

Alveolar Tunneling Suture Technique of Flap Stabilization

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Abstract

Background: When a corrective periodontal surgery is indicated to assist fabricating a definite prosthesis or restoration, some encountered tribulations from flap management, wound closure, and keratinized tissues preservation are required to be settled. In order to handle these complexities, a modified suture technique, alveolar tunneling technique, is proposed to facilitate flap manipulation. **Materials and Methods:** Three cases requiring a crown lengthening procedure were presented in this report. After processing the routine dental examination, evaluation and periodontal cause-related treatment, a crown length mix procedure was applied and the flaps were stabilized using the alveolar tunneling suture technique. Preoperatively and postoperatively, the width of keratinized gingiva and the pocket probing depth were measured and recorded. The findings on radiographs were also compared. A final prosthesis was delivered at least 3 months later, followed by supportive periodontal therapy. **Results:** The therapeutic effects of the applied suture technique include a better bleeding control, a decreased hematoma formation at the dead space, an established definite position of a flap, a secured mucosa or flap, and a preserved keratinized gingiva. A predictable wound healing can therefore be enhanced. Nevertheless, some disadvantages such as extra alveolar bone preparation, technique sensitivity, more time consumption, anatomic limitation, mild postoperative discomfort, soft tissues pull, and cheek biting in molar area may occur. **Conclusion:** A satisfactory treatment outcome of the periodontal procedure of which flaps are managed carefully according to the described alveolar tunneling technique can be achieved. However, the clinical and histological implications of this modified approach on wound healing of soft and hard tissues require further investigation. **Clinical relevance :** To stabilize the flap tissues is not an easy task during periodontal operation. The aim of this case report was to present a novel technique (alveolar tunneling technique) to assist flap stabilization and to position the flap accurately onto an intended location. In such way, it may assist in bleeding control, decrease hematoma formation from the dead space at the surgery site, establish a definite position of flap, secure a mobile mucosa or flap, and preserve almost all keratinized gingiva. A better wound healing can therefore be enhanced.

Keywords: alveolar tunneling technique; apical positioned flap; crown lengthening procedure; keratinized gingiva.

Introduction

A prosthodontic-periodontal surgery is indicated once the interfering situations such as subgingival decay, a short clinical crown, a fractured tooth or esthetic demands are encountered that prevent fabricating a definite restoration¹. With interrelated periodontal flap operations, including distal wedge, apically positioned flap, crown lengthening procedure or gingivectomy, a subtle and atraumatic flap management is important for the treatment outcome. Whatever the reasons for a periodontal surgery, an open wound must be properly debrided, irrigated and sutured when a planned surgical practice is accomplished. There are multiple purposes for retrieving the reflected mucoperiosteal flap². One intention is to retain soft tissues in apposition with the bone to promote wound healing. The reunited flap may assist the formation and maintenance of blood clots, by which a potential aggressive postoperative bleeding or a hematoma is prevented. The wound with an exposed bone could evoke worse postoperative pain, and the entrance of food debris into a surgical site may induce possible postoperative infections or contaminations that delay healing. These complications can be avoided when the open wound is well protected and closed³.

Less keratinized tissues are noted around the buccal and lingual gingiva of the mandibular molars⁴. The soft tissues immediately distal to the mandibular terminal molar consists of a small retromolar papilla, situated in varying proximities to the base of the anterior border of the ramus. The specific anatomic and histological characteristics of retromolar pad tissues contain an aggregation of loose fatty tissues and glands but little fibrous attached gingiva. The retromolar papilla extends distally into the prominent loosely attached mucosa, glands, muscle and connective tissues, and forms the base of the cheek. In many cases, the treatment of periodontal pockets and subgingival dental caries on the distal surface of the last molar is complicated by the presence of bulbous tissues over a prominent retromolar pad. Various surgical techniques have been proposed to facilitate accessing and modifying the soft and hard tissues, such as the distal wedge procedure⁵ and the modified distal wedge procedure⁶.

