

MANAGEMENT OF INCISION DESIGN IN SYMPHYSIS GRAFT PROCEDURES: A REVIEW OF THE LITERATURE

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KEY WORDS

Incision
Bone grafts
Symphysis grafts

Symphysis graft procedures are being performed in clinical practice more frequently than ever before. Convenient surgical access, proximity of donor and recipient sites, low morbidity, availability of larger quantities of bone over other donor sites, minimal resorption, no hospitalization, and minimal discomfort are some advantages of this procedure over other intraoral sites. Three types of horizontal incisions can be performed during this procedure: the sulcular, the marginal, and the alveolar mucosal. Most studies regarding the chin graft technique are more concerned with the bone graft aspect than soft tissue management. Moreover, the criteria for the selected flap design appear to be based primarily on clinical experience or the same surgical approach regardless of interfacing factors. The periodontal status, amount of bone loss, periodontal risk of root fenestration, amount of keratinized gingiva, restorations in the gingival margin, and local musculature are some of the clinical findings that should be assessed to indicate the best incision design. In this review article, the advantages, disadvantages, indications, and contraindications of each incision design will be discussed.

INTRODUCTION

An important diagnostic factor in patient evaluation for dental implant placement is the available bone at the desired implant location.^{1,2} Insertion of an endosteal implant requires sufficient bone volume for complete bone coverage. In many instances, alveolar resorption following extraction, trauma, or pathology has resulted in a ridge form with inadequate height and/or width for implant replacement.³

In these situations, autogenous bone grafts are a more predictable alternative for repair of most severe jaw defects.⁴ Local bone grafts are a convenient source of autogenous bone in alveolar reconstruction.¹ These have been used extensively in the restoration of alveolar atrophy and repair of bone defects and continue to be the "gold standard" of jaw reconstruction.^{5,6} Various donor sites for reconstruction have been investigated and described in the literature, including the calvarium,⁷⁻¹¹

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clavicle,¹² tibia,¹³ fibula,¹⁴ scapula,¹⁵ and ilium.^{16,17} Alternative areas for graft harvest have been suggested¹⁸; these include the maxillary tuberosity,¹⁹ palate,²⁰ zygomatic arch,²⁰ and mandibular coronoid process.²¹

In addition, local bone grafts from the maxilla and mandible have also been used.^{1,22–25} The obvious advantage of local bone grafts is their convenient surgical access.^{1,22,23,25,26} This proximity of donor and recipient sites can reduce operative and anesthesia time.^{4,27} In addition, these areas may offer a decreased morbidity from graft harvest and greater quantities of bone over other intraoral donor sites. Mandibular bone grafts result in an improved quality of bone with a shorter healing period when compared with other methods of bone repair.⁴ Minimal resorption (0%–25%),^{4,23–25,28} no hospitalization (decrease cost), minimal discomfort, no alteration in ambulation, and no cutaneous scars are some of the other advantages.^{1,11,21–23,25} In addition to the procedural advantages, bone harvested from the chin or ramus appears to have inherent biological benefits attributed to its embryologic origin.^{27,29–31} Mandibular symphysis bone grafts have been used for alveolar repair to allow implant placements with favorable results.¹ This location has two advantages over other intraoral sites: (1) topographic accessibility, and (2) significant volume of cancellous and cortical bone for harvesting.^{4,22}

In past studies, 3 types of incisions have been used in symphysis graft procedures: an incision in the alveolar mucosa, a submarginal incision of attached gingiva, and an intrasulcular incision of the attachment apparatus.¹⁸ Most studies regarding the chin graft technique have been more concerned with the bone graft aspect than the soft tissue management. The criteria for the flap design selected appear to be based on clinical experience or the use of the same surgical approach, regardless of the interfacing factors. Few studies describing this technique report the type

or the reasons why an incision was chosen.

Sindet-Pedersen and Enemark²⁵ evaluated the effect of mandibular bone grafts for reconstruction of alveolar clefts. Twenty-eight patients were treated by a chin graft procedure. In these cases, the incision of choice was placed on the border between the attached gingiva and alveolar mucosa. After the bone was placed in the alveolar process defect, the incisions were sutured with 4-0 Vicryl (Ethicon Inc, Somerville, NJ). A dehiscence at the donor site occurred in 1 patient, but the region healed uneventfully after continued antibiotic therapy and chlorhexidine mouthrinse.

