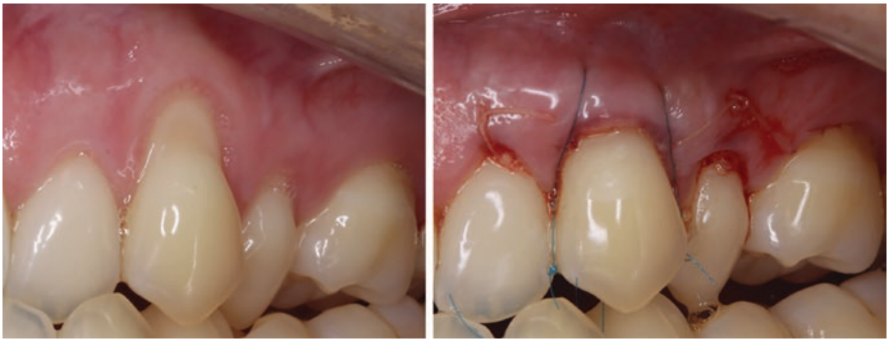


Fig. 73 Female patient with multiple type I recessions treated with tunneling and connective tissue graft

Fig. 74 Evaluation after 6 months of treatment

Fig. 75 Male patient with multiple type I recessions treated with tunneling and connective tissue graft. Evaluation after 1 year of treatment

11 Microscope-Assisted Autograft Harvesting

Autologous connective tissue is the ideal tissue to reconstruct soft tissue defects such as root and peri-implant covering, increased toothless ridge, and prosthetic gingival thickening among others [35, 36]. The grip on the graft with the use of magnification and illumination provided by a surgical microscope aids in the identification of the type of intervened tissue and to create a more symmetrical graft in thickness and size, which is an essential requirement for its survival. Although working in the palatine area with a microscope is not very comfortable for the operator, it is recommended to have and use pivotal objectives and slanted optics. This allows the microsurgeon to maintain an upright comfortable position at all times, independent of the angle in the oral cavity, which makes the position and access to the palate easier.

There are mainly three techniques to obtain a graft of palate connective tissue:

11.1 Trapdoor Technique

This technique was described by Edel et al. [35] in the year 1974. It involves the creation of a partial thickness flap with a horizontal incision (same size as that of the graft in a meso-distal sense) and two vertical incisions (at least 2 mm away from the gingival margin and apically extending 1 mm beyond the graft in the apico-coronal direction). All of the initial incisions should be perpendicular, and the thickness of the graft should be determined by the horizontal incision (approx. 1 mm). At that point, the angle of the scalpel blade is changed and is made parallel to the tissue, while ensuring that the thickness is consistent throughout the whole graft, horizontal incisions meet vertical incisions, and connective tissue is removed. Finally, the access flap is sutured with simple interrupted 7/0 polypropylene sutures (Polypropylene, AD Surgical Sunnyvale CA, USA).

11.2 Envelope Technique

The envelope technique was first described by Hurzeler et al. [36] and modified by Lorenzana et al. [37]. This technique involves a single horizontal incision, through which a flap of partial thickness is created to access the subepithelial connective tissue. In this technique, the thickness of the soft tissue of the palate should not be less than 3 mm (Fig. 76).

The horizontal incision should be 4 mm greater than the meso-distal width of the graft and the envelope should be at least 2 or 3 mm apical to the apico-coronal limit of the graft. A horizontal incision is made 2 mm away from the gingival margin (Fig. 77). Thereafter, a second incision is made parallel to the tissue by changing the direction of the scalpel to create an envelope. After the envelope has been created, the deep surface is accessed and through three incisions (horizontal, coronal, and apical) that meet the vertical incision, the connective tissue graft is obtained (Fig. 78).

The donating area is sutured with suspension sutures with crossed teeth or horizontal mattress sutures as reported by Borguetti [24] (Fig. 79).

11.3 Connective Tissue Graft (De-epithelialized Epithelium)

This technique is a modification of the free epithelial graft [38], is recommended when the palate thickness is not sufficient (<3 mm) to obtain connective tissue using other techniques. A free epithelized graft was dissected through a horizontal

Fig. 76 The thickness of the soft tissue of the palate should not be less than 3 mm

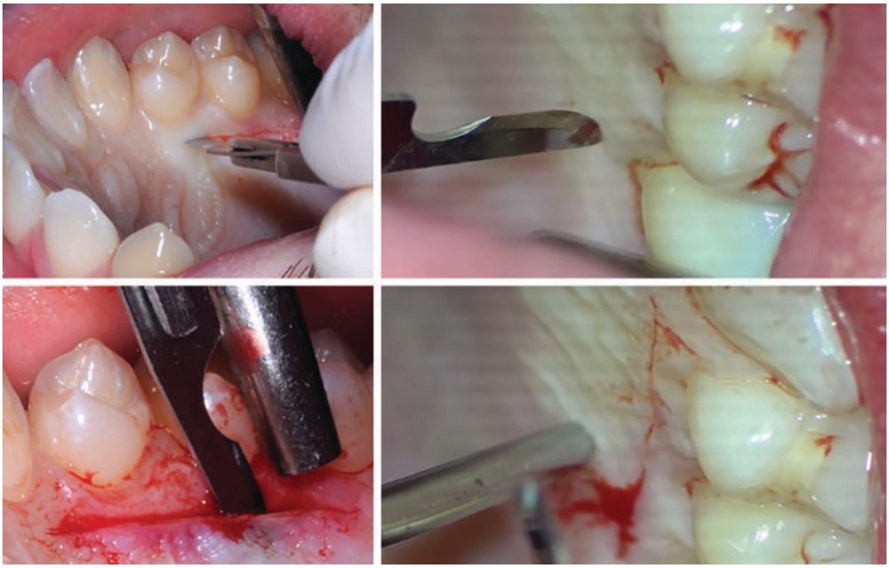


Fig. 77 The horizontal incision

incision 2 mm away from the gingival margin. The angle of the scalpel blade should be perpendicular to the osseous tissue and the depth should be according to the thickness of the required tissue (1–1.5 mm). The length of the meso-distal part of the incision depends on the size of the desired graft, which depends on the wound being treated. Thus, vertical incisions (mesial and distal) are made according to the size of the desired graft. Thereafter, the blade is rotated within the horizontal incision and made parallel to the osseous tissue. The graft is excised from the meso-coronal corner and through the length of the horizontal coronal incision to the meso-apical corner (Fig. 80). It is important to ensure that the graft is of the same thickness and size. Lastly, the apical horizontal incision is made by bringing together the apical part of the vertical incisions to release the graft.

The epithelial layer of the graft is removed under a magnification of more than 6× to be able to differentiate between the epithelium (appears shining when illuminated) and the connective tissue (appears dull when illuminated). The epithelium is removed using a new blade placed parallelly to the external surface of the graft. The epithelial (rough) tissue and connective (soft) tissue can be differentiated based on the appearance (Fig. 81; Video 13).

The donating area is sutured with suspension sutures with crossed teeth or horizontal mattress sutures (Fig. 82).

The exposed area of the palate is protected with a resorbable collagen membrane and is sutured to immobilize it for greater postoperative comfort. An acrylic stent can be used to protect the palate for 7 days (Fig. 83).

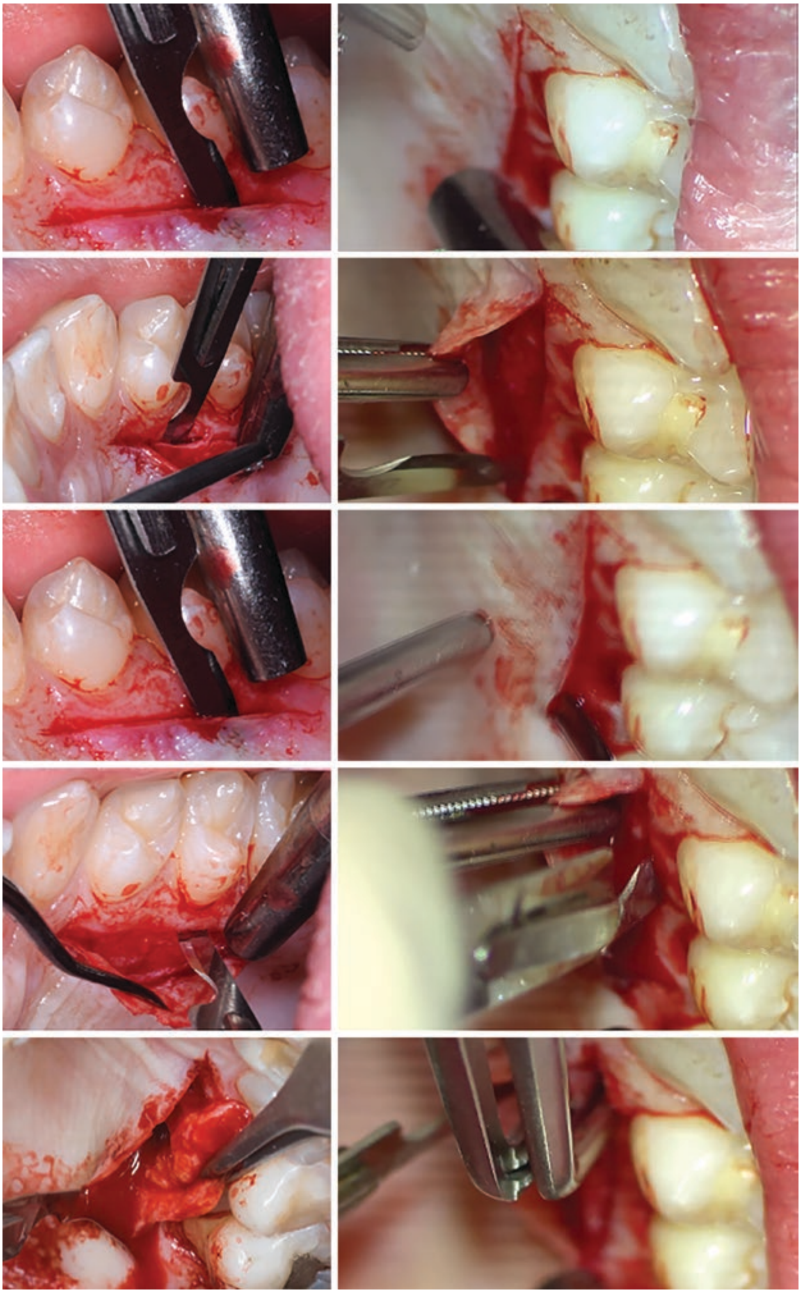


Fig. 78 Thereafter, a second incision is made parallel to the tissue by changing the direction of the scalpel to create an envelope. After the envelope has been created, the deep surface is accessed and through three incisions (horizontal, coronal, and apical) that meet the vertical incision, the connective tissue graft is obtained

Fig. 79 The donating area is sutured with suspension sutures with crossed teeth or horizontal mattress sutures as reported by Borguetti

Fig. 80 The graft is excised from the meso-coronal corner and through the length of the horizontal coronal incision to the meso-apical corner

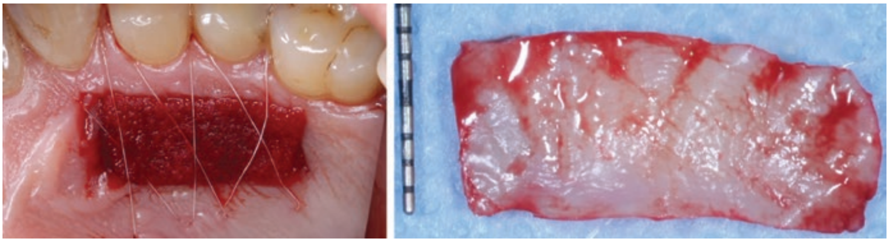


Fig. 81 The epithelial (rough) tissue and connective (soft) tissue can be differentiated based on the appearance

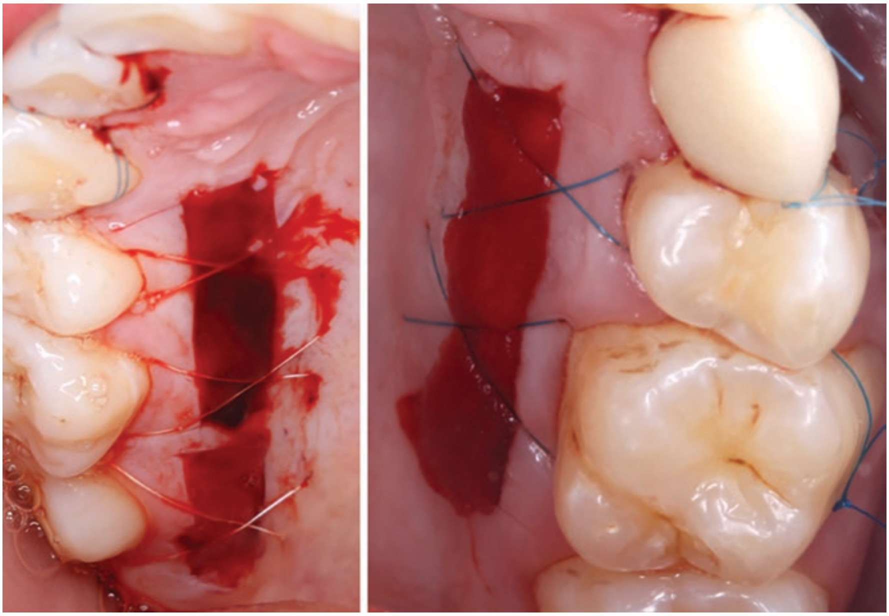


Fig. 82 The donating area is sutured with suspension sutures with crossed teeth or horizontal mattress sutures