Due to the limitation to be approached

and the extensive loose cheek tissues at the retromolar area, precise flap management and fixation is always complicated and unpredictable. It has been reported that the high rebounding rate of soft tissues and the mean distance between the restoration of the tooth and bone crest is 2.4 mm instead of 3.0 mm post-operatively⁷. Another study showed the mean tensile strength needed to detach the flap from dentin was markedly weaker than that from bone at all testing time points, while the tensile strength of both flaps significantly increased after the seventh day of healing and continued to be improved thereafter⁸. These findings imply that the routine schedule for suture removal at one week after surgery may not be long enough for flap stabilization, especially since the healing between the tissues and dentine requires an even longer period of time. In addition, a stronger flap fixation is therefore indicated.

Stabilizing the flap tissues at the end of the operation by anchoring a detached flap onto the alveolar bone in the oral cavity through suturing has not yet been reported. In this report, we presented a novel technique (alveolar tunneling technique) to assist flap stabilization and to position the flap accurately onto an intended location. The possible advantages and complications are also discussed.

Case description

Three Asian patients with non-contributory medical histories and non-smoking habits were referred to the Periodontics Department in Chang-Gung Memorial Hospital for a Prosthetic-Periodontal evaluation and treatment. Preceding the clinical and radiographic examination, diagnosis, consultation and treatment planning, the indications for the intervention of periodontal surgery were confirmed. A cause-related therapy, including oral hygiene instructions and plaque control, was accomplished and a signed informed consent was obtained prior to the operation. The patients were instructed to rinse for one minute with 0.12% chlorhexidine (Scodyl, Beauteeth Company Ltd, Taiwan). The flap, a full thickness design, was elevated over the mucogingival junction and a mucoperiosteal flap followed. During surgery, following an adequate anesthesia, an incision was made, flaps were reflected, granulation tissues

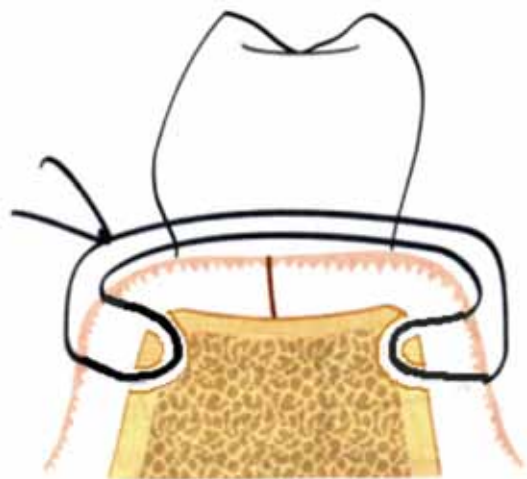


Fig 1 A “U” shape alveolar tunnel can be created with No. 520 round bur at buccal or lingual site in a safe distance away from the proximal tooth.

were removed, the root was planed, osseous resection/plastic was performed, the alveolar tunnel was made (Fig 1) and the wound was closed by suturing. Stitches were removed 10 to 14 days postoperatively. Amoxicillin 500mg, t.i.d for seven days, if a bone graft was applied, and Scanol® 400mg, q.i.d for seven days, were prescribed post operatively. Also, a regimen of 0.12% chlorhexidine rinse b.i.d was utilized for 3-4 weeks following the surgery. The patient after that received periodontal maintenance was recalled once every three months. Preoperatively and postoperatively, the width of keratinized gingiva and the pocket probing depths were measured and recorded. The findings on periodical radiographs were also compared.