Borstlap et al²⁴ operated on 61 patients with complete unilateral clefts for early secondary reconstruction of the alveolar process during 1981 to 1988. Twenty-two cases were treated by symphysis graft procedures. All patients were operated on by experienced maxillofacial surgeons. The incisions were made into the gingival sulcus along the lower incisors with 2 vertical relieving incisions in the canine region or below the mucogingival junction in the vestibular sulcus. However, no data were given regarding the numbers from one or another. In the cases where the sulcus incision was chosen, the soft tissues were replaced and sutured with interdental interrupted sutures (3-0 Vicryl). No data were presented explaining the type of suturing in the vestibular sulcus. The authors mentioned personal preference for the sulcular incision in the gingival sulcus, instead of the vestibular incisions. With regard to the complications, in only 1 patient was wound dehiscence seen. This was small and healed uneventfully. In this case, the incision was made in the vestibular region.

Twenty-six cleft palate patients received an autogenous bicortical chin bone graft for early reconstruction of the alveolar process.³² In 20 patients, an incision in the gingival sulcus along the lower incisors was used, with two vertical tension release incisions at each

end in the canine region. In 6 patients, an incision in the vestibular region was used, and 1 patient experienced a wound dehiscence. Except for the vertical tension relieving incisions in the canine region, the sulcular incisions resulted in a slight scar as opposed to the vestibular incision. Postoperative examination of the periodontal status revealed no gingival retractions or periodontal pockets.

In a study by Misch et al,²³ 11 partially edentulous patients with alveolar defects contraindicating implant placement were treated with bone grafts obtained from the mandibular symphysis. The incision was made in the alveolar mucosa 3 to 4 mm beyond the mucogingival junction between the first premolar teeth. Two and 16 weeks postoperatively, the complications encountered in the donor site were minimal and uneventful. Three patients developed partial dehiscence of the mandibular incision, which healed completely following antibiotic therapy and chlorhexidine rinses. The same authors²⁷ related that the incision design varied according to the local musculature and periodontal status of the mandibular anterior teeth. In patients with shallow vestibule or tense mentalis posture, a sulcular incision along the mandibular anterior teeth was used. The presence of marginal inflammation or alveolar bone loss around the lower incisors usually warrants a vestibular incision. A vestibular approach beyond the mucogingival junction permits easier access but produces more soft tissue bleeding and intraoral scar formation. Limiting the distal extend of the vestibular incision to the canine area has reduced the incidence of temporary mental nerve paresthesia to less than 10%. No long-term paresthesia was observed.

In an interview article, Pikos³³ favored the intrasulcular incision approach of flap surgery for the donor sites in chin graft procedures. He states that its advantages are (1) minimal temporary morbidity to the mental neurovascular bundles, (2) easy retrac-

tion to gain access to the actual bone grafts site, and (3) virtual elimination of bleeding problems.

Hunt and Jovanovic²² also used the mandibular symphysis for harvesting intraoral autografts in implant reconstruction cases. A retrospective analysis of 48 chin graft harvesting procedures in 44 patients was completed. As mentioned by the authors, the flap designed began with a beveled partial- to full-thickness mucoperiosteal incision placed 10 mm below the mucogingival junction, extending from the distal aspect of both mandibular canines to allow for adequate access and easier adaptation of the flap for tension-free closure. Suturing the donor site was accomplished with a 2-layer technique that consisted of internal and external suturing. This technique, according to the authors, allows tension-free flap closure (with the use of resorbable material such as Vicryl). Internal sutures involving the periosteum and muscle layers were done with a horizontal mattress technique. The suturing of the external flap began with several horizontal mattress sutures followed by a continuous locking suture. This technique promotes rapid healing and low morbidity. The complications reported in this study were related to the type of osteotomy from the donor site with the extent of bruising, paresthesia, facial deformities, or muscle prolapsing of the chin. No data relating to the complications of the incision line at the donor site were included in the report.