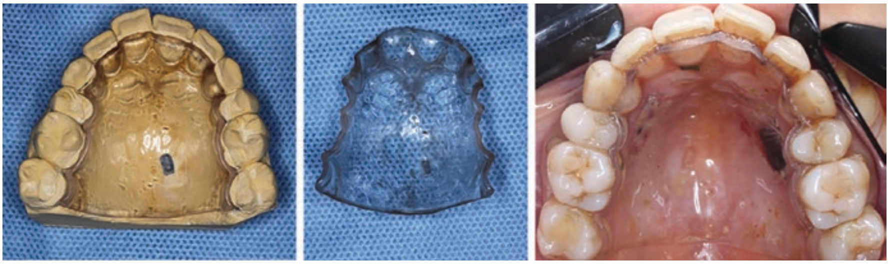


Fig. 83 An acrylic stent can be used to protect the palate for 7 days

12 Treating Non-carious Cervical Lesions Associated with Gingival Recessions Defects

12.1 Classification of Root Defects

The effects of the tooth surface or CEJ are described in the literature as non-carious cervical lesions (NCCLs) [39]. In many cases, the CEJ cannot be recognized when NCCLs occur. This is a clinical problem given that the CEJ acts as a reference point for the diagnosis and treatment of gingival recessions [40]. The absence of an identifiable CEJ can be because of erosion, abrasion, and abfraction, resulting in

Fig. 84 Classification of root defects

diagnostic problems as well as serious surgical challenges when the root surface is structurally significantly affected [41]. Piniprato et al. [42] described a classification system for affected tooth surface in the areas of gingival recession. Based on the visual presence (A) or absence (B) of the CEJ and the presence (+) or absence (−) of a tooth surface discrepancy caused by the loss of tissue, there are four possible classes (A+, A−, B+, and B−) (Fig. 84).

12.2 Digitally Guided Root Coverage Predetermination: A Multidisciplinary Approach

The absence of an identifiable CEJ can be because of erosion, abrasion, and abfraction, resulting in diagnostic problems as well as serious surgical challenges when the root surface is structurally significantly affected [43]. The ideal treatment for crown-radicular NCCL should be a combination of restorative and periodontal treatments. Different approaches have been presented in terms of the sequence of clinical actions that should be performed to achieve a successful outcome. However, completing the restorative therapy before mucogingival surgery has been found to have several clinical advantages for both procedures: restorations can be easily performed and finished in an isolated field with no interference of the soft tissues. In addition, root coverage surgery is facilitated by the reconstruction of the emergence profile of the clinical crown, which provides a stable, smooth, and convex anatomy for surgical flap repositioning [44, 45]. The main objective of a periodontal surgical procedure for esthetic root coverage is to adequately reposition soft tissues to reproduce an ideal and natural emergence profile and thereby protect the underlying structures. Although different authors have proposed different techniques to treat this type of defect, there is no consensus on treatment protocols for a deep cavity (≥3 mm) beyond the CEJ (Fig. 85a). Zucchelli et al. [45] defined topographically the maximum root coverage after a mucogingival surgical correction (Fig. 85b). This maximum line of root covering substitutes the CEJ when it is not clinically detectable or the conditions for a complete covering are absent (e.g., complete height of the papilla). Although factors such as the partial loss of the height of the papilla, dental rotation, extrusion, and occlusal abrasion should be considered for pre-surgical analysis. The most common mistake is not being able to establish the location of the CEJ in the recession zone and mistaking it for abrasion. Hence, the use of a 20× high magnification microscope is essential because it allows us to clearly differentiate between tissues, enamel and dentin, root surface, presence of cervical lesions, cavities, and restorations (Video 14). Generally, the CEJ is a curved and convex line, unlike abrasion lines that are flat and concave. In the absence of the CEJ, it is recommended to reconstruct it using one of the various methods available [45, 46].

A chart illustrating the decision-making process for treating NCCLs associated with gingival recessions is presented (modified Zucchelli [43]) (Fig. 85c).

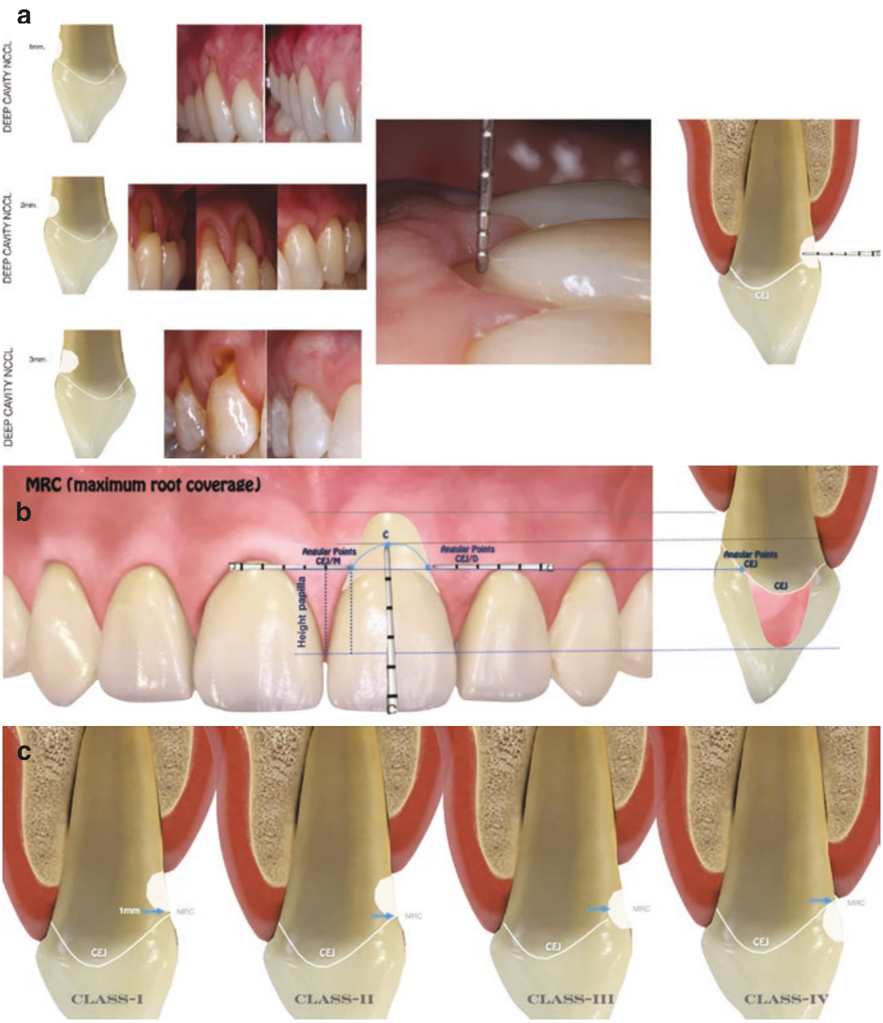


Fig. 85 (**a**) Deep cavity NCCL. (**b**) The maximum root coverage. (**c**) A chart illustrating the decision-making process for treating NCCLs associated with gingival recessions

12.3 Treatment Options

12.3.1 Class 1

A CAF or tunnel is indicated when the maximum line of coverage is 1 mm coronal to the NCCLs and the defect is less than 1 mm deep (Fig. 86).

12.3.2 Class 2

A CAF or tunnel is indicated when the maximum line of coverage is on the coronal border of NCCLs and the defect is less than 2 mm deep. Connective tissue graft is indicated for a patient with a fine phenotype (Fig. 87).

12.3.3 Class 3 (Option 1)

A coronal displaced flap or tunnel is indicated when the maximum line of coverage is in the middle of the NCCLs and the defect is greater than 2 mm (Fig. 88).

12.3.4 Class 3 (Option 2)

A coronal displaced flap or tunnel is indicated when the maximum line of coverage is in the middle of the NCCLs and the defect is greater than 2 mm. A connective tissue graft is indicated for patients with a fine phenotype (Fig. 89).

12.3.5 Class 4

Only restorative treatment is indicated when the maximum line of coverage is apical to the NCCLs (Fig. 90).

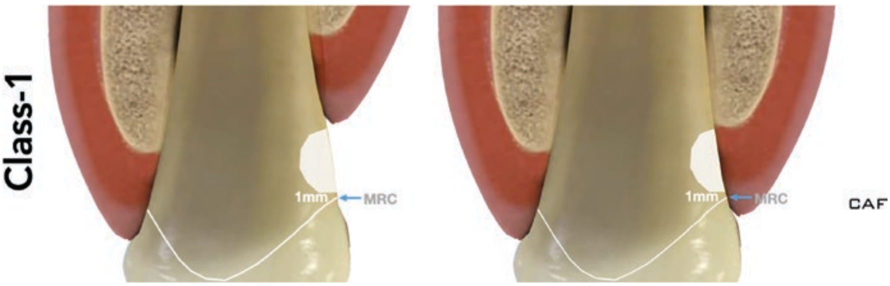


Fig. 86 Class-1

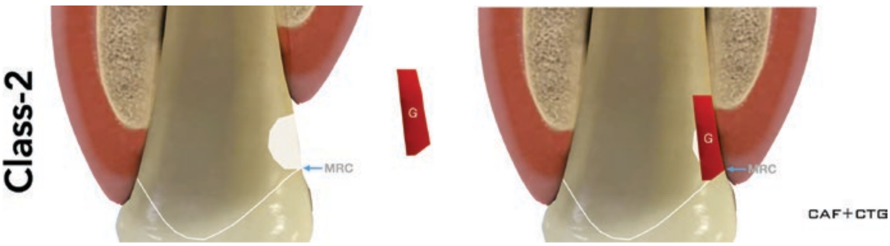


Fig. 87 Class-2

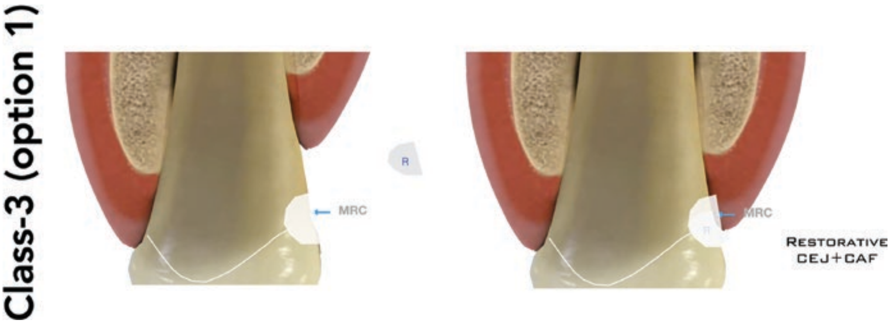


Fig. 88 Class-3 option-1

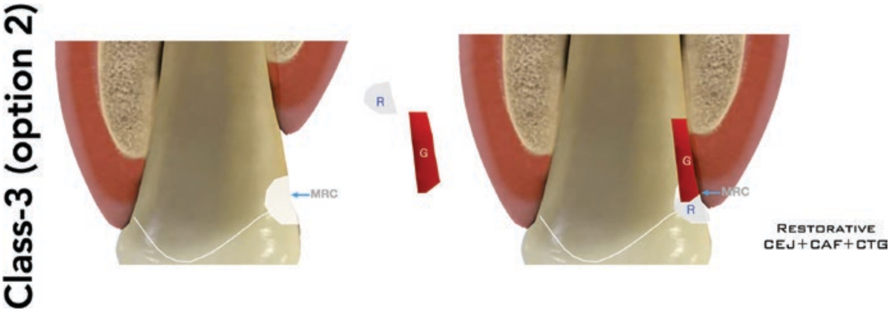


Fig. 89 Class-3 option −2

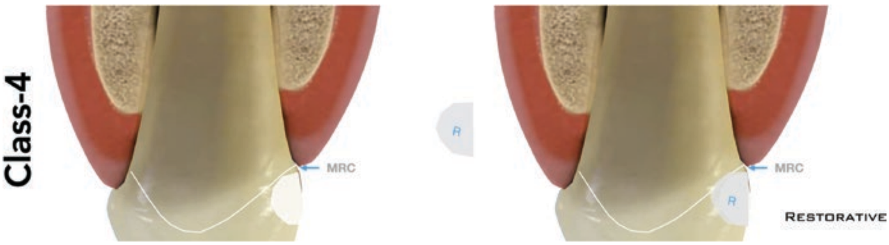


Fig. 90 Class-4

The incorporation of computer-aided design/computer-aided manufacturing CAD/CAM technology into the profession opens the door for new and innovative possibilities for dental treatment. Currently, the method to determine the CEJ and maximum line of root covering is through digital means. This protocol has been adopted from previous reports [45, 46].

