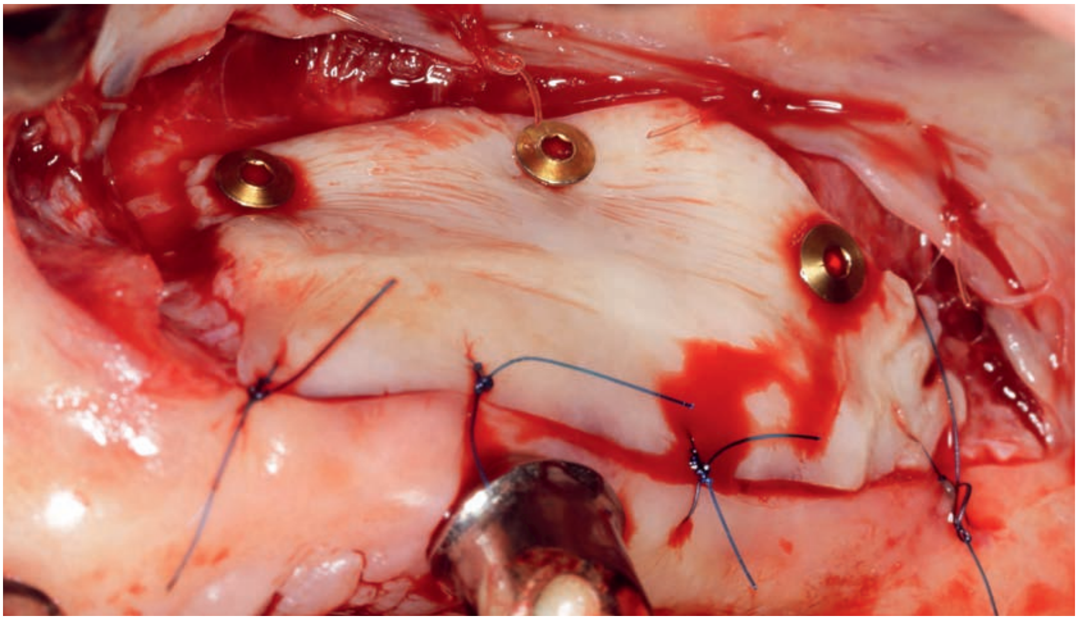

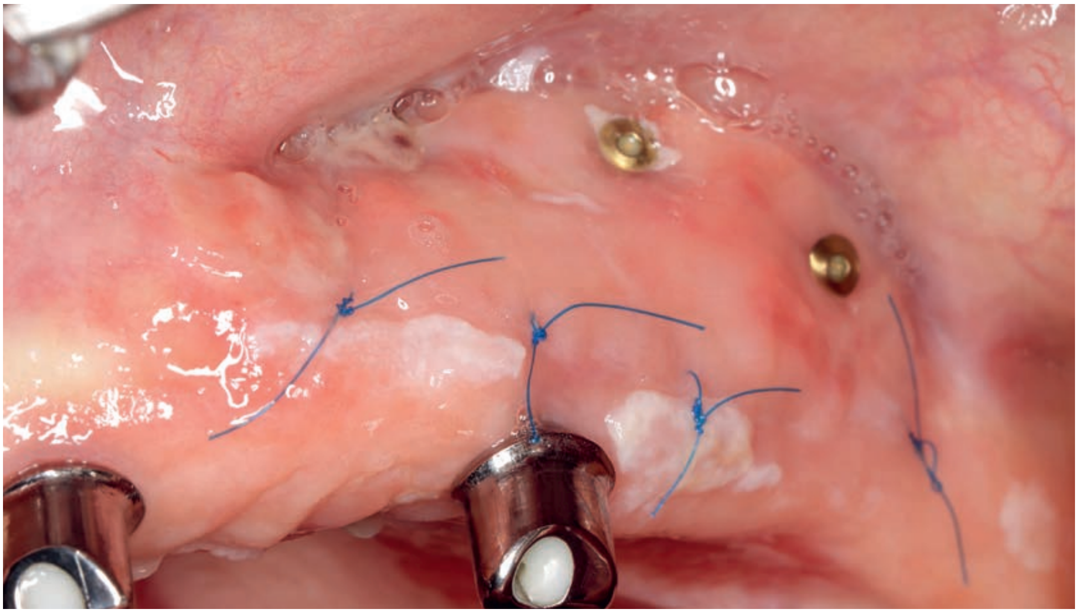

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The Use of Titanium Pins for the Management and Fixation of Free Gingival Grafts and Apically Repositioned Flaps During Vestibuloplasty: A Technique Report

