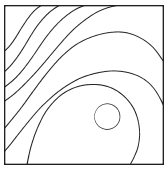
Modified Suture Technique for Stabilization of Connective Tissue Graft in Immediate Implant Placement and Provisionalization: A Short Technical Report



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Immediate implant placement and provisionalization with subepithelial connective tissue graft is considered the reference therapy for achieving a good esthetic outcome, especially in cases with a thin periodontal phenotype. Positioning sutures are usually required to maintain graft stability. This article describes the use of a modified suture technique involving vertical/horizontal double-parallel mattress sutures in immediate implant placement to achieve stable passive fixation of the graft in the appropriate position and to provide a more equal distribution of tension in the wound. A novel, simplified, reproducible technique is described in two cases of immediate implant placement and provisionalization with subepithelial connective tissue grafting and double-parallel mattress sutures.
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Dental implants have achieved high success rates for osseointegration.[1] However, achieving optimal esthetics around implants in the esthetic zone is still a challenge, and gingival recession has been observed in anterior single implants.[2] In 1998, Wöhrle reported success with immediate implant placement and provisionalization (IIPP) of single anterior maxillary implants,[3] and numerous studies have since demonstrated the viability of IIPP.[4,5] Recent evidence indicates that IIPP is a favorable clinical protocol based on a number of different considerations.[6,7] A careful presurgical diagnostic evaluation includes the alveolar bone morphology and the periodontal phenotype, followed by surgical planning to guide implant placement, manage the periimplant gap, and allow less-invasive soft tissue management and eventual soft tissue thickening.[8,9] Immediate loading with the provisional prosthetic restoration plays an important role in conditioning the soft tissues during healing and can reduce the treatment time.[10]

Recession and an unfavorable pink esthetics of the midbuccal mucosa are considered the major drawbacks of IIPP.[11,12] The esthetic success of IIPP is influenced by a number of factors.[13] Intrinsic factors are patient-dependent, including the hard and soft tissues and

the sagittal root position in the alveolar bone.[14,15] Changes in horizontal bone thickness from the IIPP procedure are within reasonable ranges, and the vertical facial bone height can be maintained by this technique. The labial gingival tissue shows a propensity to undergo recession after surgery, with thin gingival tissues around the implant. The absence of a labial bone plate and the presence of a thin periodontal biotype are considered to be risk factors for peri-implant tissue recession.[15] In addition, because tooth extraction results in bone loss, especially on the buccal side, postextraction immediate implant placement does not reduce bone resorption.[16,17] The ultimate esthetic goal in implant therapy is to recreate a natural appearance. Therefore, in terms of esthetics, a combination of surgical procedures should be performed to reduce any potential risk factors. Surgical interventions should include bone tissue augmentation and soft tissue thickening to achieve long-term stability. In patients with a thin periodontal phenotype, a thin soft tissue, and (usually) a thinner bundle bone (regardless of the use of bone grafts), connective tissue (CT) grafts alone can thicken the soft tissues and compensate for unavoidable tissue contraction following tooth extraction, leading to good esthetic results. A recent systematic review found that the combination of immediate implant loading and a CT graft (CTG) achieves better gingival margin stability and thickens the peri-implant soft tissues.[18]

A number of techniques, such as the tunnel or bilaminar technique combined with a subepithelial CTG, have been proposed[19,20] to create thicker soft tissues and a harmonious gingival margin.[20,21] A good blood supply to the CTG is a key element of success. The use of a tunnel without surgical papilla dissection or vertical releasing incisions contributes to a comparatively low impairment of the local blood supply and a minimal risk of postoperative scar tissue formation.[22] Positioning sutures are usually required to draw the CTG into the tunnel and achieve graft stability throughout the procedure.

This article presents a modified suturing technique in the IIPP procedure to enhance stability and accuracy of CTG localization in the tunnel and to promote tension distribution and wound healing.