Clinical Case A female patient with multiple inferior recession type I (RT-I) Cairo, NCCL B (+), and a thick phenotype (Fig. 91a). Treatment protocol (Class 3 Option 2): hygienic phase, treatment of the NCCL and reconstruction of the CEJ (Fig. 91b), and surgery (Fig. 91c). Tunneling in zones 3.3 and 4.3 was performed using connective tissue grafts.

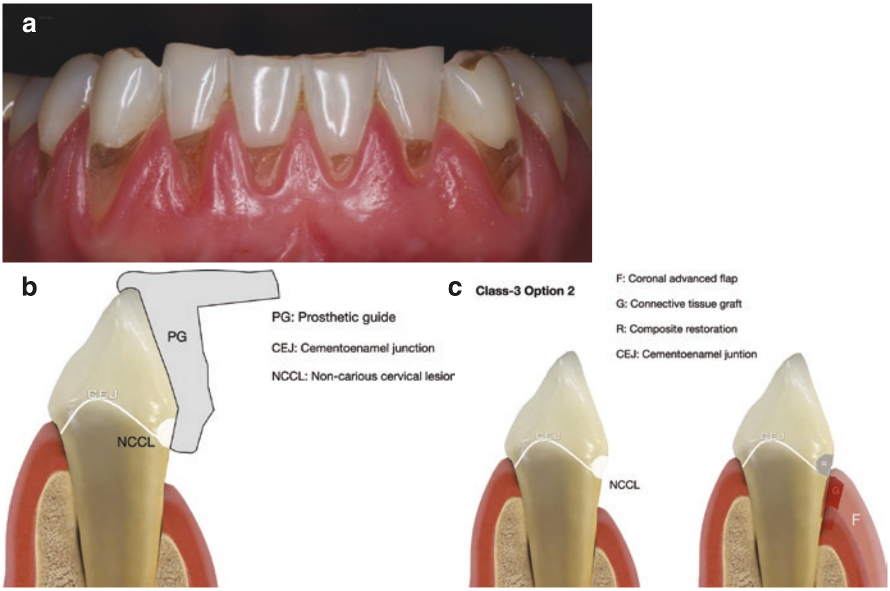


Fig. 91 (**a**) A female patient with multiple inferior recession type I (RT-I) Cairo, NCCL B (+), and a thick phenotype. (**b**) A prosthetic guide was designed for the reconstruction of the CEJ and projected on a digital model. (**c**) Treatment protocol (Class 3, Option 2)

Fig. 92 A digital impression

12.4 Restorative Treatment

1. A digital impression and intraoral photographs of the maxilla or jaw to be treated were captured (Fig. 92).
2. Stereolithography models were exported to the Meshmixer (Autodesk trademarks) software (Fig. 93).
3. The location of the angular points of the CEJ was clinically established to transfer the data to the digital model (Fig. 94).
4. Projection to the CEJ location was performed by measuring the height of the papilla, the vertical distance between the horizontal line of angular points of both

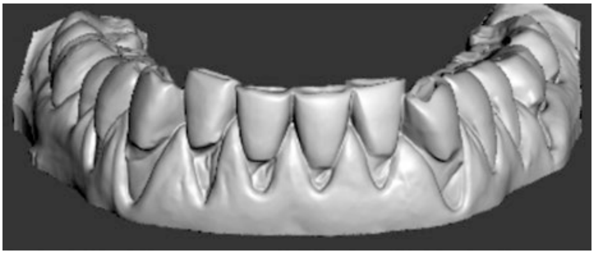


Fig. 93 Stereolithography models

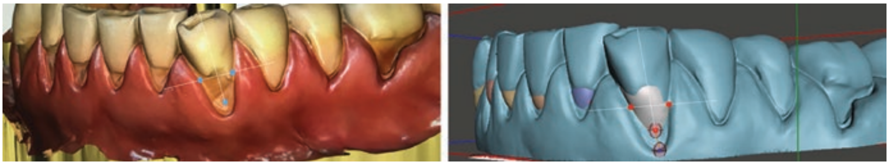


Fig. 94 The location of the angular points of the CEJ

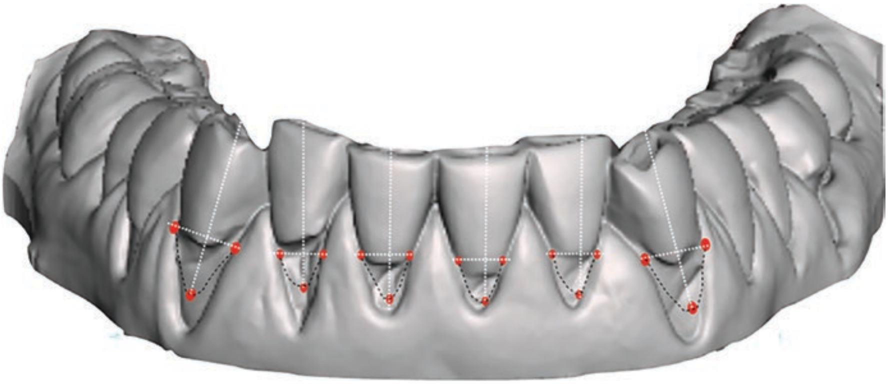


Fig. 95 Projection to the CEJ location

adjacent teeth, and the peak of the papilla using a digital model (Fig. 95). After obtaining the mesial and distal points, they were brought together by a curve-sinuated line that depended on the scalloping associated with patient's phenotype (Fig. 96).

5. A prosthetic guide was designed for the reconstruction of the CEJ and projected on a digital model (Fig. 97).
6. The CEJ reconstruction prosthetic guide was printed (Fig. 98).
7. After testing the adaptation of prothesis to the mouth (Fig. 99) (Video 15), the area was completely isolated for the CEJ and NCCL reconstruction with composite resin (Fig. 100).
8. The restoration was completed after grinding heads to polish (Figs. 101 and 102).

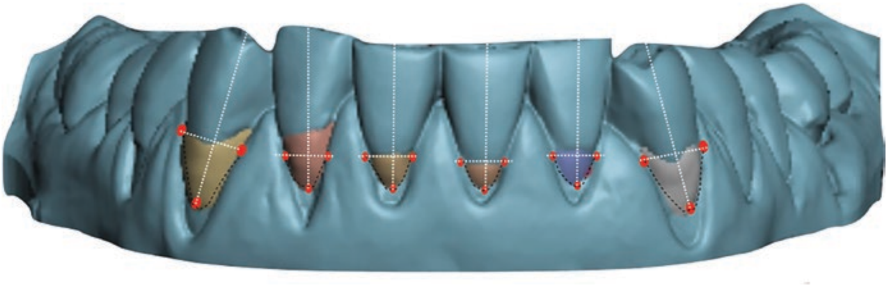


Fig. 96 After obtaining the mesial and distal points, they were brought together by a curve-sinuated line that depended on the scalloping associated with patient's phenotype

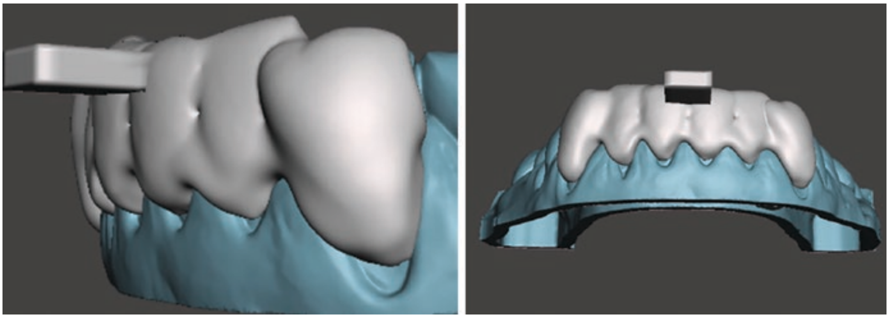


Fig. 97 A prosthetic guide was designed for the reconstruction of the CEJ

Fig. 98 Prosthetic guide was printed

Fig. 99 After testing the adaptation of prothesis to the mouth

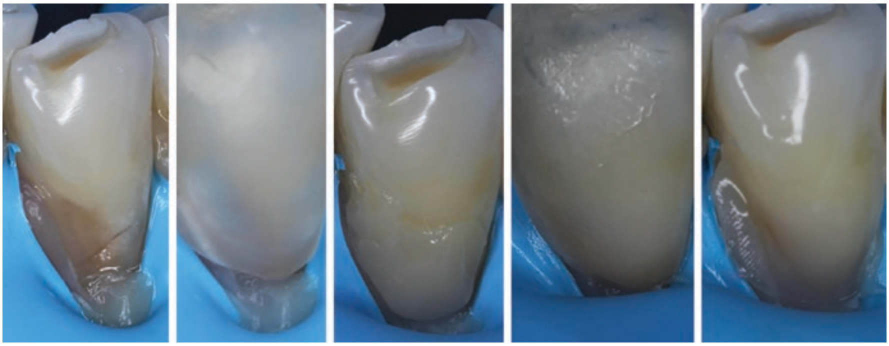


Fig. 100 The area was completely isolated for the CEJ and NCCL reconstruction with composite resin

Fig. 101 The restoration was completed after grinding heads to polish

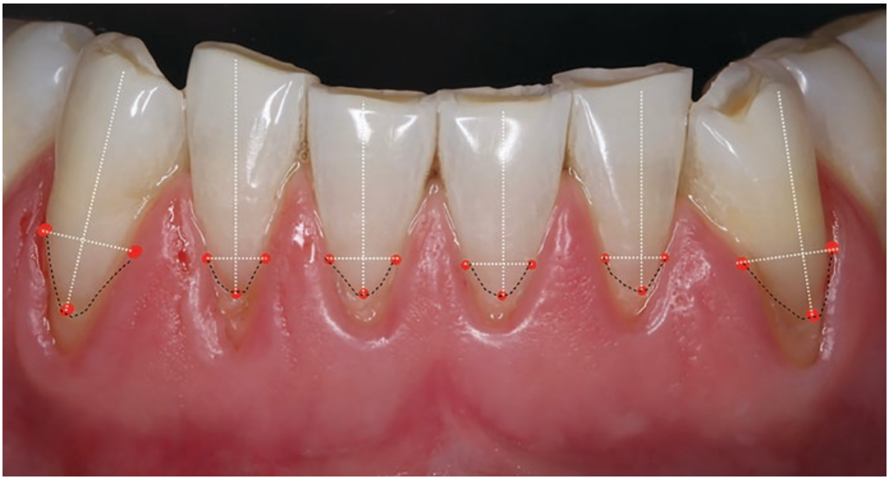


Fig. 102 Projection digital to the CEJ reconstruction

12.5 Surgical Treatment

9. The modified tunnel plus connective tissue graft (MTT + CTG) technique was selected (Fig. 103).
10. Point-of-contact sling 7/0 polypropylene sutures (Polypropylene, AD Surgical Sunnyvale CA, USA) (Figs. 104, 105, and 106). Evaluation at 2 weeks post-treatment and suture removal (Fig. 107).
11. The incisal borders are reconstructed (Fig. 108).
12. Evaluation at 6 months post-treatment (Fig. 109).

Clinical Case A non-smoker, female patient without any relevant medical conditions complained of poor esthetics and tooth sensitivity. The patient had RT-I Cairo, multiple recession defects in the maxillary and mandibular zones. The teeth had deep abrasion caused by an acidic diet and hard brushing was observed (Fig. 110).

Fig. 103 The modified tunnel plus connective tissue graft

Fig. 104 Point-of-contact sling 7/0 polypropylene sutures

Fig. 105 Point-of-contact sling 7/0 polypropylene sutures

Fig. 106 Point-of-contact sling 7/0 polypropylene sutures

Fig. 107 Evaluation at 2 weeks post-treatment and suture removal

Fig. 108 The incisal borders are reconstructed

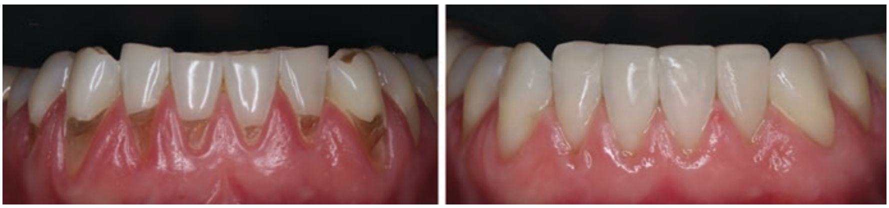


Fig. 109 Evaluation at 6 months post-treatment

Before starting the treatment, the occlusion of the patient was stabilized with a mouth guard. The patient was instructed to reduce the acidity of the diet, change the toothbrush, and modify the brushing technique. The CEJ level was identified using the Pini Prato's technique (Fig. 111).