Case one

The 44-year-old otherwise healthy female patient complained that her tooth #37 was sensitive to cold water and she had a swollen gingiva. Several findings were observed after examination, including a secondary caries apical to the amalgam restoration extended to subgingival 2.0-3.0 mm in this lingual tilting secondary molar (Fig 2a, 2b, 2c). Swollen retromolar tissues and a 6.0-7.0 mm probing pocket depth at distal site of the tooth were also noticed. In order to expose the defect to repair the impaired restoration, to remove the excessive soft tissues for better oral hygiene accessibility and to perform a flap operation for decreasing pocket depth, a crown lengthening procedure was indicated. The measured

keratinized gingiva was 2.0-3.0 mm at the buccal site, 3.0-4.0 mm at the lingual location and 1.0-2.0 mm at the retromolar position. The decay was temporary filled with Ketac Silver⁺⁺ to prevent the tooth from becoming sensitive (Fig 2a). Intrасucular incisions were made from tooth #37 to tooth #36 at both buccal and lingual aspects⁹ (Fig 2d). A trap door technique instead of a traditional distal wedge was carried out at the distal side of tooth #37¹⁰. After trimming away the undermine connective tissues, a full thickness with a mucoperiosteal flap was reflected for better and passive wound closure¹¹. When the interested field was exposed, a 4.0 mm infrabony defect and a tooth defect were noted at the distal side of tooth #37. A thorough degranulation, root planning and an osseous plastic surgery with autogenous bone graft were carried out to eliminate the bony defect and to re-establish enough accommodation for a biological width^{12,13,14}. A “U” shape tunnel was created with a no. 520⁺⁺ round bur at a safe distance of 3.0 mm away from the tooth (Fig 2d). Since the size and shape of the tunnel depends on the type of needle used for wound closure, a No. P3 needle shaped tunnel was created and a 4-0 Vicryl® suture was applied (Fig 2e). The wound was protected with COE-PAKTM packing. The patient returned one week later for oral hygiene reinforcement and examination. The suture was removed after 14 days and recalls took place once a month for three months. The wound healing was normal and the 2.0-3.0 mm limited keratinized gingiva persisted. The probing depth at distal side of the tooth decreased to 3.0 mm. The shallow vestibular did not deteriorate (Fig 2f).

Case two

A 26-year-old male patient was referred from the Prosthodontic Department for evaluation and treatment of mesial shifting and a tilting tooth #48. An undermine caries was found before the original fixed partial prosthesis was discarded. The severely damaged tooth structure amplified the challenge to rehabilitate a healthy, functional and aesthetic restoration (Fig 3a). A crown lengthening procedure with apically placed flap was required to expose more tooth structure to enhance essential retention for the renewed 3-unit bridge. No significant mobility was detected for the involved teeth. A 3.0-4.0 mm probing depth around the tooth