Double-Parallel Mattress Suture

IIPP + CTG is a feasible method in daily practice for dealing with the impending loss of a single tooth in the esthetic zone in a patient with a healthy thin periodontal phenotype. In the IIPP + CTG procedure, a modified microsurgical tunnel technique is used, as described by Zuhr et al.[22] Briefly, preparation of the recipient site begins with the use of a microsurgical blade (Zepf Medical Instruments) to create an intrasulcular incision, and tunneling blades (Zepf Medical Instruments) to prepare the buccal split-thickness flap, leaving the interdental papillae intact. Partial-thickness flaps have a good blood supply, which can enhance CTG integration into the surrounding soft tissues. Moreover, partial-thickness flaps can prevent bone resorption due to buccal bone exposure.[23] The procedure should be performed carefully to minimize the risk of perforation. In areas with a prominent bony ledge, particularly in cases with very thin gingival tissue, part of the full-thickness tunnel is prepared with a semi-sharp elevator, such as a papilla elevator. Generally, a partial-thickness tunnel is created in patients with a thick biotype, and a full-thickness tunnel is created in patients with a thin biotype. The tunnel should extend apically beyond the mucogingival junction to ensure adequate space to accommodate the CTG.

The subepithelial CT is harvested from the lateral palate with free gingival tissue that is de-epithelialized extraorally.[24] CT harvested by this technique is mainly composed of lamina propria, with less glandular and adipose tissue than in CT harvested from deep palatal tissue.[25,26] The length of the CT was determined by the horizontal distance between two adjacent papillae, and the height was 6 mm. A subepithelial CT was prepared (1.0 to 1.5 mm thick).

A double-parallel mattress suture (DPMS) was used to draw the graft into the tunnel. The CTG was localized to the buccal flap by DPMS according to the following steps (Figs 1a to 1f):

First, the needle was inserted into the mesioapical **[Au: Correct?]** section of the tunnel (point 1), then engaged the mesial edge of the graft tissue—from the superficial layer to the supraperiosteal layer

(point 1′), and then at a more coronal position (point 2′), from the supraperiosteal layer to the superficial layer—after which, the needle passes through the flap at the coronal section of the tunnel (point 2). Therefore, the pathway of the needle is: 1-1′-2′-2. In this way, the mesial part of the graft is fixed in the mesial section of the tunnel with one vertical mattress suture (Fig 1b).

Second, a procedure that similar to the one described above is repeated, with the needle reinserted from the distocoronal **[Au: Correct?]** section of the tunnel (point 3), after which it engages the distal edge of the graft tissue—from the superficial layer to the supraperiosteal layer (point 3′), and then at the apical position (point 4′), from the supraperiosteal layer to the superficial layer—after which, the needle is returned to the tunnel at the apical section (point 4). Therefore, the pathway of the needle is: 3-3′-4′-4. In this way, the distal part of the graft is fixed in the distal section of the tunnel by another parallel vertical mattress suture (Fig 1c).

Third, controlled insertion and positioning of the CT in the tunnel is achieved by gently tugging on the suture. In this process, the flap is carefully raised with a papilla elevator (Zepf Medical Instruments), and the CT is gently pushed into the tunnel with a second instrument, such as a periodontal probe (Figs 1d and 1e).

Lastly, a surgeon's knot was tied at the buccal side of the tunnel by applying gentle pressure (Fig 1f). By DPMS, the graft fixed in the appropriate position in a stable manner.