The cervical defect had a depth of 2.5 mm, no decay, and a positive vitality. According to Pini Prato's classification [42], the lesion was Type B+ (Fig. 112).

12.6 Restorative Treatment

In teeth 2.1, 2.2, 2.3, 2.4, 2.5, 3.3, 3.4, and 3.5, the therapeutic CEJ and lost enamel were restored with composite resin, sandblasting, adhesive technique, and thorough polishing of the surface (Fig. 113).

12.7 Surgical Treatment Plan (Right Side)

In teeth 1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 4.1, 4.2, 4.3, 4.4, 4.5, and 4.6, the modified tunnel technique described by Azzi and Etienne with connective tissue graft (MTT + CTG) was performed [24].

Fig. 110 The patient had RT-I Cairo, multiple recession defects in the maxillary and mandibular zones

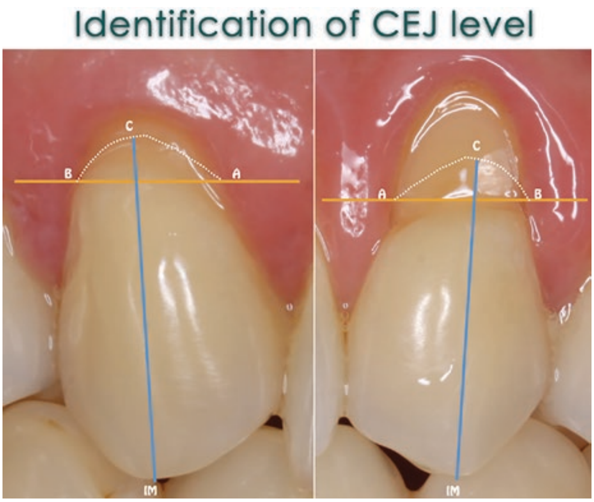


Fig. 111 The CEJ level was identified using the Pini Prato's technique

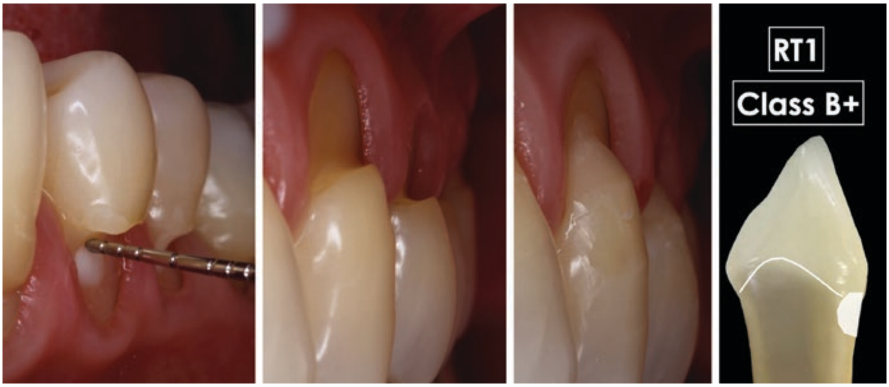


Fig. 112 The cervical defect had a depth of 2.5 mm, no decay, and a positive vitality. The lesion was Type B+

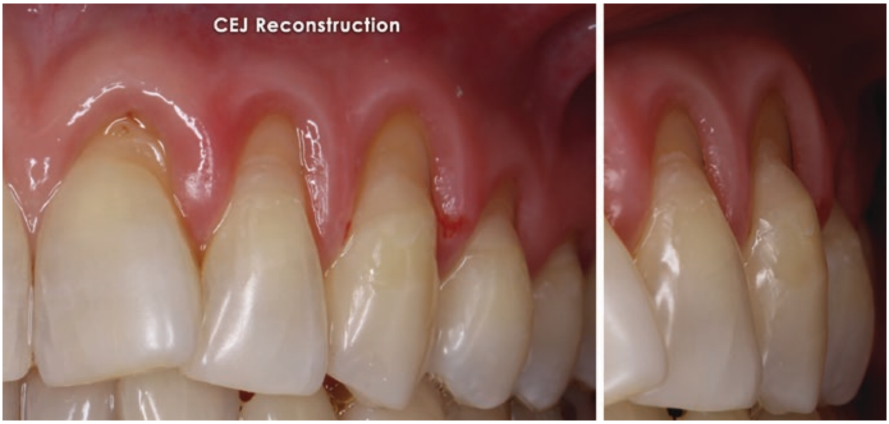


Fig. 113 In teeth 2.1, 2.2, 2.3, 2.4, 2.5, 3.3, 3.4, and 3.5, the therapeutic CEJ and lost enamel were restored with composite resin

12.8 Surgical Treatment Plan (Left Side)

In teeth 2.1, 2.2, 2.3, 2.4, 2.5, and 2.6, the CAF technique was performed, as described by De Sanctis and Zucchelli [28] (Figs. 114a, b, 115, and 116).

12.9 Mandibular Surgical Plan (Left Side)

Root polishing was performed under infiltrative anesthesia. Subsequently, submarginal incisions were made (Fig. 117). To increase the thickness of the soft tissue to improve long-term stability, the CAF technique with a connective tissue graft (CAF + CTG) was used in teeth 3.2, 3.3, 3.4, 3.5, and 3.6 (Fig. 118a, b; Video 16).

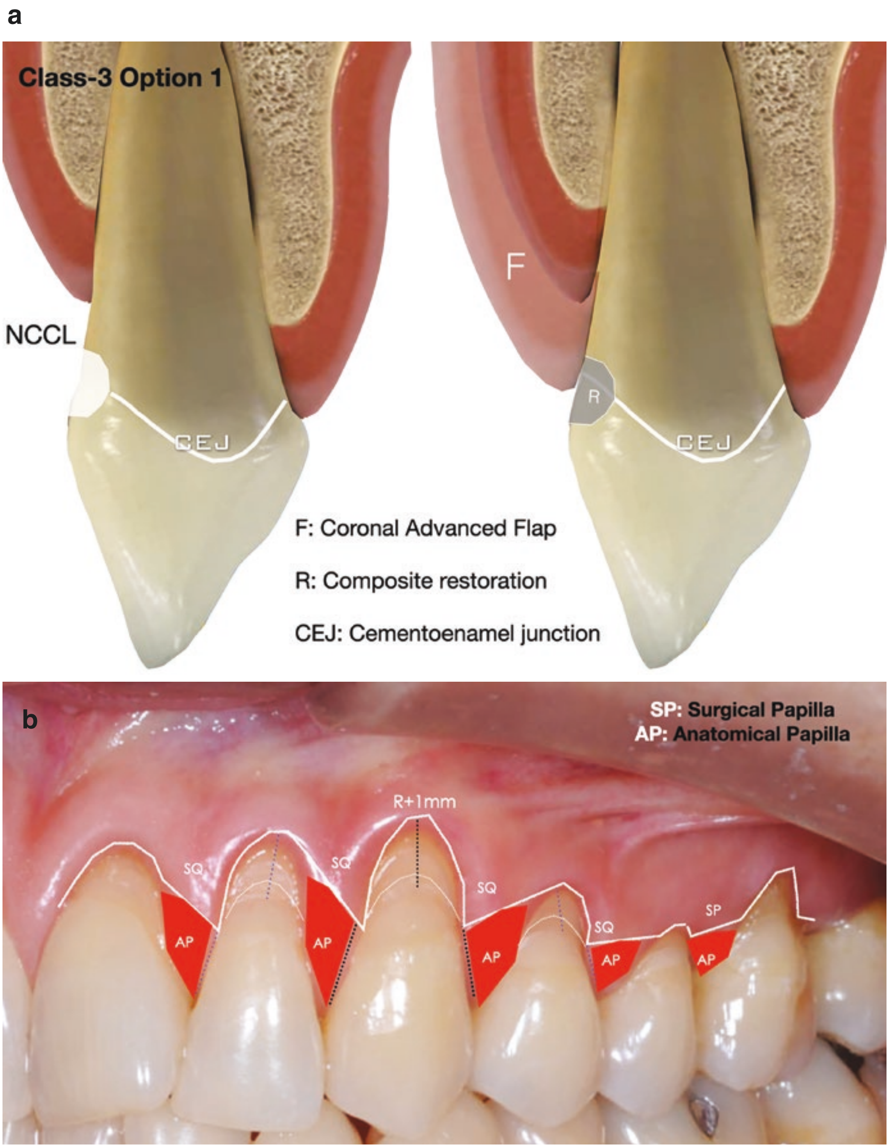


Fig. 114 (**a**) Treatment protocol (Class 3 Option 1). (**b**) In teeth 2.1, 2.2, 2.3, 2.4, 2.5, and 2.6, the CAF technique

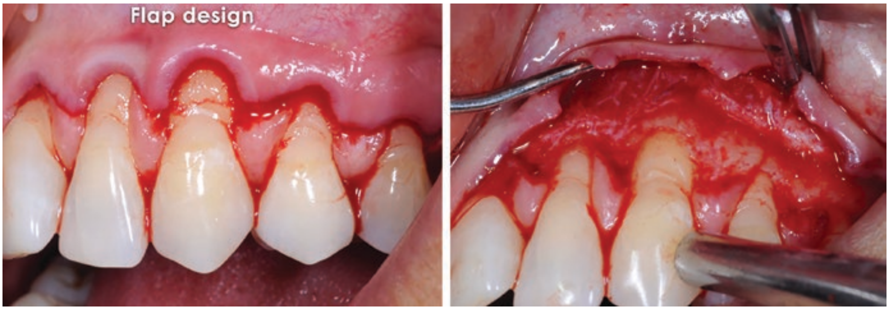


Fig. 115 Flap design

Fig. 116 Postsurgical immediate

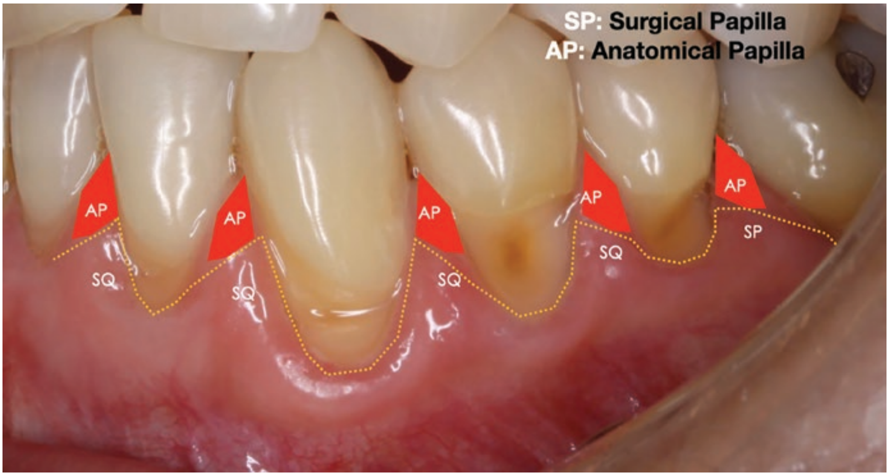


Fig. 117 Submarginal incisions were made

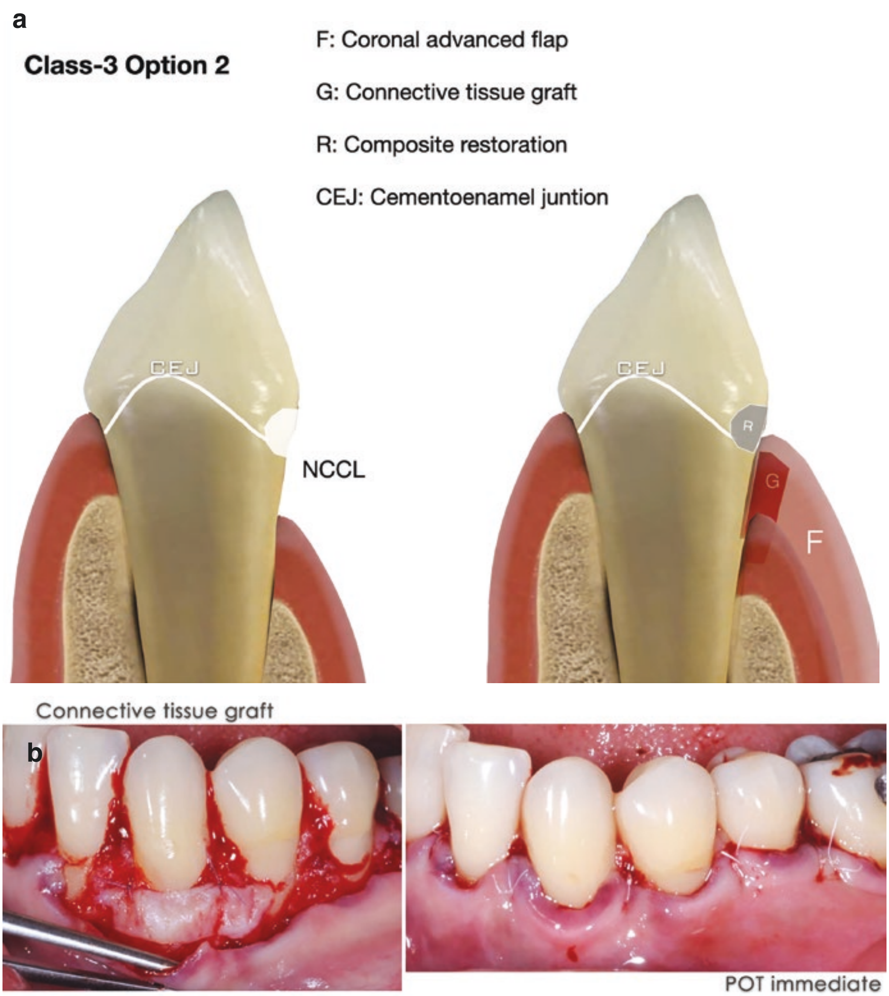


Fig. 118 (**a**) Treatment protocol (Class 3, Option 2). (**b**) Technique with a connective tissue graft (CAF + CTG) was used in teeth 3.2, 3.3, 3.4, 3.5, and 3.6

12.10 Clinical Outcomes

Esthetic outcome and root coverage in the four quadrants were achieved with the MTT + CTG, CAF, and CAF + CTG techniques. The stability of the gingival tissues was maintained after 3 years in all quadrants, regardless of the surgical technique used. The mucogingival line did not migrate to a position other than that obtained after surgery (Fig. 119a–c).