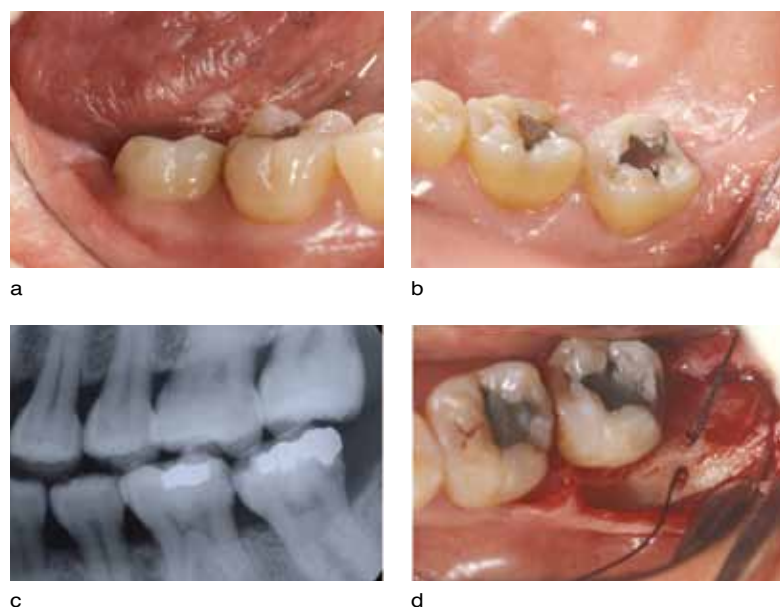


Fig 2 A lingual tilting tooth #37 with secondary caries was noted. Preoperatively, the decay was temporarily filled with Ketac Silver. (a) buccal view of tooth #37, (b) lingual view of tooth #37, and (c) the bite-wing radiograph showed a secondary caries extended 2-3 mm into subgingival tissues before Ketac Silver temporary filling. (d) Subsequent to reflecting buccal and lingual full thickness flaps from tooth #36 to #37 and removing the granulation tissues at distal wedge, osseous resection and plastic were performed. A 3 mm distance from crest to caries margin was established for the accommodation of biological width and an alveolar tunnel was created at distal buccal site - sewed by a 3-0 silk suture. (e) Wound was closed with a 4-0 Vicryl suture. (f) Post-operative buccal view of the surgery site 3 months later. (g) lingual view. (h) vertical bite wing radiography.

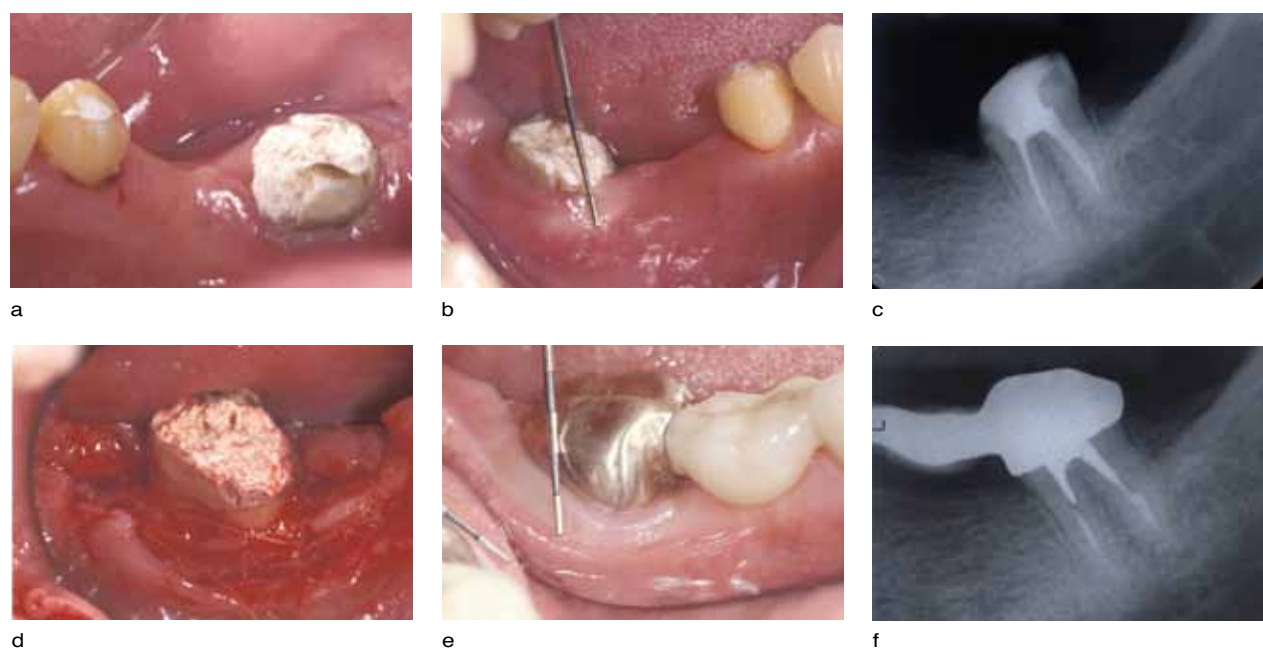
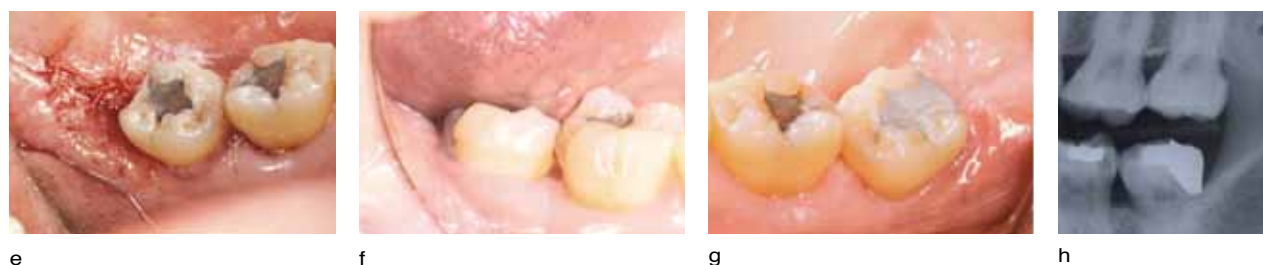