It appears that the design of the surgical flap in most cases has been determined by empiric factors and clinical preference, although it may influence the healing process. The overlying factors that may affect the location of the incision line include marginal gingival recession, contraction or necrosis of the gingival papilla, hemostasis, ease of access, visibility, maintenance of an adequate blood supply, presence of a dehiscence or fenestration, minimal trauma to the wound margins, the presence of crowns and their margin position, and the affect of soft tissue

scarring.^{1,18,20,22,23,27,31} Because of these implications and the clinical conditions present, the selection of a particular surgical flap design should be based on available information of the post-operative healing of the incisional wound.³⁴ Very little information exists in the scientific literature regarding donor site wound healing following chin graft procedures. Some data, however, can be taken from animal studies.

Alveolar mucosa incision

The incision in the alveolar mucosa in chin graft procedures have been shown to have a common complication: dehiscence (Figure 1a and b). This can be because of the friable nature of the tissue of the alveolar mucosa; the endodontic literature states that it may be difficult to gain complete closure and healing by primary intention.³⁴ This has not been reported in the literature dealing with donor bone grafts for implants.^{18,23,27,31,65} More importantly, Misch and Misch¹⁸ have observed that the pulling action of the surrounding musculature tends to cause some separation of the wound edges, even after suturing has been completed. In addition, due to its greater vascularity, increased and prolonged hyperemia and edema is more often seen than in other types of incisions, presenting more problems in maintaining hemostasis.^{18,33,34} This type of incision should be performed, however, with the presence of marginal inflammation or alveolar bone loss around the lower incisions.²⁷ It is also the incision line of choice when crown margins of the mandibular anterior teeth are within the aesthetic or speaking zones, if recession may cause their exposure. In addition, if root dehiscence is suspected, or if past periodontal therapy had a long junctional epithelial attachment, the alveolar mucosa incision has less risk of root exposure after healing. Scarring of the tissue has been observed, but is always out of the aesthetic zone and without clinical significance.

Intrasulcular incision

With the intrasulcular incision, according to Kramper et al³⁴ the anatomy of the papillae makes reapproximation of the wound edges less than ideal (Figure 2a and b). Inversion of the epithelial layer is seen so that primary healing is not easily accomplished. Healing by second intention, union by adhesion of granulation surfaces, is the common finding when this flap design is utilized.³⁵ In addition, it seems that either the alveolar mucosa or intrasulcular incisions have a longer chronic inflammatory state,³⁴ probably due to the lower maturation of the collagen fibers.^{36,37} This maturation of the collagen fibers in the incision area is important for the wound to resist rupture.³⁸ These results, however, were not found by Harrison,³⁹ in which there was no difference in the incisional wound healing process of the two flap designs (marginal and sulcular) in any evaluated or observed biological events of wound healing.

The presence of dehiscence has been cited as either an indication or contra-indication for both the intrasulcular incisions and incision in the attached gingiva. A dehiscence may be present, but is not detectable clinically because probing of the sulcus is within normal limits and no mucogingival problem is apparent, yet a fibrous attachment of the gingiva to the root surface of the tooth may be found. If an intrasulcular incision is made to reflect a full-thickness flap (used in chin graft procedures), this epithelial attachment will be injured and reattachment will most probably occur at a more apical level.^{34,40-52} In addition, some degree of alveolar bone loss will occur once the periosteum is reflected.^{46,53-55} Wood et al⁵³ demonstrated in 9 patients a mean loss of crestal alveolar bone of 0.62 mm for full-thickness flaps and 0.98 mm for partial-thickness flaps procedures. Kohler and Ramfjord,⁵⁴ after full thickness flaps, found slight crestal bone loss in a study of 14 patients, with an average loss of 0.23 mm. Donnenfeld et