The presence of adequate keratinized mucosa (KM) around dental implants and natural dentition is pivotal for the long-term success of dental restorations. Despite various techniques to augment KM, challenges persist in achieving stable, keratinized, and adherent mucosa, especially in the context of significant muscle pull or compromised tissue conditions. This study introduces a novel application of titanium pins for the fixation of free gingival grafts (FGGs) and apically repositioned flaps (APFs) during vestibuloplasty, aiming to overcome important limitations associated with traditional suturing methods, shorten the treatment time, and reduce patient morbidity. Three patients with insufficient KM width presented discomfort during oral hygiene care and showed inflammation around implant restorations and natural teeth. These patients underwent soft tissue augmentation using titanium pins—traditionally used in guided bone regeneration—to stabilize the FGGs and APFs. This method ensures intimate contact between the graft and the periosteum, which facilitates proper graft perfusion and revascularization, minimizes shrinkage, and reduces the risk of graft necrosis. A postoperative follow-up revealed successful graft integration, with minimal shrinkage and increased KM width and depth. The use of titanium pins allowed for reliable fixation in challenging surgical sites where traditional suturing methods were impractical due to the presence of extensive muscle pull and an unstable recipient bed. The application of titanium pins for the fixation of FGGs and APFs during vestibuloplasty provides a promising alternative to traditional suturing techniques, particularly in complex cases where the recipient bed is suboptimal for suturing. This method simplifies and shortens the procedure, offering a predictable outcome with increased mechanical stability and minimal graft shrinkage. Randomized clinical trials are recommended to further evaluate the efficacy of this technique. *Int J Periodontics Restorative Dent 2025;45:395–405. doi: 10.11607/prd.7197*

Keywords: *apically repositioned flap, dental implants, free gingival graft, graft survival, periodontal surgery, titanium pins, vestibuloplasty*

In the evolving landscape of dentistry, the importance of keratinized mucosa (KM) around both teeth and dental implants is getting more attention.[1] Although a number of authors previously concluded that keratinized tissue around implants may not be essential for maintaining peri-implant health,[2,3] more recent research suggests a significant correlation between the presence of KM and long-term successful implant maintenance.[4] It has been suggested that peri-implant soft tissue thickness and quality can affect marginal bone loss, highlighting the critical nature of keratinized gingiva for the health of both natural teeth and implants.[5,6]

The role of KM in implant health is multidimensional, including ease of cleaning,[7] as it has been shown that a deficiency or minimal presence of KM around implants impedes patient oral hygiene, leading to more soft tissue inflammation, mucosal recession, and attachment loss.[8] The absence of KM is linked to peri-implant complications,[9] and its factors (such as the physical constraints, including muscle pull) may contribute to persistent inflammation of the peri-implant soft tissues.[10] In situations where KM is missing, muscle contractions can pull the peri-implant tissue, resulting in a broken peri-implant seal, which has been associated with chronic irritation and patient discomfort.[11]

Higher incidence of peri-implantitis has been observed in implants with insufficient KM with reports of discomfort during maintenance and oral hygiene activities.[9,12] A minimum KM width of 2 mm has been shown to have a protective effect on peri-implant health. In fact, when this threshold is not reached, implants are more prone to develop biologic complications.[13] Implants that are not surrounded by KM are also more prone to plaque accumulation and recession, even in patients who exercise sufficient oral hygiene and receive periodic supporting periodontal therapy.[14]

Like with implants, sufficient keratinized tissue around natural teeth is essential for ensuring periodontal health and preventing inflammatory reactions. A lack of adequate keratinized tissue is associated with increased gingival recession and higher susceptibility to periodontal diseases over time.[15] It is therefore essential to ensure KM existence and proper dimensions around implants and natural teeth.[16]

In cases of deficient KM, it is essential to improve the baseline situation by performing soft tissue augmentation. A range of surgical interventions have been described to increase KM around implants and teeth, most using the method of deepening the vestibule. These include vestibuloplasties using autogenous grafts from the palate,[17] allografts,[18,19] and apically positioned flaps,[20] as well as procedures that do not involve grafting and only require flap management.[21]

The current consensus, which based on a comprehensive analysis of various methods used for soft tissue augmentation around implants, supports the combination of an apically repositioned flap (APF) with a free gingival graft (FGG) as the most effective technique for enhancing peri-implant soft tissues.[22,23] The original technique describing this procedure in natural dentition involves suturing both the APFs and FGG to the recipient bed in order to improve the KM.[24]

Despite being the method of choice to augment KM and fixed mucosa, there is an inherent complexity in performing APF and FGG. This challenging surgical procedure needs appropriate case selection and experience to avoid common complications such as relapse,[21] excessive graft shrinkage,[19,25] inadequate graft thickness due to inappropriate graft harvesting,[26,27] graft detachment due to hemorrhage,[24] lack of stabilization to the underlying tissue (leading to "movable grafts"),[28] and loss of the entire graft.[25,28] Indeed, improper preparation of the recipient site, inadequate graft size and thickness, and poor adaptation to the recipient bed with a lack of proper graft stabilization can all lead to failure of the procedure.[29] The anatomy of the posterior mandible has also historically been considered a limiting factor in any surgical procedure designed to establish or increase attached gingiva, and altering the position of muscles that attach to the mandible is particularly challenging if the height of the mandibular body is below average.[25] Such clinical situations with extensive muscle pull near the surgical site require the removal of all muscle fibers, leaving the clinician with little surface to suture the graft to, as the goal is to leave enough periosteum to suture the graft but thin enough to prevent mobility or muscle insertions. This described situation, commonly found in specific areas of the mouth (eg, posterior mandible), could make the graft fixation a challenging procedure and lead to partial or total failure of the procedure.[25] Another complication linked to this type of surgery is patient morbidity, which directly correlates to the length of the procedure.[30]

The following manuscript introduces a novel application of titanium pins, traditionally employed for guided bone regeneration (GBR), to manage soft tissues and FGG fixation during APF and vestibuloplasty procedures in cases with suboptimal anatomical circumstances. This technique has the potential to simplify the surgical procedure, reduce graft shrinkage, and significantly reduce treatment time, potentially reducing patient morbidity.