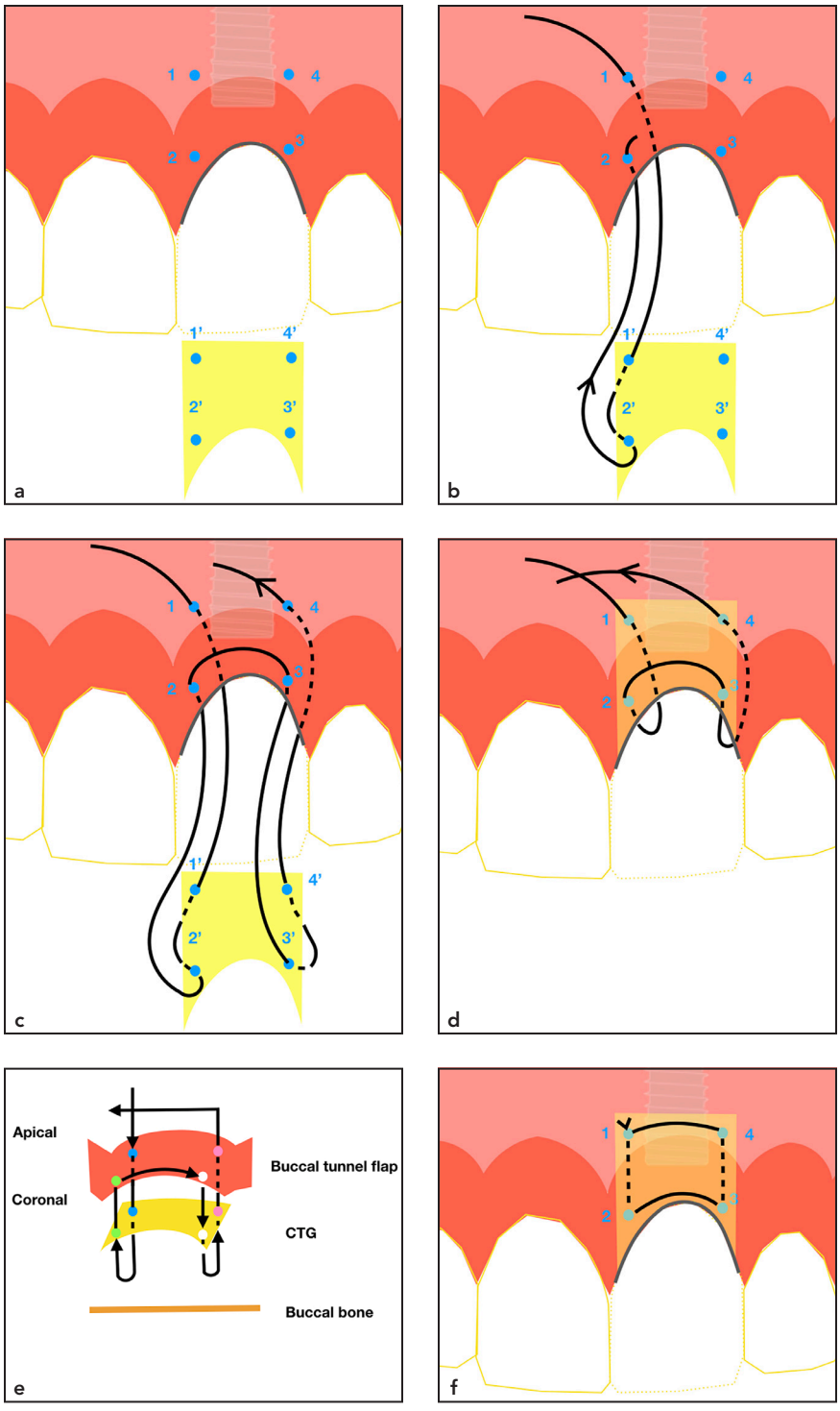

Fig 1 *Fixation of the CTG using DPMS. The points used here are described in the text.* (a) *The CTG is localized in the tunnel by DPMS.* (b) *First suture: The pathway of the needle was 1-1′-2′-2. In this way, the mesial part of the graft was fixed in the mesial section of the tunnel with one vertical mattress suture.* (c) *Second suture: The pathway of the needle was 3-3′-4′-4. In this way, the distal part of the graft was fixed in the distal section of the tunnel with another parallel vertical mattress suture.* (d) *The CTG was drawn into the tunnel by the suture.* (e) *Occlusal view: the CTG was drawn into the tunnel by the suture.* (f) *The suture was gently tied at the buccal side.*