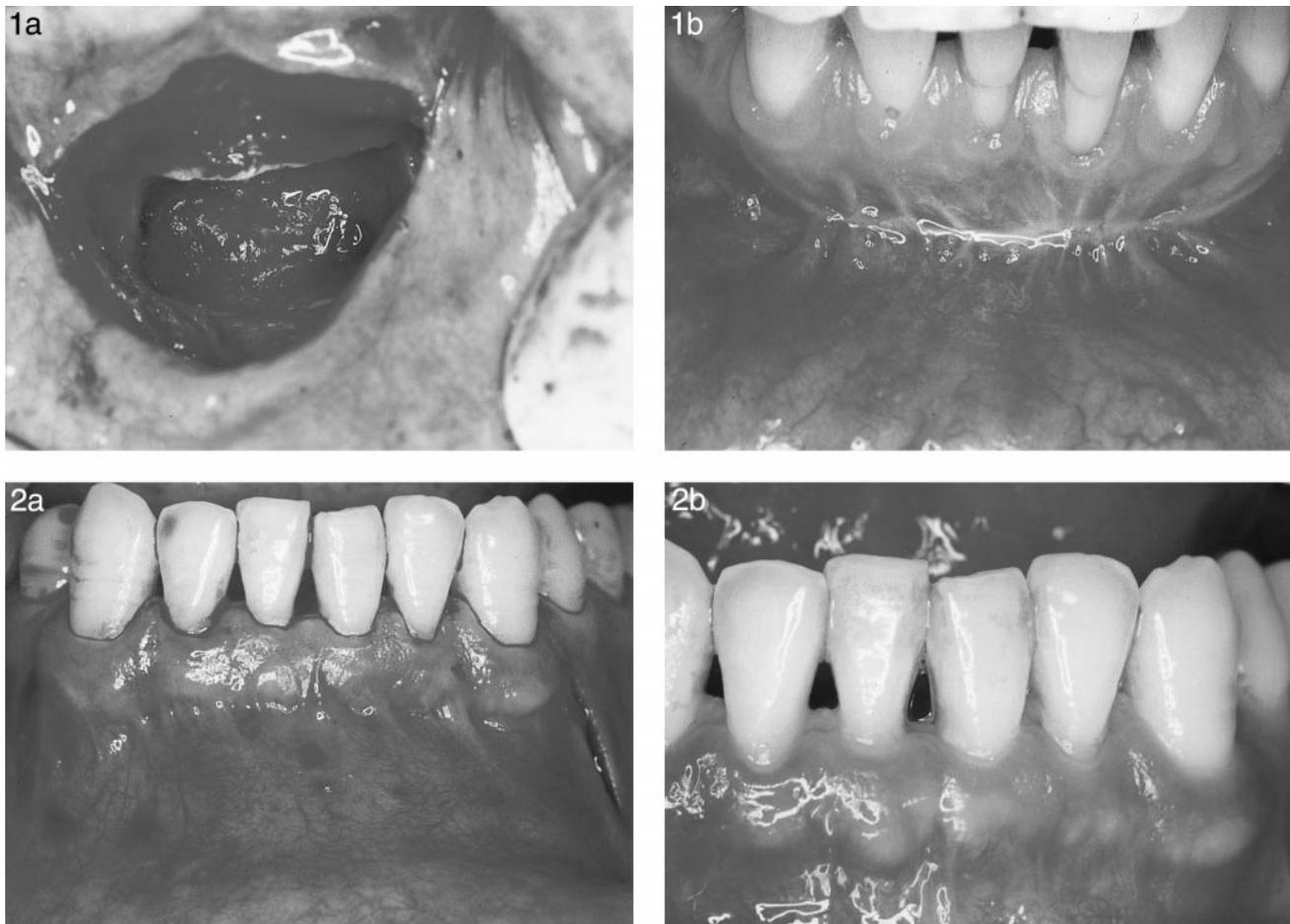


FIGURE 1. (a) Alveolar mucosa incision. This type of incision usually presents more problems in maintaining hemostasis. (b) Alveolar mucosa incision after complete healing. Note the postoperative scar. FIGURE 2. (a) Intrasulcular incision. The periodontal condition of the donor area appears normal. Limiting the distal extent to the canine can reduce the incidence of temporary mental nerve paresthesia to less than 10%. (b) Intrasulcular incision after complete healing. Note that minimal recession has occurred.

al⁵⁵ also reported loss of crestal bone after full thickness flaps. They observed a mean loss of 0.63 mm, with 5 of the 6 patients they reevaluated demonstrating a loss of 1.05 to 1.2 mm.