Clinical Presentation of Patients

This manuscript adheres to the CARE guidelines for case reports. All three patients presented to a private practice in Bielefeld, Germany, with an insufficient or inadequate amount of KM, discomfort whilst performing oral hygiene, inflammation, and plaque accumulation around implant restorations and natural dentition.

Patient 1

APF and FGG in the posterior mandible

The first patient presented with an old implant-supported restoration that was stable and in function but presented a with limited amount of KM around the implant and neighboring natural teeth (Fig 1a). The patient's main concern was the inflammation around their implants and teeth and their significant difficulties in maintaining oral hygiene. Thus, an APF combined with an FGG was planned to increase the KM. After local administration of anesthesia (articaine hydrochloride and epinephrine hydrochloride; Ubistesin Forte, 3M ESPE) via buccal and lingual infiltration, a split-thickness incision was made above the mucogingival border of the first and second molars using 15C and 12B blades (Henry Schein). The incision extended mesially to the distal aspect of the first premolar and distal towards the ramus, preserving the KM in the second molar area. After the incision was made, a split-thickness flap was carefully elevated. Because the vestibular depth allowed it, the flap was repositioned apically using resorbable horizontal mattress sutures running through the flap and the periosteum (Serafast 5-0, Serag Wiessner). To avoid any mobility from the compromised site, muscle insertions were thoroughly removed, leaving a thin and slightly mobile periosteal bed (Fig 1b).

FGG harvesting

An FGG was harvested from the palate with consideration to the dimensions of the recipient site. The primary incision was outlined through a 1-mm–deep cut, following the recommendations of Egli et al regarding the ideal thickness of the FGG.[27] Next, the blade was guided parallel to the external palatal surface, moving apically to elevate a split-thickness flap. Then the blade continued to move parallel to the external graft surface in order to harvest the graft, maintaining a standardized thickness.[31] The donor site was covered with a stent-like device, which functioned as a custom bandage plate. No further suturing or wound dressings were needed.