Fig 3 (a) A mesially shifting and tilting tooth #48 presented an extensive decay on short clinical crown that extended subgingivally. (b) A 3 mm wide keratinized gingival at the buccal surface was noted. (c) X-ray shows insufficient biological width at mesial margin. (d) Two alveolar tunnels were prepared in a safe distance 2.0 mm away from the tooth at both mesial and distal sides, then; the flaps were repositioned apically and stabilized by a vertical mattress 4-0 Vicryl® suture that passed through the tunnels. (e) Three to four months later, a final prosthesis was delivered and the same 3.0 mm keratinized gingival was preserve. (f) Post-operative radiograph demonstrated a normal healing pattern of alveolar bone.

and a 3.0 mm width keratinized gingiva at the buccal surface was noted (Fig 3b). A mid-crestal incision from distal tooth #45 to tooth #48 was made initially and an intrasutural incision around tooth #48 and a distal wedge followed. Releasing incisions of the flap were made mesially and distally. Subsequent to elevating the planned flap, granulation tissues were removed, the root surface was planed and a 3.0 mm accommodating zone for biological width was created. A tunnel was generated with a No. 520 round bur at a 2.0 mm safe distance away from the tooth mesially and distally. The flap was repositioned apically and stabilized by a vertical mattress 4-0 Vicryl® suture that passed through the alveolar tunnel (Fig 3c). Suture removal and the following recalls were held according to the schedule (Fig 3d). A permanent prosthesis was provided four months later. A normal healing pattern without complication took place. The same 3.0 mm keratinized gingiva and probing depth were retained (Fig 3e, 3f).

Case three

A 26-year-old male in generally good health asked for a prosthesis replacement of his upper anterior teeth because of gingival recession and the metal color of the prosthesis had begun to show through (Fig 4a). Secondary subgingival caries associated with

the prosthesis were found on pre-operative radiograph (Fig 4b). After removing the ill-fitting prosthesis, short clinical crowns with a biological width violation and subgingival finishing margin were found at teeth #12 and #11 (Fig 4c). A crown lengthening procedure combined with an apically positioned flap from tooth #13 to tooth #23 was planned to reestablish a healthy biological width and an aesthetic smile line^{12,13,14}. Intra-oral examination revealed no significant mobility for all of the involved teeth. A 3.0-4.0 mm acceptable probing depth around the teeth and a 5.0 mm width keratinized gingival tissue at buccal surface were noted. Intrasutural incisions were made from tooth #14 to tooth #24 at both buccal and lingual sides. Two vertical incisions at the distal-buccal line angle of teeth #13 and #23 were made. A full thickness with a mucoperiosteal flap was lifted. Subsequent to degranulation, root planing and osseous resection/plastic, a 3.0 mm distance from alveolar crest to the prepared margin was established to restore enough space for a biological width. A tunnel was created with a no. 4 round bur at a 1.0 mm safe distance away from the tooth (Fig 4d). The flap was repositioned apically and stabilized by a 4-0 Vicryl® suture that passed through the alveolar tunnel and secured the flap with a vertical mattress tie (Fig 4e). The suture was removed