Clinical Case A non-smoker, female patient without any relevant medical conditions presented with an RT-I Cairo recession in teeth 5 and 6 with a thin gingival

Fig. 119 (**a**) Lateral view evaluation at 1and 3 year post-treatment. (**b**) Frontal view 3 years follow-up. (**c**) Frontal view mucogingival line 3 years follow-up

phenotype [47] (Fig. 120). NCCLs were present in both teeth. The canine and premolar recessions were described as Type A+ according to the Pini Prato classification, meaning that the CEJ was identifiable and a step was present between the CEJ and abrasion lesion. The cervical lesion depths in teeth 6 and 5 were 2.5 and 1 mm. Scheme of the periodontal and restorative approach for the treatment of the NCCL is shown in Fig. 121.

Fig. 120 A non-smoker, female patient without any relevant medical conditions presented with an RT-I Cairo recession in teeth 5 and 6 with a thin gingival phenotype

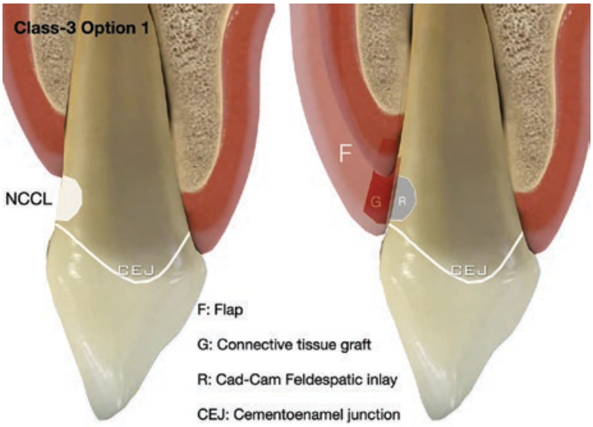


Fig. 121 Scheme of the periodontal and restorative approach for the treatment of the NCCL

12.11 Restorative Treatment

After local anesthesia, cervical lesions in teeth 1.4 and 1.3 were cleaned and flattened using rotary instruments at high speed. Digital optical impressions of teeth 1.4 and 1.3 were obtained (Fig. 122). An indirect restoration was designed for tooth 1.3 using specialized software. A cervical feldspathic ceramic inlay was milled using a milling unit. After milling, the restoration was confirmed intraorally and absolute isolation was performed. The adhesive cementation process was performed according to the manufacturer's instructions. The cervical lesion in tooth 1.4 was shallower and smaller than that in tooth 1.3; hence, cervical lesion in tooth 1.4 was restored with direct composite (Fig. 123).

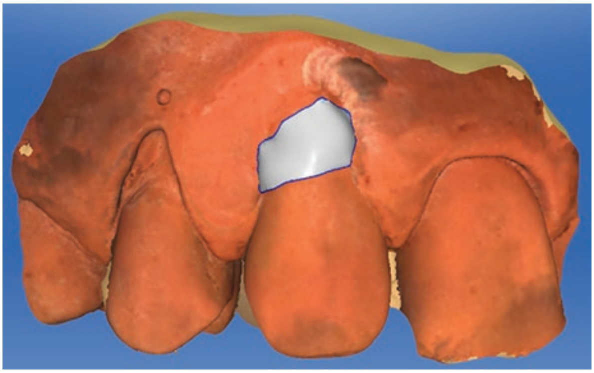


Fig. 122 Digital optical impressions

Fig. 123 Cervical lesion in tooth 1.4 was restored with direct composite

12.12 Surgical Treatment

A microblade was used to create a mucogingival tunnel from teeth 1.6–1.2. All muscle insertions were released to facilitate coronal soft tissue advancement. CTG was harvested from the palate using the one-incision approach. The graft was 12 mm long, 5 mm wide, and 2 mm thick. The subepithelial CTG was inserted into the mucogingival tunnel and its coronal limit was fixed at the CEJ level of teeth 1.4 and 1.3 with vertical mattress and sling sutures. Final flap anchoring to the palatal aspect of both teeth was performed with a 7/0 sling suture (Polypropylene, AD Surgical Sunnyvale CA, USA) (Fig. 124). This procedure allowed intimate adaptation of the buccal flap over the underlying CTG.

12.13 Clinical Outcomes

Complete root coverage was achieved. Parameters showed that bleeding on probing BOP maintained negative, PD remained stable, and relative gingival recession RGR and CAL decreased by 2.3 mm showing a favorable integration of the restoration and a predictable response of soft tissues during the entire follow-up period

(Figs. 125 and 126). Clinical measurements of teeth 1.4 and 1.3 are presented in (Table 6). At 60 month follow-up, cone beam computed tomography of tooth 1.3 was requested for imaging analysis (Fig. 127) and final photographs were captured. Treatment outcomes and their evolution were compared schematically (Figs. 128, 129, and 130).

Fig. 124 Final flap anchoring to the palatal aspect of both teeth was performed with a 7/0 sling suture

Fig. 125 Complete root coverage was achieved

Fig. 126 Parameters showed that bleeding on probing BOP maintained negative, PD remained stable

Table 6 Recorded parameters measurements

Tooth 1.3	Baseline	12 Months	24 Months	36 Months	60 months
BOP	(−)	(−)	(−)	(−)	(−)
PD	2 mm	2 mm	2 mm	2 mm	2 mm
RGR	(−) 2.3 mm	0 mm	0 mm	0 mm	0 mm
CAL	4.3 mm	2 mm	2 mm	2 mm	2 mm
Tooth 1.4	Baseline	12 months	24 months	36 months	60 months
BOP	(−)	(−)	(−)	(−)	(−)
PD	2 mm	2 mm	2 mm	2 mm	2 mm
RGR	(−) 1.5 mm	0 mm	0 mm	0 mm	0 mm
CAL	3.5 mm	2 mm	2 mm	2 mm	2 mm

BOP bleeding on probing, *PD* probing depth, *RGR* relative gingival recession, *CAL* relative clinical attachment level determined by PD + RGR

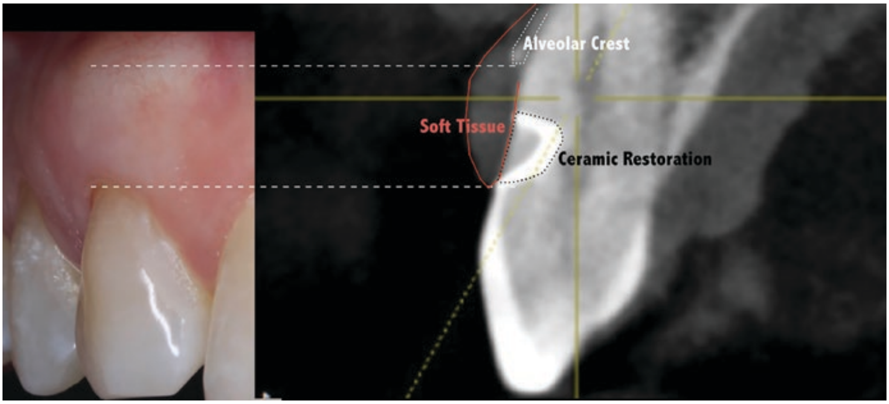


Fig. 127 At 60 month follow-up, cone beam computed tomography of tooth 1.3 was requested for imaging analysis

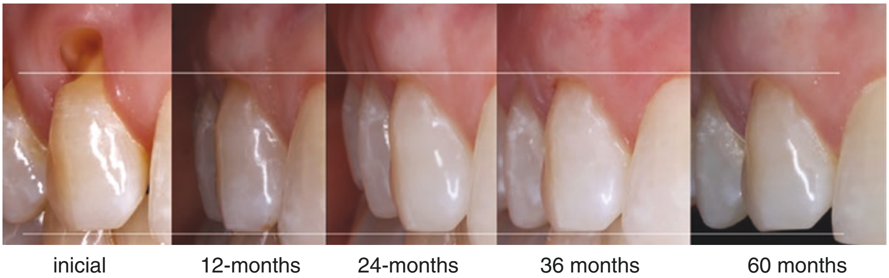


Fig. 128 Treatment outcomes and their evolution were compared schematically

Fig. 129 12, 24, 36, 60 months follow-up

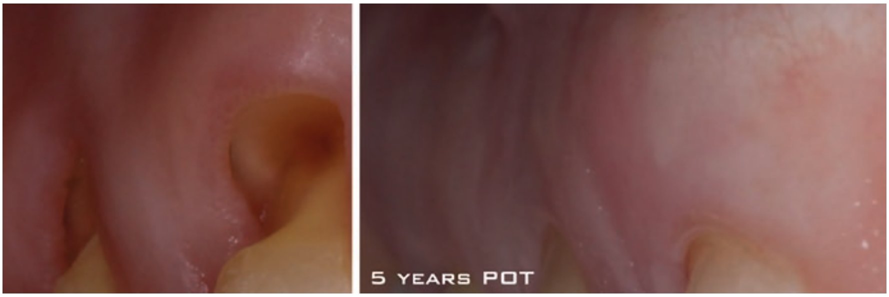


Fig. 130 12, 24, 36, 60 months follow-up

13 Treatment of Peri-implant Soft Tissues Dehiscences/Deficiencies in the Esthetic Zone

The final goal of an implant-supported restoration in the esthetic zone is to achieve long-term esthetic and functional performance. From the surgical point-of-view, achieving a harmonious gingival margin without sudden changes in tissue height while keeping the papilla undamaged and preserving the convexity of the outline of the alveolar crest is a desirable result. This depends on the following four anatomical and surgical parameters [48] (Fig. 131a–c):

1. The submucous position of the implant platform
2. The precise 3D position of the implant
3. The long-term stability of the peri-implant soft tissue outline
4. The volumetric symmetry of clinical crown between the implant zone and contralateral teeth.

Since Furhauser [49] proposed the Pink Esthetic Score in 2005 to evaluate the peri-implant soft tissue, the results and treatment of soft tissue in implant therapy are evaluated using seven clinical variables (Fig. 132).

The preparation and development of the zone implant prior to implant placement have been emphasized as one of the most effective methods of preventing possible defects and complications in soft tissues. Apical displacement of the peri-implant facial tissue can be defined as a recession of the peri-implant margin, mucous recession or dehiscence, deficiency, or dehiscence of the soft tissue or soft tissue defect. The term peri-implant soft tissue dehiscence/deficiency (PSTD) may be the most appropiate [50].

The management of the peri-implant tissue can be based on the management time point:

1. Immediate management during the placement of implants
2. Later management on rehabilitated implants

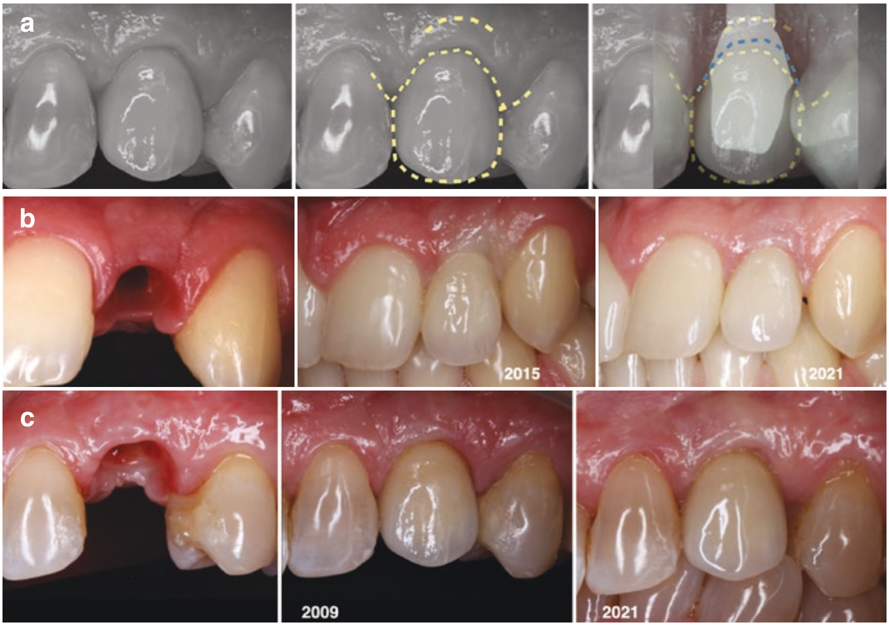
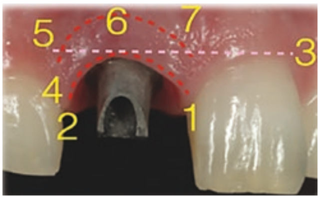


Fig. 131 (**a**) The final goal of an implant-supported restoration in the esthetic zone is to achieve long-term esthetic and functional performance. (**b**) Implant-supported restoration 6 years follow-up. (**c**) Implant-supported restoration 11 years follow-up

P.E.S.