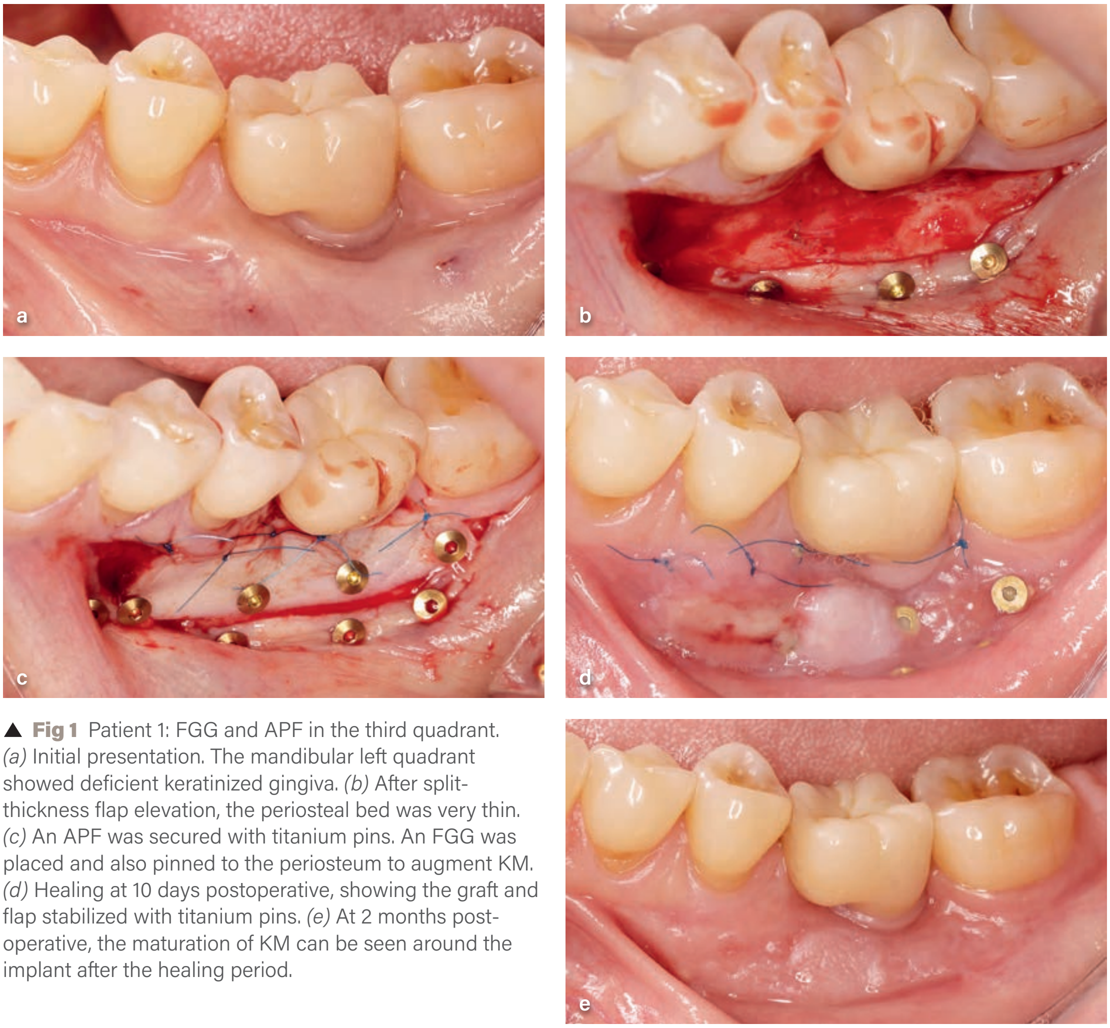
Gingival graft fixation

Because the periosteum on the recipient side was very thin and slightly mobile, and the surrounding tissues were frail, only nonresorbable sutures could reliably be used on the coronal aspect to position the graft (Seralene 6-0, Serag Wiessner). On the apical aspect of the FGG, titanium pins (Ti-System, Curasan) were used to fixate the graft to the recipient bed and ensure the graft had intimate contact with the periosteum (Fig 1c), confirming proper perfusion and consequent revascularization and significantly reducing treatment time.

The patient was dismissed, and postsurgical indications were given. A nonsteroidal anti-inflammatory drug (600 mg Puren, Puren Pharma) was prescribed.

Postoperative care

The patient attended a follow-up the next day and at 10 days postsurgery without presenting any complications. Pins were easily removed by pulling them with a Luniatschek device, typically used for packing gauze. It has a bifurcated design featuring two sharp, needle-like tips that make it adept at grasping and removing the pins. The 10-day follow-up period allowed for initial healing and graft integration (Fig 1d), typically characterized by the initial revascularization and graft integration into the surrounding



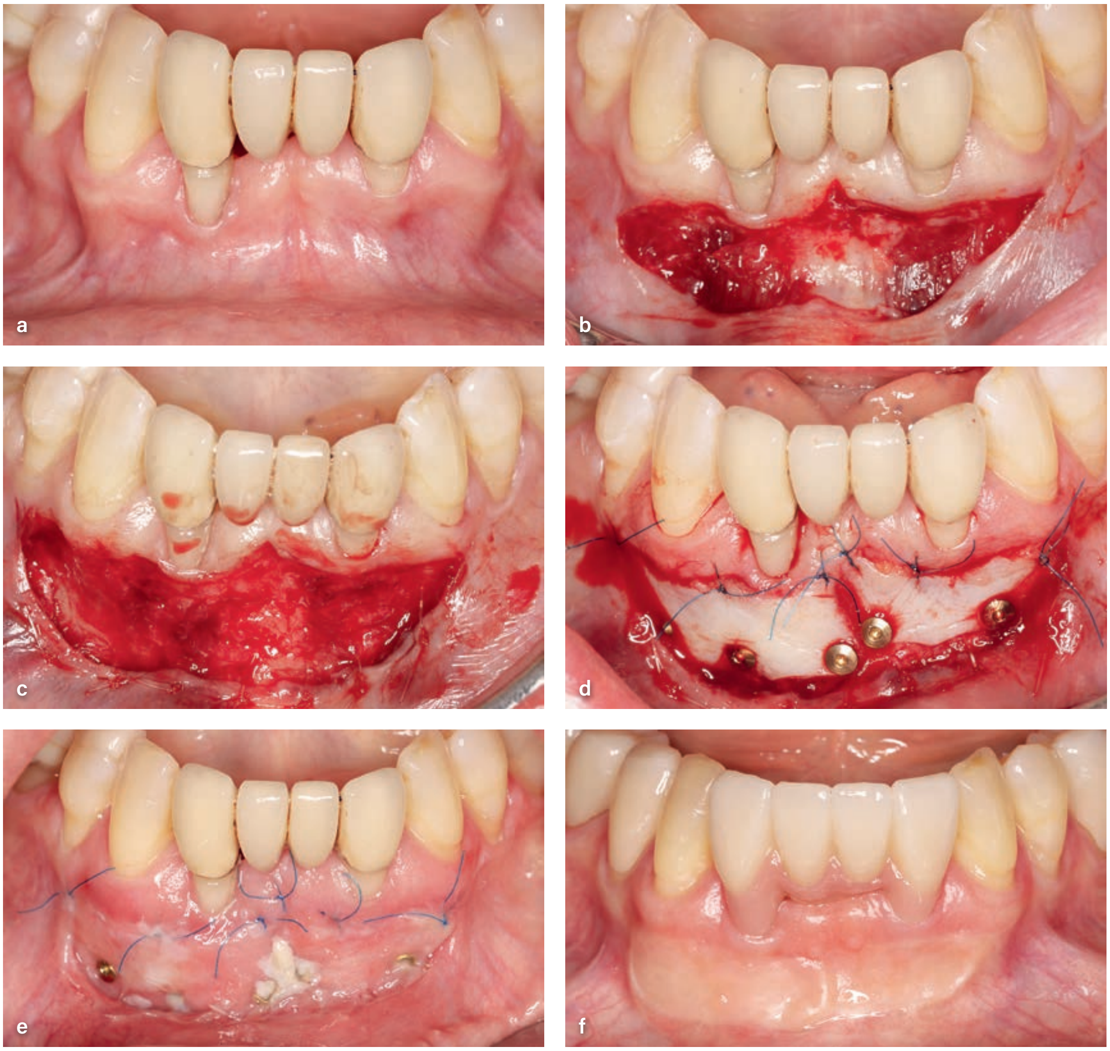
▲ **Fig 1** Patient 1: FGG and APF in the third quadrant. *(a)* Initial presentation. The mandibular left quadrant showed deficient keratinized gingiva. *(b)* After split-thickness flap elevation, the periosteal bed was very thin. *(c)* An APF was secured with titanium pins. An FGG was placed and also pinned to the periosteum to augment KM. *(d)* Healing at 10 days postoperative, showing the graft and flap stabilized with titanium pins. *(e)* At 2 months post-operative, the maturation of KM can be seen around the implant after the healing period.