Selvig and Torabinejad,⁵⁶ however, after raising mucoperiosteal flaps in cats for 30 minutes, found that bone resorption did not seem to be a major reaction. Harrison and Jurosky,³⁹ studying the wound healing in the tissues of the periodontium following periradicular surgery, confirmed these findings. He stated, however, the importance of maintaining the vitality of root-attached tissues to enhance rapid wound healing and impede apical epithelial downgrowth along the root surface. The presence of root-attached

tissues would provide an intrasulcular incisional wound site with edges of like tissues, which would have a tremendous advantage because both wound edges could contribute to the healing. Levine et al,⁵⁷ who suggested the maintenance of attached gingival fibers to aid in predicting postsurgical attachment levels, also stated these findings. Assuming that curettement or planning of the root surfaces is not necessary in chin graft procedures, the root-attached tissues (including vital connective tissue and epithelium) could be maintained, allowing "reattachment," rather than "new attachment." This goal, according to Harrison and Jurosky,³⁹ could be achieved by preventing those tissues from dehydra-

tion by frequent irrigation with sterile physiological saline during the surgical procedure. Thus it appears loss of soft tissue attachment level following chin graft surgery with an intrasulcular incision may not be inevitable. It is important to note, however, that the short duration of bone exposure (15–30 minutes) and the absence of gingival inflammation before surgery may have contributed to the limited extent of resorption and osteocytic cell death in those studies. In addition, differences between the studies^{39,53–56} may be related to different species, extent, and design of the surgical procedure.⁵⁶

Considering these factors, loss of attachment may occur with a sulcular incision. As a consequence, the probabil-

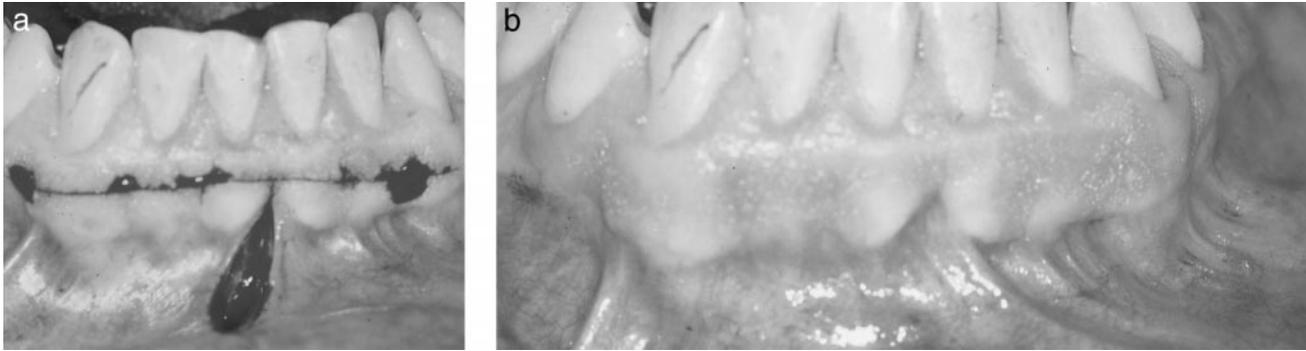


FIGURE 3. (a) Attached gingiva incision. The donor area for this type of incision requires a great amount of keratinized gingiva. A midline vertical release was performed to gain access to the donor site. (b) Attached gingiva incision after complete healing. Scarring may occur with this type of incision.

ity of a gingival cleft resulting is increased. Clinically, the most severe consequences would be severe gingival recession (especially if the remaining cortical plate is extremely thin along the remainder of the exposed tooth root), altered aesthetics with a low lip position during speech, hypersensitivity, and root caries. Therefore, the patient should be informed about these possibilities before treatment is undertaken.