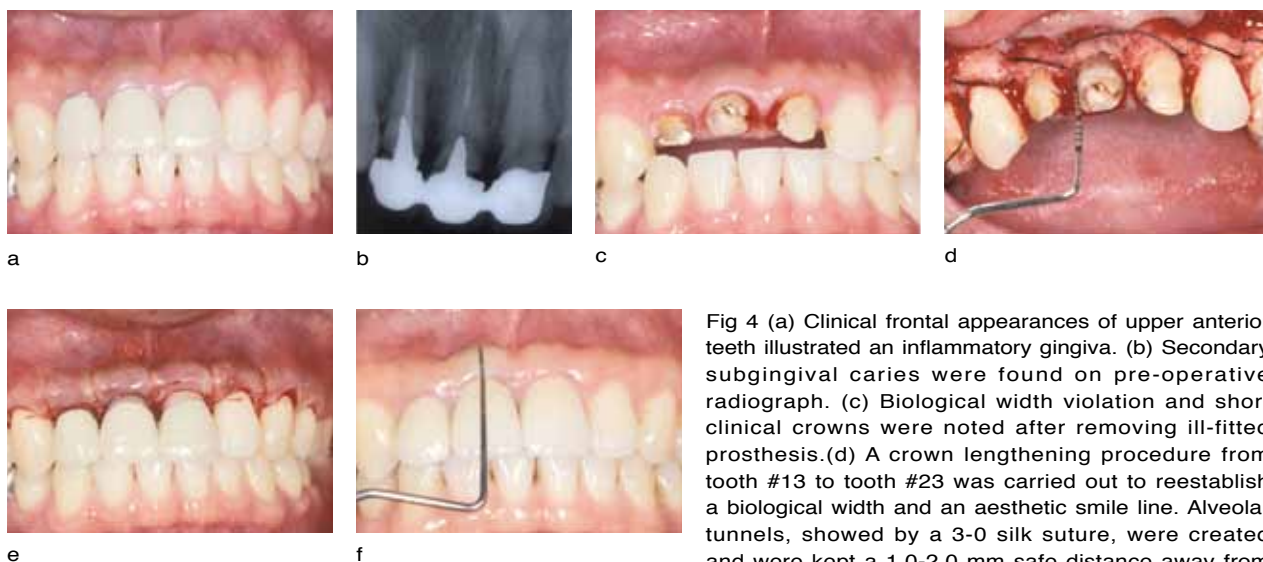


Fig 4 (a) Clinical frontal appearances of upper anterior teeth illustrated an inflammatory gingiva. (b) Secondary subgingival caries were found on pre-operative radiograph. (c) Biological width violation and short clinical crowns were noted after removing ill-fitted prosthesis. (d) A crown lengthening procedure from tooth #13 to tooth #23 was carried out to reestablish a biological width and an aesthetic smile line. Alveolar tunnels, showed by a 3-0 silk suture, were created and were kept a 1.0-2.0 mm safe distance away from the teeth. (e) The flap was repositioned precisely and stabilized by a 4-0 Vicryl® suture that passed through the alveolar tunnel. (f) Permanent crowns were provide four months later and a healthy keratinized gingiva was retained.

after 14 days and recalls were held once every three months. Permanent crowns were delivered four months later (Fig 4f). Healing was within normal limits. There were no noted complications and oral aesthetics, health and function have improved. In addition, almost the same 5.0 mm keratinized gingiva and 3.0-4.0 mm probing depth were retained (Fig 6f).

Discussion

Crown lengthening can be used for esthetic reason or teeth with subgingival destruction, such as caries or fracture. By using this technique we are able to establish biological width and ensure ferrule length. It has been confirmed that if the distance between the margin of restoration and the osseous crest is less than 3 mm, it can cause chronic inflammation and has the risk of losing periodontal attachment and, eventually, bone resorption. Crown lengthening technique can help recreate enough distance to maintain biological width to avoid this problem. If the tooth in need of restoration has poor clinical crown structure, we often find the restoration fall off or fracture again easily. This would happen if the crown fabrication process fails to provide enough tooth structure at apical one third of preparation. The occlusal forces may transmit to the interface of post and root, and in turn causes the cement to become fatigue and post dislodgement or crown fracture. It is important to have enough tooth structural ferrule length (1-2 mm circumferentially) to resist the occlusal stress concentration at this area.