tissue. The healing process was monitored after another 7 days and after 21 days, paying attention to any signs of graft necrosis or infection. During this period, the graft usually shows signs of increased stability and color adaptation as it matures. By 21 days, the graft generally appears more integrated, with less pronounced demarcation from the adjacent tissues. At 2 months postprocedure (Fig 1e), the healed outcome revealed a new band of keratinized and attached mucosa, presenting almost no shrinkage, a satisfactory width and length, a subtle color difference, and well-integrated tissue.

Patient 2

APF and FGG in the anterior mandible

A man presented with discomfort during oral hygiene, attributed to a shallow vestibule, severe muscle pull, and absence of KM around the anterior mandibular teeth (Fig 2a). Thus, an APF combined with an FGG was planned to increase the KM. After local administration of anesthesia, a split-thickness incision was carefully made. Significant muscle pull was noted during the flap elevation (Fig 2b). A split-thickness flap was apically repositioned and sutured using resorbable sutures (Serafast 5-0) to improve the vestibular depth and graft stability. Muscle fibers were removed to expose a thin periosteal bed, which presented a challenging situation for graft stabilization (Fig 2c). Titanium pins were used to secure the FGG to the periosteum, allowing for intimate contact and revascularization of the graft (Fig 2d). Figures 2e and 2f show the clinical situation at 10 days and the final follow-up, respectively.