Attached gingiva incision

The complications of the sulcular incision can be avoided with the attached gingiva incision (Figure 3a and b).³⁴ This type of incision can be very closely repositioned and sutured to place with little tension placed on the postoperative wound. In this situation, healing by primary intention, rather than by granulation, is allowed to proceed.^{34,58} As a consequence, epithelial migration appears to close faster and to proceed more quickly to cellular maturation and histodifferentiation. In addition, this incision showed the most advanced collagen bundle formation at 60 days after surgery,³⁴ leading to the conclusion that the tensile strength will be greater than alveolar mucosa and intrasulcular incisions wounds. This contradicts the findings by Harrison and Jurosky, who found fibroblast migration and collagen synthesis less evident in this type of incision than in intrasulcular wounds of the sulcular incision.⁶⁴ The incidence of dehiscence

may increase because of the reflection of periosteum; however, collateral circulation will maintain the integrity and vitality of the marginal epithelium.⁵⁹⁻⁶²

Kramper et al³⁴ evaluated in beagles the clinical and histological features of healing of 3 common types of surgical flap designs, including the incision of alveolar mucosa, attached gingiva, and intrasulcular incision. Scaling and root planning was performed 2 weeks before the surgery. A marker was made approximately 2 mm from the crest of the free marginal gingiva to access the amount of gingival recession and alveolar bone loss with the intrasulcular incision. For the attached gingival incision, a minimum of 2 mm was present. Vertical incisions were performed in all groups, and a sufficient number of sutures were placed to aid healing by primary intention.

The inflammatory changes of redness and swelling were more severe during the early wound repair with the semilunar (alveolar mucosa) and intrasulcular incisions. Their return to normal appearance was delayed when compared with the submarginal incision wounds. Epithelial closure was faster and more predictable with the submarginal incision, although closure was complete by the 15th day with each flap design. Recession of the marginal gingiva occurred in the intrasulcular incision, but not by a predictable degree. The amount of recession varied

from 0 to 1.2 mm. No recession was observed with the other 2 incisions, since injury to the epithelial attachment apparatus was avoided. On the other hand, scarring was evident on those surgical flap designs. The amount of bone loss could also not be predicted (from 0 to 1.2 mm).

These authors concluded that the flap design of choice, when not otherwise contraindicated, would include a submarginal incision in attached gingiva, rather than an intrasulcular incision.^{34,61,62} The results of Harrison et al³⁹ showed little difference in the healing of intrasulcular and submarginal incisional wounds. In a study using rhesus monkeys, both wounds showed an epithelial seal at 1 day, collagen formation at 2 days, and no persistence of inflammation at 14 days.

Kramper et al³⁴ observed wound healing by more than a single epithelial layer after 2 days with attached gingival incisions, whereas the semilunar incision showed just one layer healing at the same time increment. Thus the root surface would be more protected from direct contact with the inside of the flap by a relatively inert fibrous layer with the attached gingival incision. The risk of scarring that occurs with the attached gingiva incision should not be of concern, especially in symphysis graft procedures, where the location of the scar is usually not visible. This type of incision should be used when not contraindicated by in-

TABLE 1

Indications, advantages, and disadvantages for each incision method

Type of Incision	Indications, Advantages, and Disadvantages
Attached gingiva	Indications: minimum of 3 mm of keratinized gingiva. Incision line of choice. Advantages: prevent gingival recession, less bleeding, minimal trauma, easier retraction, easier suturing, less crestal bone loss.
Intrasulcular	Disadvantages: incidence of scarring. Indications: shallow vestibule, tense mentalis posture, normal periodontal condition at the donor site. Advantages: less bleeding, minimal trauma, and easier retraction of the flap. Disadvantages: crestal alveolar bone loss and recession may occur; more difficult suturing.
Alveolar mucosa	Indications: marginal inflammation, alveolar bone loss around the lower anterior teeth, and presence of crown margins that are in the aesthetic zone. Advantages: prevent gingival recession and further crestal alveolar bone loss; easier suturing. Disadvantages; dehiscence, increased bleeding, edema, and postoperative scarring (out of aesthetic zone).

sufficient attached gingiva tissue. It is important to note, however, the reported decrease in predictable healing when the submarginal incisions were used.³⁹ Intersample variations in wound healing responses of this flap resulted from greater difficulty encountered in obtaining good flap reapproximation and stabilization. However, in the extent of soft tissue reflection to gain access for the donor site, approximation of the tissues without tension has been clinically relevant.