The mandibular retromolar area is formed by a flat buccal shelf and creates a shallow vestibular fornix. The inherent architecture of the retromolar area makes it difficult to be accessed and managed during periodontal surgery. How to achieve a harmonized physiologic bony architecture depends on the alveolar bone management and surgical flap reposition. According to the purposes of periodontal therapy, the retracted flaps may be repositioned or replaced (e.g. apically positioned, coronally positioned, or laterally positioned) along with specific operative techniques¹⁵. If keratinized gingival tissues are minimal, or once the keratinized gingival tissues are minimized after surgery, their preservation is strongly indicated.

The tensile strength of the tooth-gingival flap interface following periodontal flap surgery in dogs increased from about 200 g

on the third day to 340 g after 5-7 days and to more than 1700 g in two weeks¹⁶. This information implied that the wound integrity relied mainly on the stabilization of the periodontal flap provided by suturing during the early healing phase. Consequently, for periodontal flap surgery, the choice of suture material, placement and removal should be emphasized on protecting the wound from plaque colonization, infection and trauma from oral hygiene procedures¹⁵.

There are many surgical principles that must be complied with to achieve a satisfactory outcome of an operation. The final location of flap should be well secured to promote an optimized wound healing. However, if the flap is pulled and anchored in a situation beyond the passive appropriateness, the created tension on the flap potentially not only interferes with blood supply for the healing periodontium, but also cause the adapted tissues to be pulled through by stitches and create an open wound that induces impeded wound healing and compromised treatment results. Under most circumstances, it is better to decide the final location of flaps before the beginning of the surgery whenever possible. This novel suture technique offers an alternative option to neutralizing some produced tensile strength of the dragged flaps.

The most evident and significant function that sutures afford is to hold the flap into position and approximate the two wound edges. If the space between the two wound edges is minimal, a fast and completed wound healing by primary intention can be achieved.

If the bleeding in the underlying tissues continues, the surface mucosa or skin would not be closed and the formation of a hematoma would occur. Sutures not only help homeostasis, but also assist holding the soft tissue flap over the bone. This is an extremely important function, since the bone that is not covered by the soft tissues will become non-vital and the wound healing requires an extremely long time. That's why unless an appropriate suture technique is employed, the flap may retract away from the bone and expose it and result in delayed healing and possibly infection.

In an oral cavity, the induced response of gingival and mucosa tissues to the placed stitch is different from the responses observed at other experimented sites. The humid and infectious environment of the oral cavity may cause bacterial migration along the sutures into

the tissue¹⁷ and there is more persistent and progressive inflammatory reaction associated with remaining sutures than in the skin. In addition, a rapid epithelial invagination was also observed^{15,18}. An epithelial migration or bacterial invasion along the sutures into the created alveolar tunnel by this method is therefore possible; however, the implicative healing pattern needs to be confirmed by histology. The suture material and the timing of suture removal may play an important role in wound healing. Silk* is a popular suture material that is extensively used in oral and periodontal surgery. However, it has been reported that silk can clinically and histologically cause a more intense and prolonged inflammatory reaction than most pertinent alternatives^{15,19, 20}. Meanwhile, braided sutures tend to encourage more bacterial migration into the connective tissues than monofilament sutures. The cellular and immunologic defense against the invasion related to the braided material is considerably compromised²¹. In a study on beagles, more evident inflammation was noted in the vestibular mucosa than in the mandibular ridge area at all tested time points and in the examined suture materials¹⁵. In general, instead of the routinely used braided silk suture, a polyglactin-made suture may be a better choice for regions such as a mandibular retromolar pad^{19,22}.