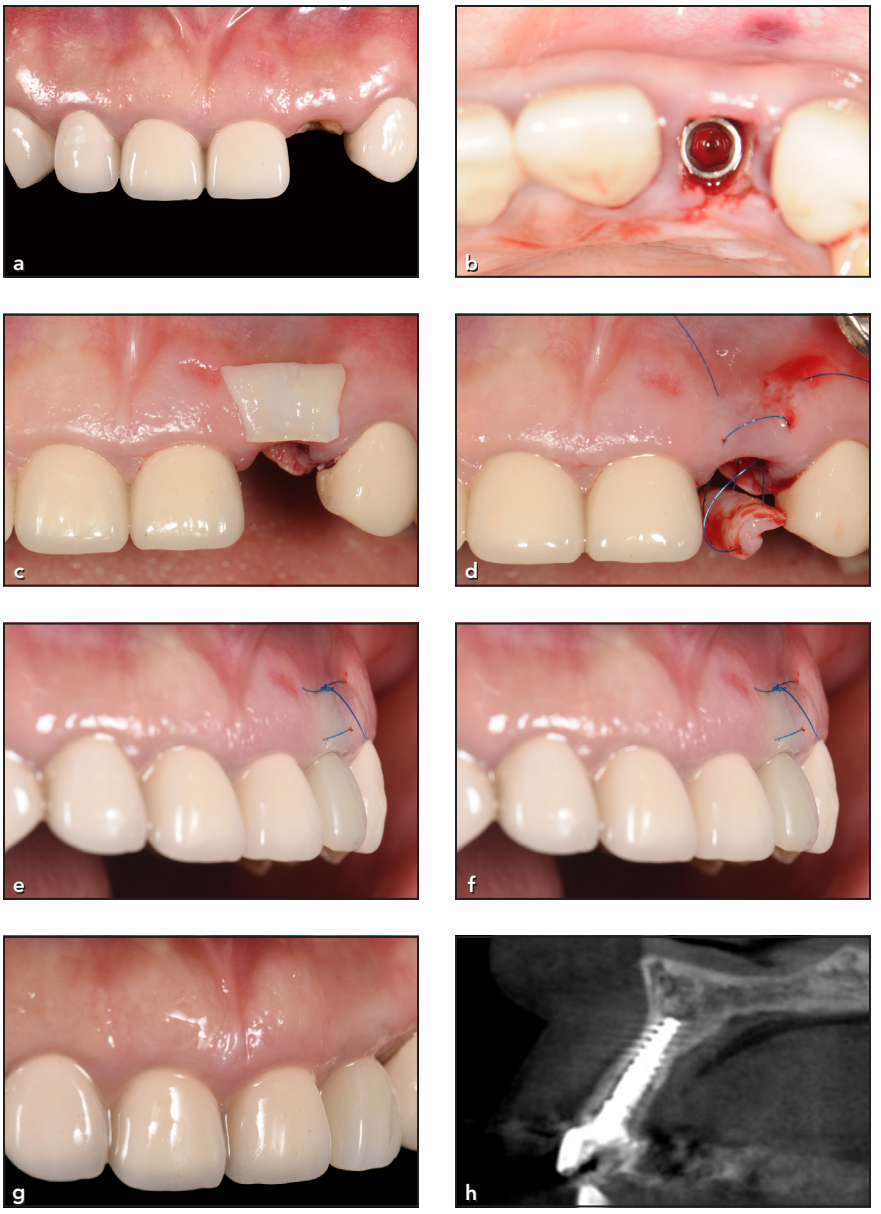

Fig 2 *After* (a) *gentle extraction and* (b) *adequate implant placement,* (c and d) *a tunnel was created and the graft was fixed in the appropriate position in a stable manner via DPMS. A bone graft was used to fill the gap.* (e) *A provisional restoration with a subgingival concave contour without occlusal contacts was placed.* (f) *Clinical view 6 months after placement of the final restoration (f).* (g) *Radiographic view after final restoration placement.*

Vertical vs Horizontal DPMS

A vertical DPMS was used in case 1 (Fig 2); the details of this procedure are as described above. In case 2, a horizontal DPMS was used (Fig 3). The horizontal DPMS differs from the vertical DPMS by the needle pathway, as follows:

First, the needle is inserted in the distoapical **[Au: Correct?]** section of the tunnel, and then engages the distal edge of the graft tissue—from the superficial layer to the supraperiosteal layer, and then at the mesial edge, from the supraperiosteal layer to the superficial layer—after which, the needle is passed through the flap at the mesioapical **[Au: Correct?]** section of the tunnel. In this way, the apical part of graft is fixed in the apical section of the tunnel by one horizontal mattress suture. A similar procedure is then repeated as described as above, with the needle reinserted from the mesiocoronal **[Au: Correct?]** section of the tunnel, and then engaging the coronal edge of the graft tissue—from the superficial layer to the supraperiosteal layer, and then at the distal edge, from the supraperiosteal layer to the superficial layer—after which, the needle is returned to the tunnel at the distocoronal **[Au: Correct?]** section. In this way, the coronal part of the graft is fixed in the coronal section of the tunnel by another parallel horizontal mattress suture. This horizontal DPMS fixed the graft in the appropriate position in a stable manner. **[Au: Should there be specific points mentioned here? (ie, 5, 5′, 6, 6′, etc)?]**

Discussion

The ultimate goal of implant therapy is to recreate a natural esthetic appearance. Nevertheless, complications are commonly associated with soft tissue recession.[27] A thin periodontal phenotype and (usually) thinner bundle bone are considered to be common risk factors for peri-implant soft tissue recession.[18]