Variables	0	1	2
Mesial Papilla	Missing	Incomplete	Complete
Distal Papilla	Missing	Incomplete	Complete
Soft Tissue Level	> a2 mm.	1 – 2 mm.	< a 1 mm.
Soft Tissue Counter	Unnatural	Virtually Natural	Natural
Alveolar Process deficiency	Clearly Resorbed	Slightly Resorbed	No difference
Soft Tissue Color	Clear Difference	Slightly Difference	No difference
Soft Tissue Texture	Clear Difference	Slightly Difference	No difference

Fig. 132 Pink esthetic score [49]

13.1 Immediate Management During the Placement of Implants

The management of peri-implant soft tissues during implant placement should be complemented with precise prosthetic management of the provisional restorations [51] to ensure the correct development of the emergent esthetic profile. It has been suggested that a connective tissue graft should be placed to enhance the phenotype and compensate the dimensional changes in the alveoli after extraction [52].

Clinical Case A 35-year-old male patient was referred from orthodontics, in his cone beam analysis horizontal bone loss is observed (Figs. 133, 134, 135, 136, 137, 138, 139, 140, and 141).

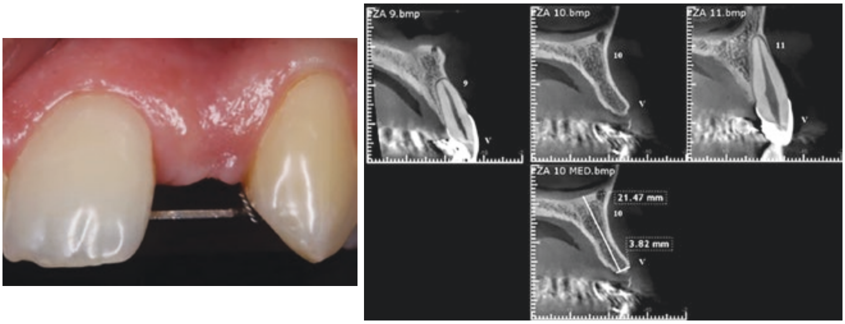


Fig. 133 A 35-year-old male patient was referred from orthodontics

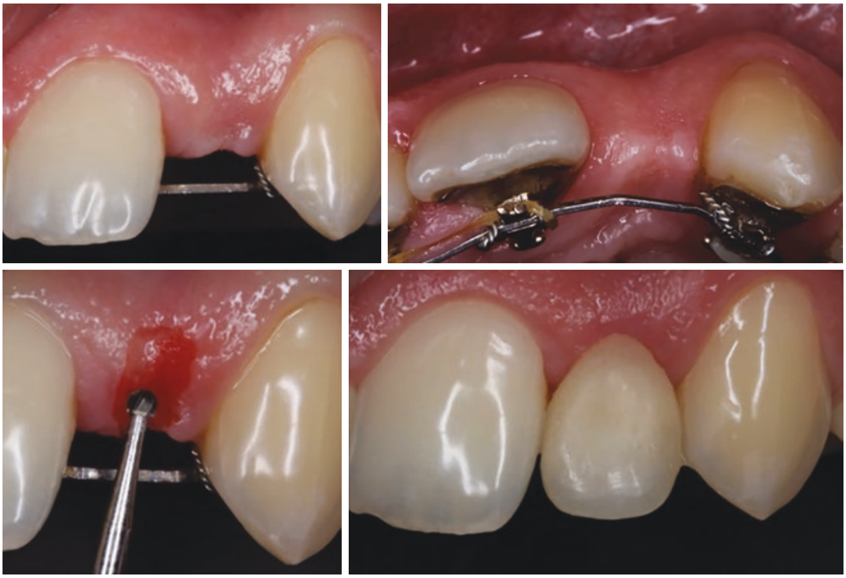


Fig. 134 Slight sculpting of gingival tissue was performed to prepare for adhesive provisional restoration

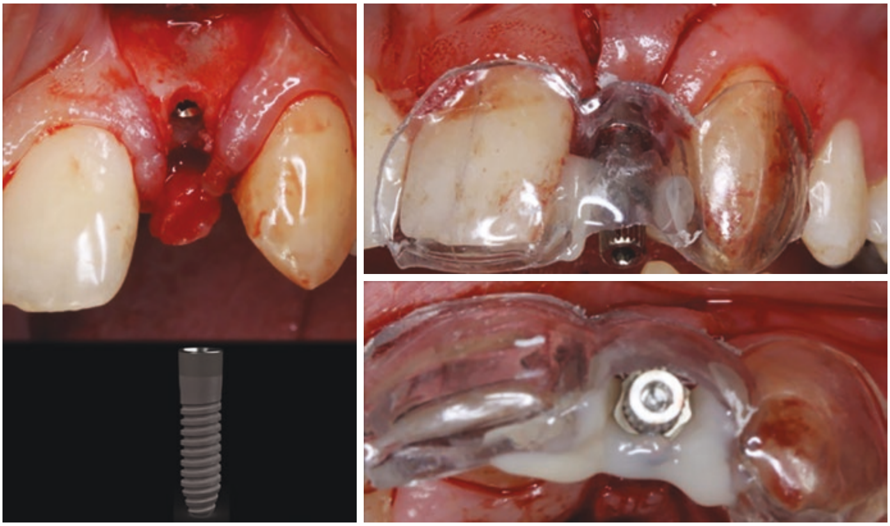


Fig. 135 A 3.0 diameter implant installation and indexing of implant position to perform provisional restoration

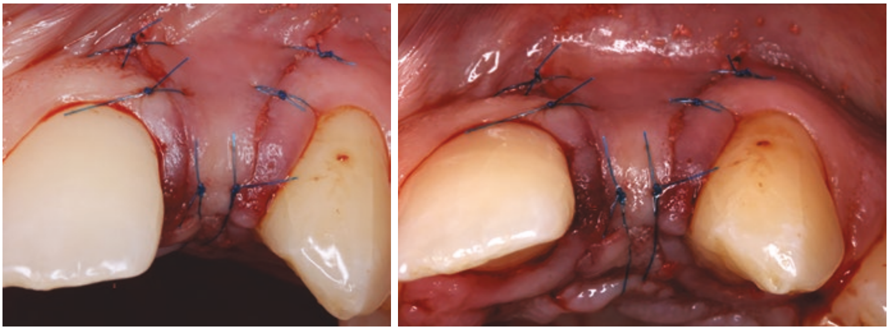


Fig. 136 Bone graft placement and primary wound closure with 7/0 polypropylene sutures

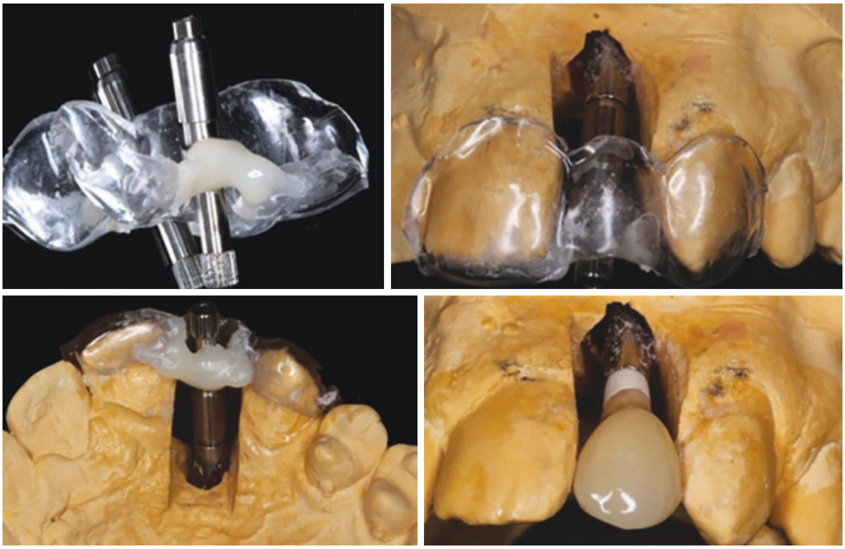


Fig. 137 Fabrication of the implant-supported fixed interim restoration (ISFIR) in the laboratory

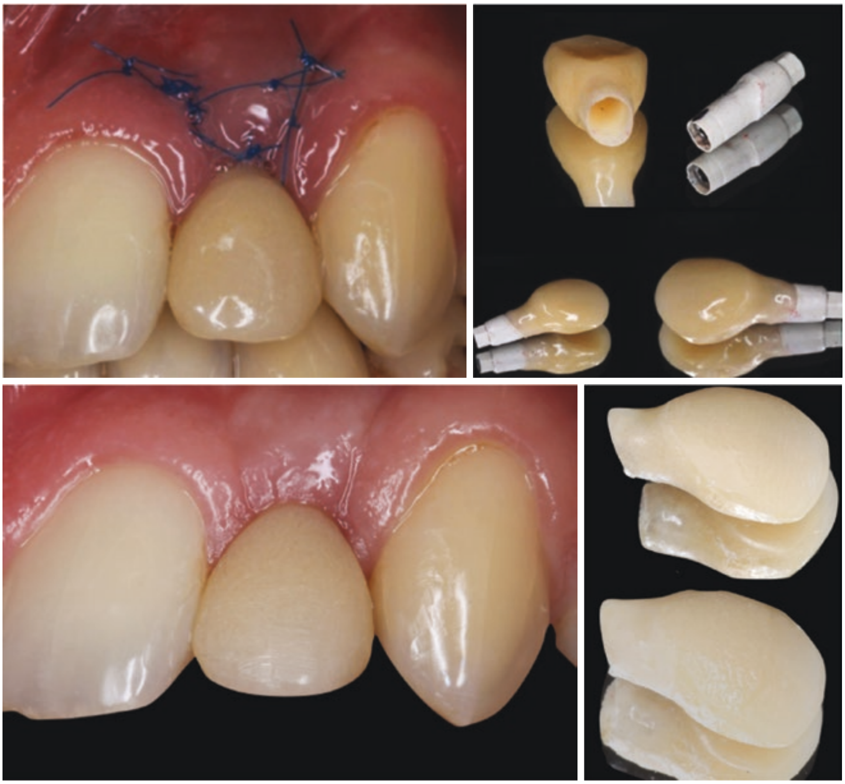


Fig. 138 Implant connection and provisional installation

Fig. 139 Critical and subcritical contour management in the ISFIR for apical zenith displacement

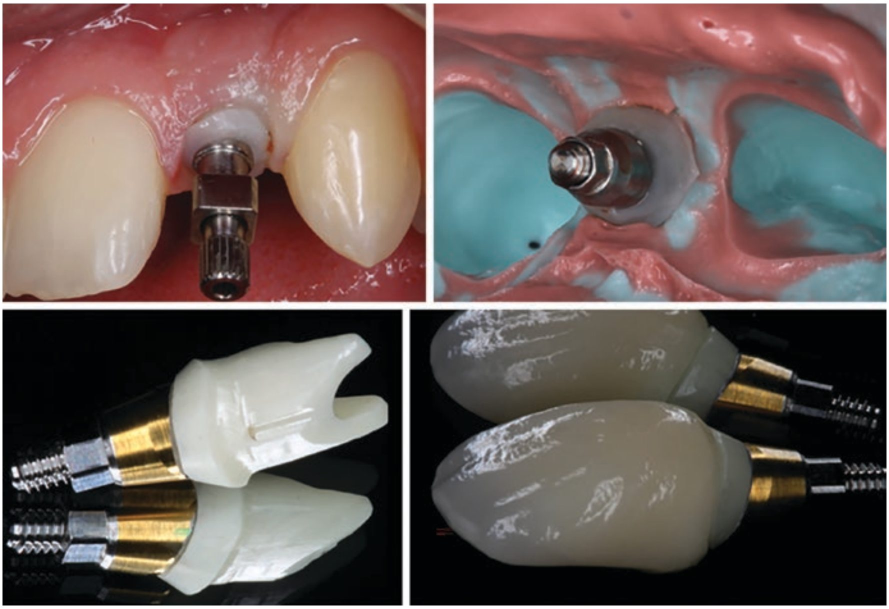


Fig. 140 Custom abutment for capturing and transferring the emergence profile, impression, CAD/CAM abutment and ceramic crown

Fig. 141 Installation of custom abutment and crown. Radiographic control

Clinical Case A 60-year-old female patient with a lost canine tooth in 1.3, total plate loss, and horizontal defect in soft and hard tissues (Figs. 142, 143, 144, 145, 146, and 147).