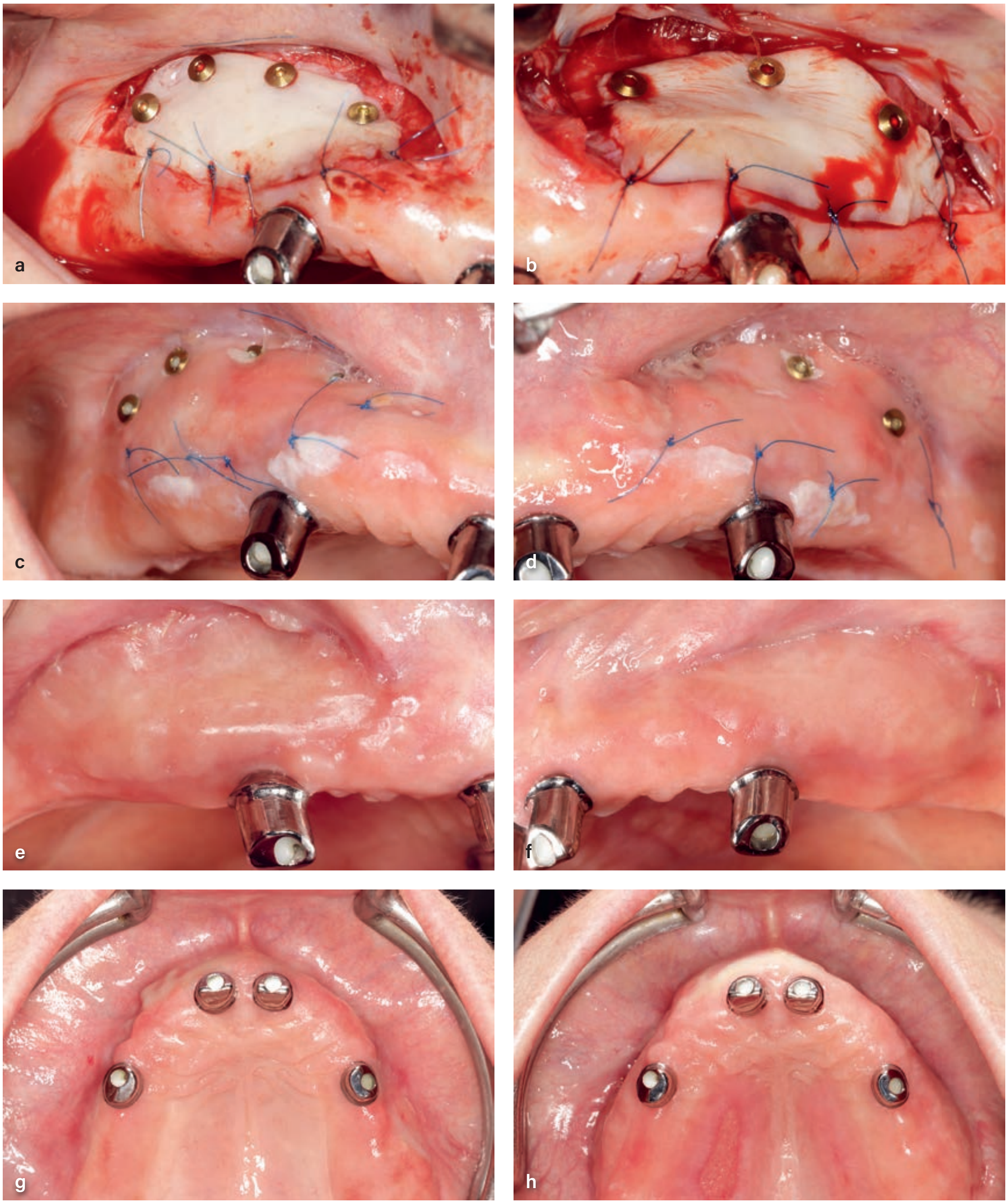
▲ **Fig 2** Patient 2: FGG and APF in the anterior mandible. *(a)* A preoperative view shows the limited keratinized gingiva around the mandibular anterior teeth. *(b)* A split-thickness flap was reflected to expose the underlying severe muscle pull. *(c)* After removing the entirety of the muscle insertions, the recipient bed was very thin. *(d)* Titanium pins were used for fixation of the FGG, with the flap repositioned apically using sutures. *(e)* Clinical view at 10 days postoperative. *(f)* Clinical view of the final situation at 2 months postoperative, demonstrating increased KM around the implant.

APF and FGG in the posterior maxilla

Concurrently, the maxilla exhibited deficient KM around the implant telescope abutments. The treatment was symmetrical on both sides, involving a split-thickness flap, which was apically repositioned, and secured with sutures to deepen the vestibular depth (Figs 3a and 3b). The FGGs were obtained in the same manner as described in Patient 1 and were fixed with titanium pins, ensuring stability and promoting optimal graft integration into the periosteum (Figs 3c and 3d). Figures 3e and 3f show the clinical situation at the final follow-up. Figures 3g and 3h compare the initial and final occlusal views, respectively.

Postoperative care and follow-up

The postoperative regimen included nonsteroidal anti-inflammatory drugs (600 mg Puren). At the 10-day follow-up, the patient exhibited signs of successful initial graft integration, revealing no de facto shrinkage and a satisfactory band, in both width and length, of keratinized and attached mucosa (see Fig 2e).



▲ **Fig 3** Patient 2: Bilateral FGG and APF in the posterior maxilla. *(a and b)* An FGG was fixed on the left and right sides, respectively. *(c and d)* Healing of the left and right sides, respectively, after 10 days. *(e and f)* Final situation at 2 months postoperative on the left and right sides, respectively. *(g and h)* Occlusal views before and after soft tissue surgery, respectively.

Patient 3

APF and FGG in the posterior maxilla

The third patient presented at the clinic with limited amounts of KM around her partially edentulous dentition in the mandibular third quadrant. The patient was already missing the first premolar and first molar. All remaining teeth were in good condition and were deemed restorable apart from the issue of limited KM (Fig 4a). The patient's main concern was the difficulty maintaining oral hygiene in that area as well as the insufficient restorations. Thus, an APF combined with an FGG was planned to increase the KM. After local anesthesia, a split-thickness flap was raised, from

▲ **Fig 4** Patient 3: FGG and APF in the fourth quadrant. *(a)* Initial presentation. The mandibular right quadrant presented with deficient keratinized gingiva. *(b)* After split-thickness flap elevation, the periosteal bed was very thin. The split-thickness flap was repositioned apically using a combination of sutures and pins. *(c)* An FGG was placed and pinned to the periosteum to augment KM. *(d)* The maturation of KM can be seen at the 2-month follow-up.

the canine to the second molar. The patient presented significant muscle insertions, which were challenging to remove due to the anatomy of the mandible. After removing all muscle insertions, a thin periosteal bed was noticed, showing slight mobility and lacking overall stability as a recipient bed. In order to apically reposition the flap, sutures (Serafast 5-0) were utilized for stability in the mesial aspect where the tissues were in better condition, and titanium pins were used in the distal aspect of the APF due to the frail tissues (Fig 4b). An FGG was harvested from the palate following the same principles outlined in earlier patient presentations. The donor site was covered using a custom stent-like bandage plate similar to the precedent cases. The FGG was secured in the coronal aspect using sutures (Seralene 6-0), and the body of the graft was fixated using titanium pins (Ti-System) (Fig 4c).