DISCUSSION

The incision-line location for a symphysis bone harvest should vary according to the periodontal status, aesthetic consequences, and local musculature. Table 1 lists the indications, advantages and disadvantages for each incision method. Indications for intrasulcular incision include patients with a shallow vestibule or tense mentalis posture.²⁷ The apparent advantages of this incision include easier retraction of the flap, less bleeding than a vestibular incision, and minimal trauma to the mental neurovascular bundles.²³ It is important to note that limiting the distal extent of the alveolar mucosal incision to the canine area can reduce the incidence of temporary mental nerve paresthesia to less than 10%.^{27,63} Alve-

olar bone loss^{46,53-55} and recession³⁴ may be a problem, especially in patients where the donor site is in the aesthetic zone.¹⁸ This situation should be of more concern in situations where the buccal cortical plate is extremely thin. In addition, as a consequence of root exposure, hypersensitivity and root caries may occur.

An alveolar mucosal incision should be performed when the intrasulcular incision is contraindicated. This would include patients with marginal inflammation or alveolar bone loss around the lower anterior teeth,²⁷ patients with crown margins on the mandibular anterior teeth that are in the aesthetic zone and may be exposed by recession,¹⁸ or in patients with previous periodontal treatment and a long junctional epithelium present at the donor site. It may also be used when the lower anterior teeth are inclined forward and appear to be outside the dental alveolus. The risk of root dehiscence is increased in these patients, and a long junctional epithelium attachment is more evident. The alveolar mucosal incision will prevent gingival recession, periodontal bone loss, and attachment loss,^{34,40-53} since injury to the epithelial attachment apparatus is avoided. Another advantage of this type of incision is that it allows easier access to the do-

nor site. On the other hand, the most common concern about this incision is dehiscence,^{23-25,32,34} followed by increased bleeding during the procedure, edema, and postoperative scarring.^{33,35,42} A shallow vestibule and/or strong mentalis muscle would be a contraindication to this type of incision.

Very few studies relating to the attached gingival incision have been documented. Conflicting findings about the rate of healing compared with the sulcular incision are reported. The presence of keratinized gingiva at the donor site is mandatory. In the study of Kramper et al,³⁴ a minimum 2-mm extension was used. Misch and Misch¹⁸ reported that the incision may be done when a very broad amount of keratinized gingiva (greater than 5 mm) is present. Therefore, this type of incision should not be used when there is insufficient attached gingival tissue. This incision does not cause recession and results in less edema than the mucosal incision. Incidence of scarring,³⁴ unpredictable healing, and difficulty in obtaining good flap reapproximation have been reported.³⁹ More studies about this type of incision should be performed, especially regarding the inclusion of a keratinized gingival incision in an area with periodontal bone loss.

As a result of retrospective analyses, the authors believe the attached gingival incision is the incision of choice whenever there is adequate keratinized gingiva. Hence if more than 3 mm of attached keratinized gingiva is found below the marginal gingiva of the mandibular anterior teeth, an incision in the keratinized gingiva at least 1 mm above the mucogingival junction is performed. There is also a need to place vertical release incisions in the donor site to gain access to the symphysis without the risk of excessive tissue damage or neurovascular compromise.

The vertical release incision may be performed between the canine and first premolar or at the midline. The

midline vertical release has become the option of choice when the harvest is for the span of 3 teeth. However, if an extensive harvest of bone is required, 2 vertical release incisions distal to the canine position are preferred. The release incision should not extend to within 5 mm of the mental foramen height to decrease the risk of local paresthesia of the soft tissue. A midline vertical release most often extends to within 5 mm of the inferior aspect of the mandible. Risks of temporary paresthesia are reduced with this approach and reflection, as well as access to the harvest site, is improved.

CONCLUSION

The clinician should be concerned about the principles of surgical procedures to diminish postoperative complications regardless of the incision location. Among them, (1) a single and clean incision, (2) minimal trauma to the wound margins, (3) prevention of hematoma formation under the surgical flap, (4) use of small gauge sutures and needles, (5) minimal tension of the sutures, and (6) asepsis. Applied surgical concepts and techniques should be based on knowledge of factors that promote rapid and complete wound healing.³⁹ Each type of incision has its indications and contraindications. The periodontal status, amount of periodontal bone loss, amount of keratinized gingiva, local musculature, and presence of crown margins are some of the clinical findings that should be assessed to indicate the best incision design. No controlled clinical trials are currently available relating to this current concept, therefore making the need for additional studies to confirm the proposed technique.

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