Clinical Case A 53-year-old male patient with poor periodontal prognosis in the central tooth 1.1, total plate loss, and horizontal defect in soft and hard tissues (Figs. 148, 149, 150, 151, 152, 153, and 154).

Fig. 142 A 60-year-old female patient with a lost canine tooth in 1.3, total plate loss, and horizontal defect in soft and hard tissues

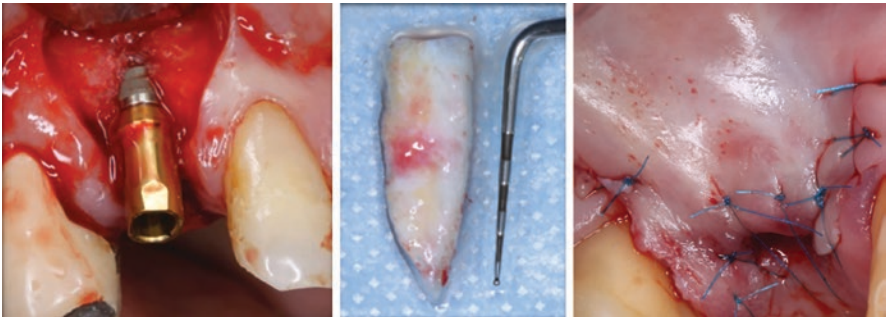


Fig. 143 Implant installation with connective tissue graft (7/0 polypropylene sutures)

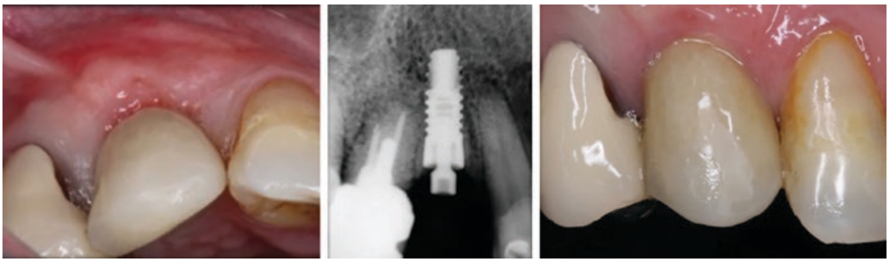


Fig. 144 Evaluation at 8 weeks after ISFIR

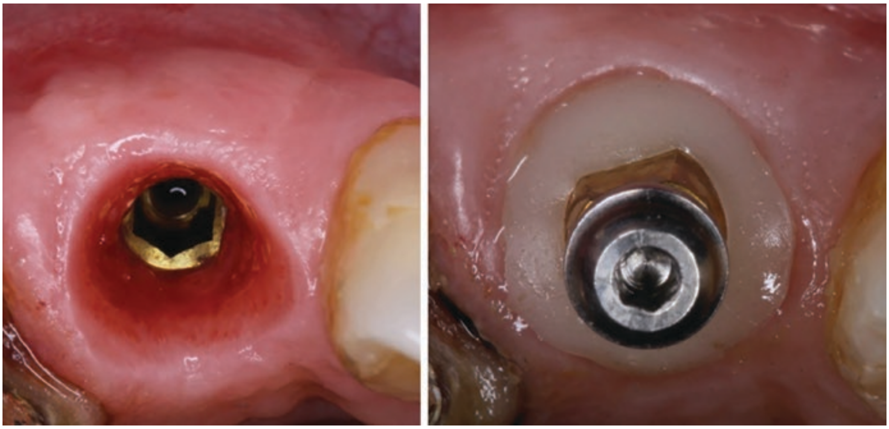


Fig. 145 Evaluation at 6 months

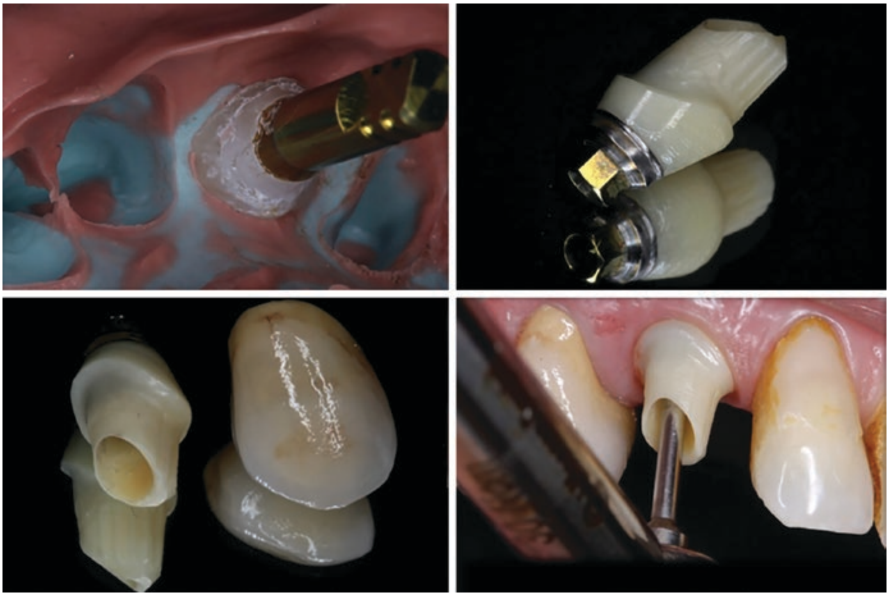


Fig. 146 Custom abutment to copy emergence profile, impression, CAD/CAM abutment, and ceramic crown

13.2 Later Management on Rehabilitated Implants

The incidence and prevalence of PSTD are high, which can be attributed to the following factors: the amount of post-implant keratinized gingiva, protocol for implant installation (immediate or mediate), phenotype, surgical experience of the microsurgeon, and 3D position of the implant [53]. The decision-making process for the

Fig. 147 Lateral and frontal intraoral view at 24 months after treatment

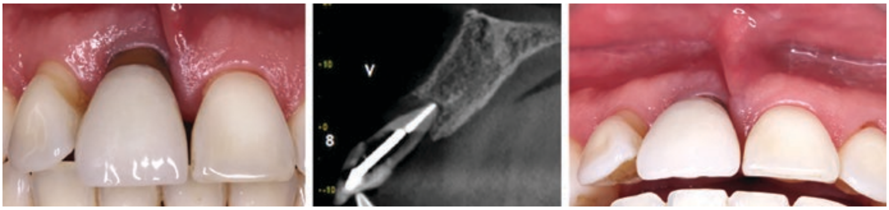


Fig. 148 A 53-year-old male patient with poor periodontal prognosis in the central tooth 1.1, total plate loss, and horizontal defect in soft and hard tissues

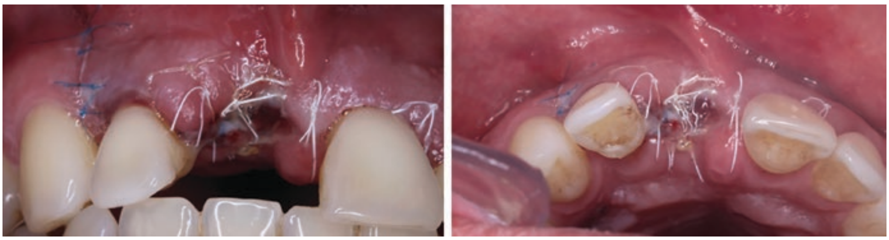


Fig. 149 Implant installation with connective tissue graft and bone graft substitutes (7/0 polypropylene sutures and 6/0 polytetrafluorethylene sutures)

Fig. 150 Evaluation at 6 months

Fig. 151 Implant connection and implant-supported fixed interim restoration

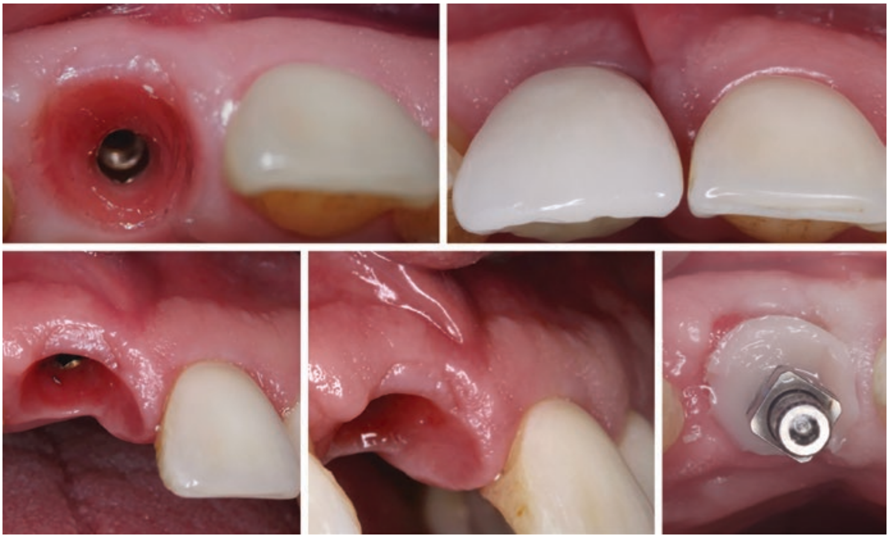


Fig. 152 Custom abutment transfer to copy emergence profile

Fig. 153 Lateral and frontal intraoral view at 12 months after treatment

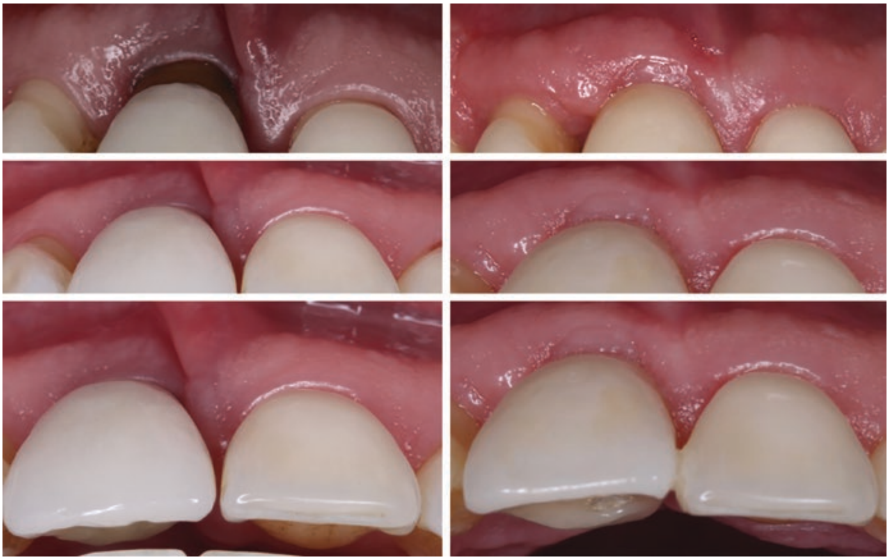


Fig. 154 Before and after peri-implant contour

treatment of PSTD is complex and requires a thorough study of the current condition and the possible causes of PSTD. Zucchelli et al. [54] (Table 7) proposed a new classification system and recommendations to support the decision-making process in the treatment of PSTDs.

Table 7 Peri-implant soft tissue dehiscence/deficiency

Class	PSDT	Recommended surgical/ prosthetic treatment
I	Soft Tissue Margin is located same level of the gingival margin homologous tooth	CAf or TUNNEL+ CTG Combined prosthetic-surgical approach
II	Soft Tissue Margin is located apical level of the gingival margin homologous tooth, implant-supported crown profile is located palatal to the profile of adjacent teeth	No crown removal, CAf + TUNNEL + CTG Combined prosthetic-surgical
III	Soft Tissue Margin is located apical level of the gingival margin homologous tooth, implant-supported crown profile is located facially to the profile of adjacent teeth. The head of the implant, evaluated after crown removal, is inside the straight imaginary line that connects the profile of the adjacent teeth at the level of the gingival margin	Crown removal, CAf + TUNNEL + CTG Combined prosthetic-surgical approach Soft tissue augmentation with
IV	Soft Tissue Margin is located apical level of the gingival margin homologous tooth, implant-supported crown profile is located facially to the profile of adjacent teeth. The head of the implant, evaluated after crown removal, is inside the straight imaginary line that connects the profile of the adjacent teeth at the level of the gingival margin	Combined prosthetic-surgical approach Soft tissue augmentation with submerged healing Implant Removal
Subclass		
A	The tip of both papilla is ≥3 mm coronal to the ideal position of soft tissue margin of the implant-supported crown	
B	The tip of at least one papilla is ≥1 mm but <3 mm coronal to the ideal position of the soft tissue margin of the implant supported crow	
C	The height of at least one papilla is <1 mm coronal to the ideal position of the soft tissue margin of the implant-supported crown	Does not apply for class I PSTD

13.3 Classification of Peri-implant Soft Tissues Defects

13.3.1 Multidisciplinary Approach

Clinical Case A 40-year-old female patient with class III, subclass B PSTD, vestibular deficiency, volume loss (Figs. 155, 156, 157, 158, 159, and 160).