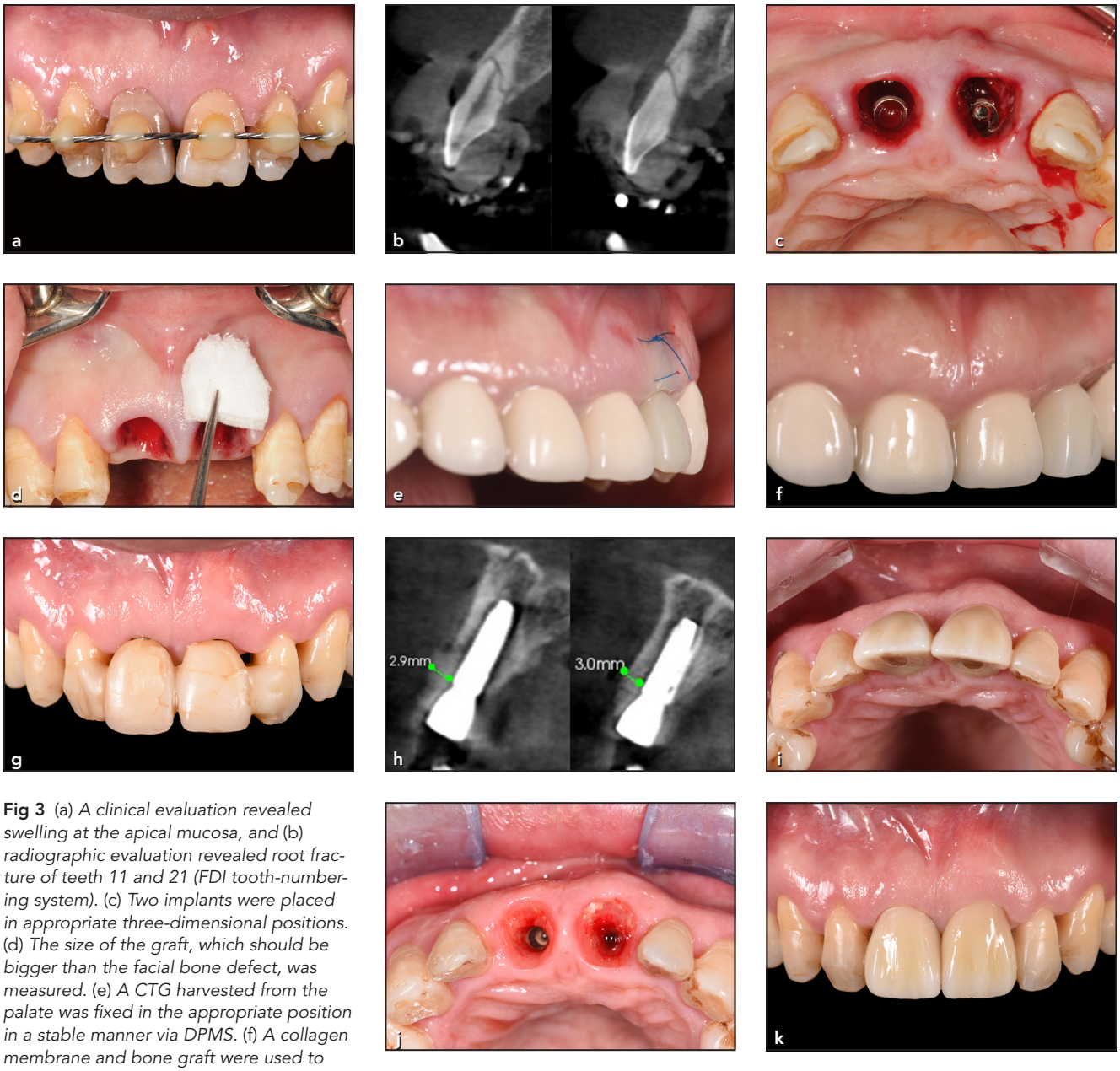

Fig 3 (a) *A clinical evaluation revealed swelling at the apical mucosa, and* (b) *radiographic evaluation revealed root fracture of teeth 11 and 21 (FDI tooth-numbering system).* (c) *Two implants were placed in appropriate three-dimensional positions.* (d) *The size of the graft, which should be bigger than the facial bone defect, was measured.* (e) *A CTG harvested from the palate was fixed in the appropriate position in a stable manner via DPMS.* (f) *A collagen membrane and bone graft were used to regenerate the buccal wall.* (g) *Provisional fixed partial dentures were used to support the soft tissue.* (h) *CBCT scans showed appropriate implant positioning.* (i) *Provisional crowns were placed 3 months later* **[Au: 3 months after the provisional restoration, or 3 months after surgery?]**. (j) *The buccal contour at site 21 was better than the initial situation.* (k) *Clinical view after treatment completion.*