The postoperative instructions and prescriptions given to this patient were identical as for the previous patients. Both the sutures and pins were removed after 14 days using a Luniatschek. After a healing period of 2 months, a thick band of KM and stable tissues were seen around all teeth, with virtually no graft shrinkage (Fig 4d).

Discussion

It has been shown that keratinized tissue around implants and teeth is a protective factor to avoid periodontal/peri-implant complications over time.[32] When keratinized tissue is deficient or nonexistent, soft tissue augmentation using FGG has been described as an effective method to reduce mucosal inflammation and patient discomfort and facilitate optimal plaque control around teeth and implants.[33] In animal studies, less frequent peri-implant pocket formation was observed in sites with sufficient KM compared to sites with nonkeratinized mucosa.[34]

Despite the recent literature on soft tissue augmentation often failing to report the success rates of these interventions, the APF and FGG is a historically complication-prone procedure.[25] The earliest reporting on this technique, by Sullivan and Atkins in 1968,[24] mentioned that intimate contact between the graft and recipient bed is not always achievable, with the authors warning that a simple postoperative hemorrhage is sufficient to detach the graft from the periosteal bed during the healing phase. According to Lim et al,[35] graft immobilization is especially challenging when there is a complete absence of attached gingiva or when the vestibule is shallow, creating an opportunity for muscle forces to move the graft. In an article looking at 36 FGGs, Pennel et al reported excessive graft shrinkage and disappearance in mandibular second molar areas and suggested that the unfavorable results may have been due to improper recipient site preparation.[25] In that study, postoperative examinations revealed that 12 of the 36 grafts either underwent considerable shrinkage and were not firmly attached to the underlying bone, decreased in size by more than 50%, or were movable. Two other mandibular second molar grafts completely disappeared. According to Pennel et al, muscle fibers that insert into the apical portion of the prepared bed may be retained, thus exerting tension on adjacent structures such as the lips or cheeks.[25] This phenomenon also presents when deep periosteal sutures are used to make up for the lack of stability in the area of the recipient bed. Both Pennel et al[25] and Sullivan and Atkins[24] suggested that the lack of firm graft attachment to the alveolar process can be prevented by making an incision along the apical and lateral borders of the recipient site, at right angles to the alveolar process, and extending to the bone surface.[24,25] While this may lead to potentially fewer complications, this incision also increases patient morbidity, which can be avoided by finding alternative methods of graft fixation.

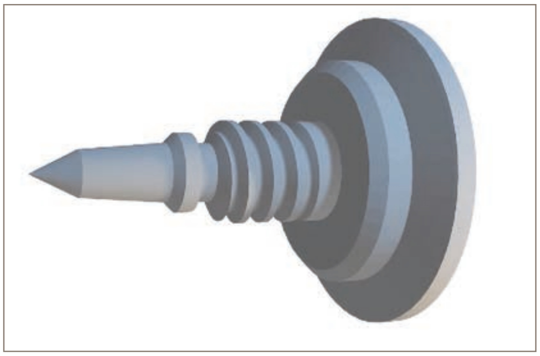
Early interventions—such as the "Loma Linda Stent,"[36] screw-retrained forms of FGG fixation,[37] and attempts to alter the suturing technique[38]—tried to address the inherent difficulties when performing this type of surgery, underscoring the limitations of traditional methods that are especially in complex cases involving fragile tissues, mobility of the periosteum, scar tissues, and significant muscle pull. These conditions challenge the clinician's ability to dissect and maintain a recipient bed conducive to both stabilizing the graft and ensuring its nutrition.[39]