Flap management with the assistance of the alveolar tunneling technique provides some noted advantages: it may assist in stopping bleeding, decrease a hematoma formation in the dead space at the surgery site, establish a definite position of flap, secure a mobile mucosa or flap, and preserve almost all keratinized gingiva. A better wound healing can therefore be enhanced.

To date, the alveolar tunneling technique has been applied into the conditions where an apically positioned flap, a reposition flap, a disposition flap and additional flap stabilization are required. It has also been applied in securing a loose or replanted tooth during surgery. An acceptable clinical result can be achieved. Nevertheless, this technique is contraindicated for a compromised wound healing patient, a situation with an anatomical limitation (such as roots proximity, thin alveolar bone, etc.), a shortage of keratinized gingiva, insufficient quality and quantity of alveolar bone, and weak practitioner expertise. Some disadvantages have been uncovered,

including extra alveolar bone preparation, technique sensitivity, time consumption, anatomy limitation and a primary wound closure that may be difficult at the interproximal areas when the flap is extensively apically positioned.

Some complaints and side effects have been induced postoperatively, for instance, mild discomfort, soft tissue pull, and cheek biting (especially in the molar area). Meanwhile, a possible alveolar resorption caused by tunnel preparation may occur. This may not be detected on the follow up radiography. The reason for soft tissue pulling or a tight feeling could be originated from an insufficient passive position or a flap release. Similar findings in the field of plastic surgery have been reported. The trap door technique may cause more scar tissue than other suture techniques. Moreover, the complications mentioned tended to decrease or disappear with time. The long term results of this technique still need to be verified.

Conclusions

This case report presented a modified suture technique to assist keratinized gingiva preservation and to stabilize the flexible flaps in a preferable position. An optimized clinical result can be achieved. However, the clinical and histological inferences of this adapted practice on soft and bone tissues wound healing remain to be further investigated. Satisfactory clinical outcomes of this periodontal procedure, in which flaps are managed according to the described alveolar tunneling technique, can be achieved on the condition that enough attention is given and precautions are taken.

- * Vicryl® suture-Absorbable synthetic material: polyglactin 910 Coated Vicryl, undyed braided, #4-0, cutting needle P-3, Ethicon
- ** Nonabsorbable organic material: silk (black braided silk, #4-0, cutting needle, P-3, Ethicon)
- ** No 520 round bur: size 1/4, diameter 0.5mm
- +++ Restorative material: Ketac™ Silver Aplicap (silver-reinforced glass ionomer restorative material, 3M ESPE)

摘要

背景：當必須施行牙周修形手術以協助製作正式鑲復體或填補物時，常常會遭遇到如手術翻瓣處理，傷口的關閉以及角化組織的保留上的困難。為能因應這些複雜的問題，在此我們提出一有助翻瓣處理的改良縫合技術(齒槽骨隧道技術)。

技術與方法：在本報告中我們呈現三個需要牙冠增長手術的案例。在進行例行的牙齒檢查及牙周相關的評估與治療之後，施以牙冠增長混合手術，並運用齒槽骨隧道技術以固定皮瓣。術前與術後角化牙齦的寬度及牙周囊袋深度均予以測量與紀錄，並比較X光攝影的結果。三個月後為病患裝上正式的假牙並給與例行之支持性牙周治療。

結果：運用齒槽骨隧道技術的療效包含對流血量有較佳的控制，能減少封閉區域內血腫的形成，最終皮瓣位置的建立，黏膜或皮瓣的穩固與角化牙齦的保留。從而加強可預測的愈後結果。然而額外的齒槽骨修形，技術的敏感度，需要較長的手術時間，結構上的限制，輕微的術後不適，軟組織的拉扯，及臼齒區域的會咬到臉頰則有可能發生奇必須注意的。

結論：當齒槽骨隧道技術被小心的運用在翻瓣手術上可以得到令人滿意的成效。然而此改良技術在臨床上及組織學上對軟硬組織的傷口愈合仍須進一步的探討。

關鍵詞：齒槽穿孔術、齦瓣根尖置位、牙冠增長術、角質化牙齦

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