Regardless of the use of bone grafts, CTG alone thickens soft tissues and allows better long-term gingival margin stability.[18] For CTG, different techniques (ie, tunnel and bilaminar) have been proposed.[19,20] The tunnel technique is a minimally invasive, esthetically superior, and reproducible method that preserves the intermediate papillae, enhances blood supply and graft nutrition, promotes initial wound healing, and results in less scar formation.[28] In addition, the flap thickness has a major impact on the outcome. The flap thickness should be ≥ 0.8 mm, whereas the flap type (full or partial-thickness) does not affect the outcome.[29,30] For patients with a very thin gingival tissue, preparation of a full-thickness

tunnel can minimize the risk of flap perforation and have beneficial effects on healing.[31]

In addition, sutures are usually required to guide the CT into the tunnel and ensure graft stability throughout the procedure. Positioning sutures are the most commonly used.[28] Briefly, in the distal region, the needle enters the tunnel, stitches the graft together, and exits the tunnel by a parallel route. The mesial suture is placed at the opposite side, as described above. The graft can be drawn into the tunnel by the suture and stabilized by knotting. However, this suture technique has a number of drawbacks, including the following: *(1)* two stitches are required; *(2)* it is time-consuming; *(3)* neither of the sutures can be knotted until the graft achieves the desired position, and sometimes the sutures can slide out; *(4)* unequal tension distribution of the two sutures will jeopardize the blood supply and compromise early wound healing; and *(5)* a graft stabilized by two sutures has a higher propensity to undergo graft dislocation, such as overlapping, twisting, and folding, thus interrupting nourishment and vascularization of the CTG and compromising wound healing during the first phase of healing.

The DPMS is a simplified, novel, reproducible technique for the treatment of a single hopeless anterior tooth treated with IIPP + CTG. This modified suture technique is designed to achieve stable, passive graft fixation in the appropriate position and to provide a more equal distribution of tension in the wound. Accurate graft placement without overlapping, twisting, or folding is crucial for nourishment and survival of the elevated buccal soft tissue flap and the CTG.[32] This modified suture technique results in enhanced healing and revascularization of the CTG, as the initial adhesion of the blood clot is of critical importance for the healing process. A thin clot promotes tensile strength and stability of the wound.[33] Capillary proliferation and ingrowth may also be accelerated. The disrupted vascular vessels can be restored earlier and can anastomose freely with the surrounding vessels to reestablish the vascular network.[34]

The design of the DPMS provides additional advantages regarding tension distribution; as the suture passes through the flap four times, the tension of the suture will not be concentrated on one area, resulting in a more equal distribution. Appropriate compression on the underlying CTG will further contribute to improved initial healing. In addition, the sutures can be removed easily, as both parts of the sutures are positioned externally, similar to cases with a single interrupted suture.

Moreover, tension-free wound closure has also been reported to be beneficial for wound healing and achieving reproducible treatment outcomes.[35] It is crucial that the sutures do not exert tension on the wound margins, which could result in constriction and collapse of blood vessels, impaired flap perfusion, and an increased risk of impaired healing and flap necrosis.[36,37] Size 6-0 and 7-0 microsurgical suture materials are recommend for use in the esthetic zone. Nevertheless, there is a risk of tearing if the sutures are tied using excessive force.[38] In clinical practice, this has been shown to be a useful restrictive adjustment to prevent the surgeon from exerting excessive tension on the flap edges during suturing.

The clinical outcomes of case 1 (vertical DPMS) and case 2 (horizontal DPMS) were similar. This two-case series demonstrated the reproducible esthetic efficacy of IIPP + CTG using DPMS. The major drawback of this technique is that turning the graft over during suturing may cause confusion for the surgeon, so it is important to hold the distal and mesial edges of the graft with two separate forceps.

Conclusions

A novel modified suture technique (DPMS) for use in the IIPP procedure was described. Preliminary results indicate that DPMS can achieve stable, passive graft fixation in the appropriate position and can provide a more equal distribution of graft tension, which may facilitate healing of the wound and the graft itself. However, additional randomized controlled clinical studies are required to evaluate the efficacy of the modified suture technique.

Acknowledgments

The authors declare no conflicts of interest.

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