In the contemporary discussion of implant health and long-term stability, the significance of achieving both keratinized and attached tissues has become an important point.[40] The distinction between keratinized and attached tissues is crucial yet often overlooked in the literature, with both terms being used interchangeably.[41] In reality, there is a significant difference, with many instances documented, where KM does not equate to fixation. This discrepancy highlights a nuanced problem within the field, stressing the importance of ensuring KM presence as well as its attachment to the underlying layers, distinguishing between merely keratinized to functionally attached tissues. This issue has been highlighted by Tarnow et al, who proposed a new definition of attached gingiva around teeth and implants.[42] In addressing the challenges posed by cases with extensive muscle pull or compromised KM conditions, clinicians often face dilemmas in their surgical management, contributing to situations where, despite achieving keratinization, the resulting mucosa is not adequately attached. Brasher et al[28] reported that when following up on patients after APF and FGG, grafts occasionally revealed a lack of stabilization to the underlying tissue. They attributed the graft movement to inadequate removal of muscle fibers and loose areolar tissue from the submucosa of the recipient site. Such "movable" grafts offer none of the advantages of attached gingiva in preventing marginal inflammation.[28] This outcome can be particularly prevalent in scenarios where the removal of all muscle fibers would leave the clinician with limited possibilities to secure the graft using traditional methods. The lack of adaptation and proper fixation can lead to relapse or partial failure of the procedure and may result in the development of keratinized but unattached/not adherent mucosa.[29] In a not insignificant number of cases, the recipient bed is either already fragile or the periosteum presents some mobility on top of the alveolar bone, which is why some of the sutures have to be placed in movable tissues; this leads to extensive graft shrinking, which has been extensively reported in past publications. McGuire and Nunn showed a shrinkage of 25% on average for APF and FGG using autologous grafts,[43] while another publication found that one-third of grafts shrunk after healing.[44]

Bhaskar et al[45] suggested that graft suturing should be eliminated or kept at a minimum and that the chances of success are enhanced if this procedure is performed with minimum delays. Indeed, patient morbidity not only depends on the invasiveness of the surgery[24] but also directly correlates with the duration of the surgery. Griffin et al demonstrated that a shorter treatment time for this type of surgery, particularly in subjects who received autologous grafts, results in less pain.[30]

The introduction of titanium pins represents a significant contribution to the surgical process, offering a straightforward solution that addresses the shortcomings of traditional methods in frail tissues and unfavorable anatomical situations and significantly reduces treatment time, therefore reducing patient morbidity.[30] A significant advantage of the pins is the elimination of the need for various needle types with different bends and lengths, which is necessary when relying on suturing alone. The use of pins not only simplifies the process of graft stabilization but also addresses the issues that have historically made suturing alone challenging for ensuring the intimate contact and nutrition for a successful graft integration. The mechanical stability provided by titanium pins facilitates the formation of both keratinized and attached mucosa, reducing the amount of graft shrinkage during healing and significantly improving the chances of successful outcomes in periodontal and peri-implant soft tissue augmentation.[33]

While the use of titanium pins in complex soft tissue surgeries presents a significant advantage, it is essential to acknowledge the potential drawbacks. Firstly, titanium pins entail higher costs compared to traditional sutures. Additionally, the application process, which involves using a mallet to position them, might be uncomfortable for patients. Mucosa may grow over the pins, necessitating anesthesia for pin removal; this is why the authors suggest removing the pins after 10 days, when the graft is already established at its new site.[45] Incorrectly fixated pins might become loose and can potentially be swallowed by the patient.



▲ **Fig 5** Titanium pin design used for soft tissue augmentation. The sharp tip ensures precise engagement with bone, which is critical for stable fixation of the soft tissue graft.

This technique also faces challenges when dealing with soft bone, particularly after extensive bone augmentation. Placing pins in softer bone can be more difficult, but this is somewhat mitigated by the fact that in these cases, soft tissues are often addressed prior to reconstructive bone surgeries. In such situations, conventional suturing remains the first choice, emphasizing the importance of tailoring the approach to the specific needs and conditions of the surgical site. For graft fixation, only a limited number of pins should be used in relation to the size of the FGG, as using too many pins could potentially affect the graft revascularization and result in necrosis. On the other hand, it may be partially impossible to place pins in very hard bone.

In terms of the titanium pin design, it is important that the pin being used can hold with its tip, and there should be enough distance from the head of the pin to the entry site in the bone to prevent piercing through the FGG, even though the process of fixating the pins is rather straightforward and the pin placement is rather intuitive (Fig 5).

An alternative way of using the titanium pins is placing them apical to the FGG and using these stable and immobile structures as anchors to perform tooth-suspended sutures, engaging the apical pins instead of the periosteum.

Conclusions

This case series introduces a novel approach utilizing titanium pins for the secure fixation of FGGs and APFs during vestibuloplasty, offering an alternative to traditional suturing techniques. The described technique addresses the limitations of traditional suturing for FGG fixation and vestibule manipulation during vestibuloplasty, especially in cases with extensive muscle pull, unfavorable anatomy, or compromised tissue conditions. Moreover, the use of titanium pins offers a straightforward and reliable solution for the described clinical situations, reducing treatment time. While acknowledging the advantages of this method, including reduced complexity, improved mechanical stability, and shorter treatment time, the potential drawbacks are also noted, such as the increased cost and patient discomfort during pin application.

Randomized clinical trials are suggested for comparative examination of the amount of shrinkage, as well as patient-reported outcomes using this technique in comparison to more conventional approaches.

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The authors declare no conflicts of interest.

Author contributions: K.Z.: surgical interventions, acquisition and interpretation of data, manuscript preparation and initial draft, final review of the manuscript. S.A.; outcome interpretation, manuscript preparation and initial draft, final review of the manuscript; L.T. and A.L.: outcome interpretation, manuscript preparation and initial draft, final review of the manuscript, project supervision.

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