Clinical Case A 47-year-old male patient with class I, subclass A PSTD, vestibular deficiency, and volume loss had active fistula at the middle 1/3 vestibular level.

Combined treatment: Removal of the crown CAF and CTG, implant-supported fixed interim restoration for creating a new emergent profile and new rehabilitation over the implant (Figs. 161, 162, 163, 164, 165, and 166).

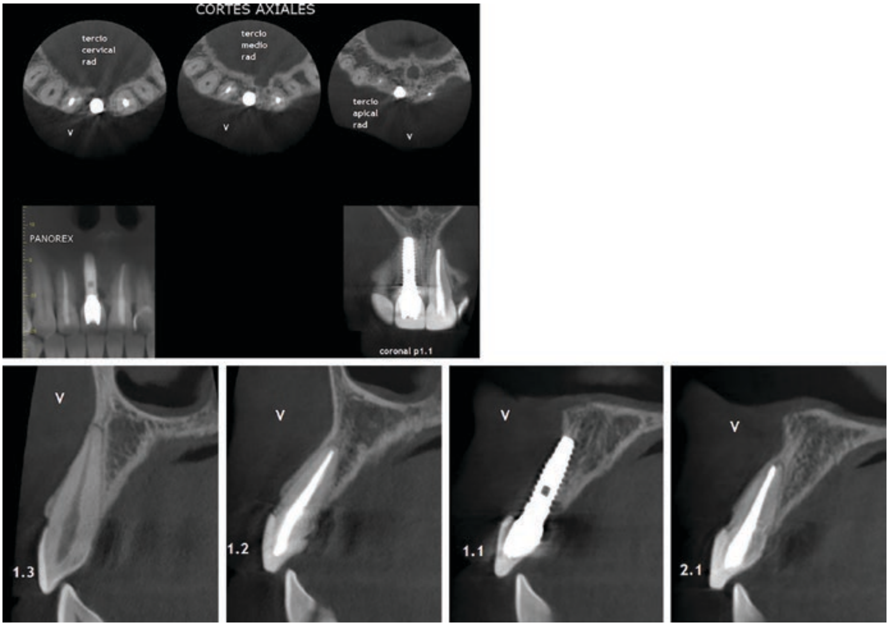


Fig. 155 A 40-year-old female patient with class III, subclass B PSTD

Fig. 156 Vestibular deficiency, volume loss, and loss of the distal papilla (1.5 mm). Profile of the crown over the implant within the imaginary line between the crowns of adjacent teeth

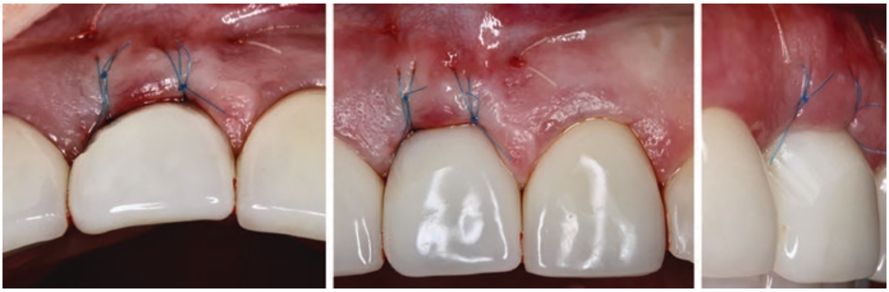


Fig. 157 Combined treatment: removal of the crown tunneling and CTG, implant-supported fixed interim restoration for creating a new emergent profile and new rehabilitation over implant and change in adjacent teeth crowns. Removal of crowns over the implant, critical and subcritical outlines were modified through over-contour elimination

Fig. 158 Evaluation of new implant-supported fixed interim restoration over implant to modify the height zenith and develop a new emergence profile after 4 weeks of treatment

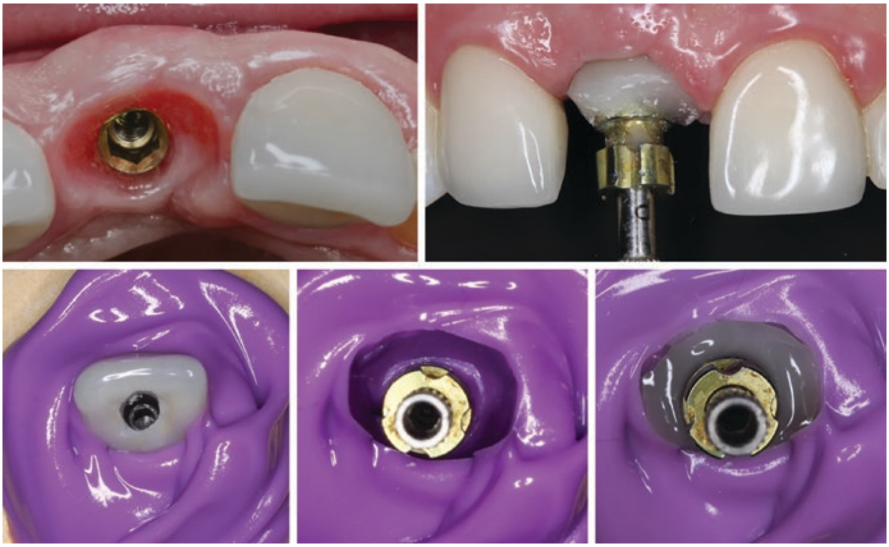
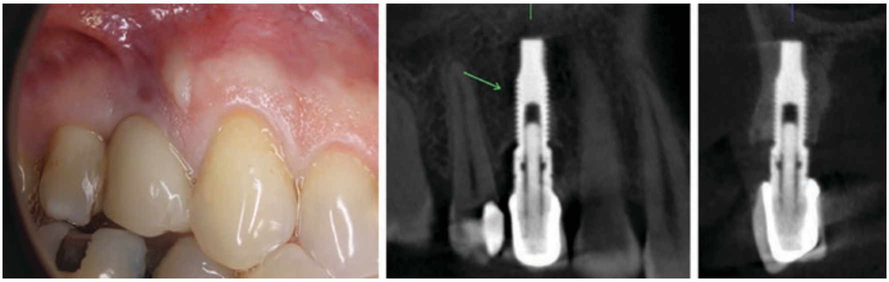


Fig. 159 Custom abutment transfer to copy emergence profile

Fig. 160 Definitive restorations resulting in marked increase in peri-implant vestibular volume



Figs. 161 A 47-year-old male patient with class I, subclass A PSTD, vestibular deficiency, and volume loss had active fistula at the middle 1/3 vestibular level

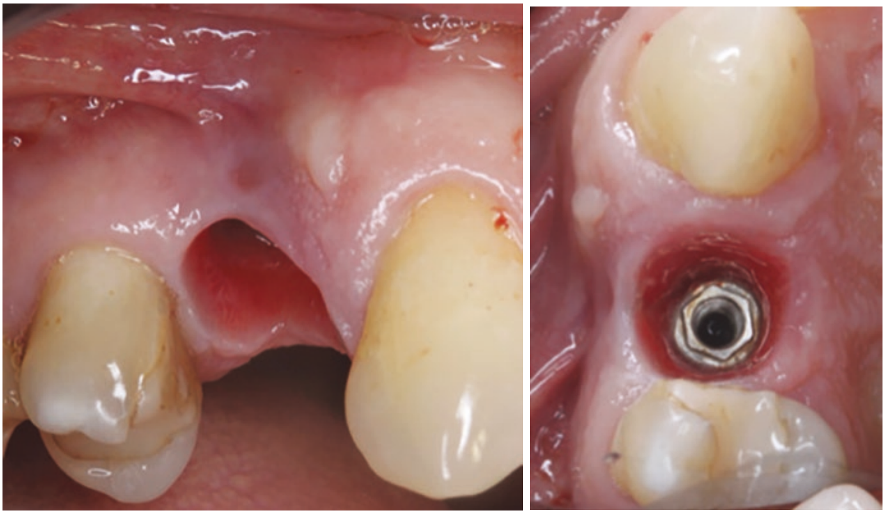


Fig. 162 Lateral and occlusal view

Fig. 163 Combined treatment: removal of the crown CAF and CTG, implant-supported fixed interim restoration for creating a new emergent profile and new rehabilitation over the implant

Fig. 164 Before and after surgery 6 months follow-up

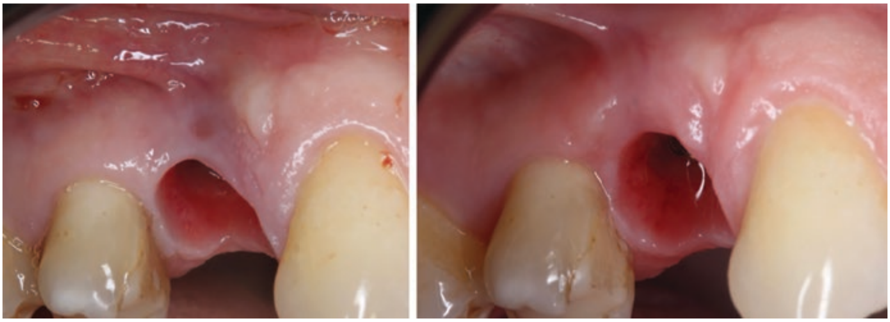


Fig. 165 Lateral view 6 months follow-up

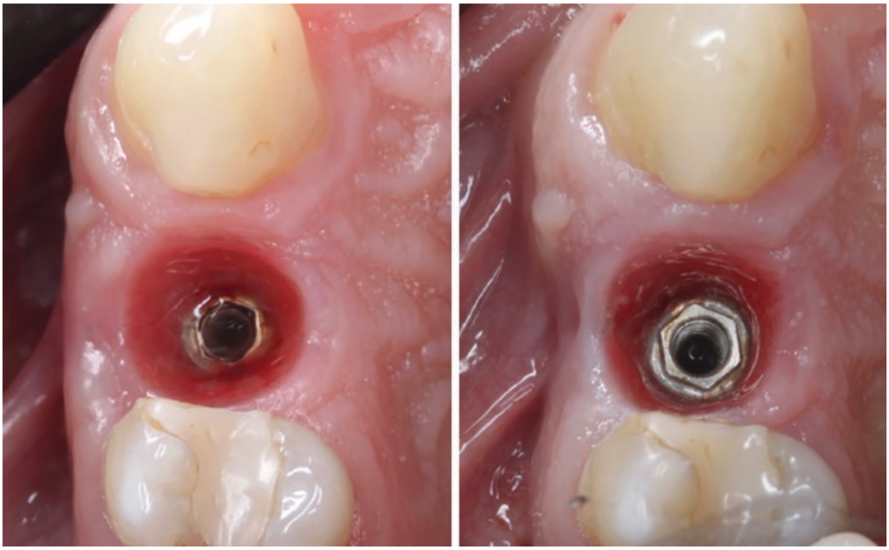


Fig. 166 Occlusal view 6 months follow-up

14 Conclusions

Microsurgical procedures usually require less extensive flap designs and offer enhanced vision fields that facilitate identification of defects and anatomical landmarks. The use of microsurgical principles and procedures provides clinically relevant advantages over conventional macrosurgical concepts and applications for plastic esthetic periodontal and peri-implant surgical therapy.

Current evidence supports the benefits of utilizing the operating microscope for periodontal and peri-implant plastic surgical treatment. Outcome superiority of root coverage surgical therapy with the use of magnification enhancing tools has been documented in the literature. This is validating clinical experience based reports that constitute the bulk of the evidence supporting this treatment approach. It is evident that the operating microscope is a superior magnification tool that has the potential to enhance esthetic outcomes in periodontal and peri-implant plastic therapy. Needless to say, the microsurgeon and the microsurgical team has to develop the necessary skills to take full advantage of what this technology has to offer.

15 Key Points

1. The use of micro-instruments and micro-sutures allows finer procedures that are difficult to achieve using macro-instruments and macro-sutures.
2. Visual acuity is enhanced by both magnification and illumination when performing periodontal surgical procedures with the aid of an OM. This translates into the controlled manipulation of soft and hard tissue structures that make up the periodontium.
3. A detailed exhaustive diagnosis and meticulous evaluation of the association of NCCls with gingival resection using a microscope is the key to decision-making in multidisciplinary treatment.
4. It is not easy to move out of the comfort zone, especially when significant changes to the daily practice need to be implemented. This is one of the main reasons for limited use of microscopes in the periodontal field. Great determination, effort, and dedication are required to incorporate microscopy into practice; however, after it is accomplished, there is no turning back. Moreover, it takes clinical performance to a new level.

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