A Decision Tree for Soft Tissue Grafting

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Periodontal plastic surgery is commonly performed for esthetic and physiologic reasons, such as alleviating root sensitivity, root caries, and cervical abrasion and facilitating plaque control at the affected site. Currently, there is a lack of information regarding the most appropriate treatment method for the various clinical situations encountered. The aims of this paper are to review and discuss the various clinical situations that require soft tissue grafting and to attempt to provide recommendations for the most predictable technique. Using MEDLINE and The Cochrane Library, a review of all available literature was performed. Papers published in peer-reviewed journals written in English were chosen and reviewed to validate the decision-making process when planning for soft tissue grafting. A decision tree was subsequently developed to guide clinicians to choose the most appropriate soft tissue grafting procedure by taking into consideration the following clinical parameters: etiology, purpose of the procedure, adjacent interproximal bone level, and overlying tissue thickness. The decision tree proposed serves as a guide for clinicians to select the most appropriate and predictable soft tissue grafting procedure to minimize unnecessary mistakes while providing the ultimate desired treatment outcome. (Int J Periodontics Restorative Dent 2011;31:307–313.)

“Mucogingival surgery” is a term first introduced in 1957 by Friedman1 and was defined as “surgical procedures designed to preserve gingiva, remove aberrant frenulum or muscular attachments, and increase the depth of the vestibule.” These procedures were performed to maintain an adequate mucogingival complex, with emphasis on the amount of attached gingiva. However, techniques were later designed not only for health reasons but also for cosmetic purposes. Subsequently, Miller not only introduced a classification of marginal tissue recession,2 he also coined the term “periodontal plastic surgery” in 1988,3 which was accordingly defined at the Proceedings of the World Workshop in Periodontics in 19964 as “surgical procedures performed to prevent or correct anatomic, developmental, traumatic or disease-induced defects of the gingiva, alveolar mucosa or bone.”

Today, periodontal plastic surgery is not only performed for physiologic reasons, but also for esthetic purposes. This paper focuses on the management of soft tissue
defects and discusses situations in which a clinician would consider a soft tissue plastic surgery procedure. In addition, the authors attempt to provide recommendations as to the appropriate technique in different clinical scenarios to minimize unnecessary mistakes through providing the predictability and overall success of treatment.

**Decision tree for soft tissue grafting**

Soft tissue grafting is a type of periodontal plastic surgery, and a decision tree for performing soft tissue grafting is herein proposed to guide clinicians in making a prudent choice of the most appropriate and predictable techniques in managing different goals and clinical situations (Fig 1). This decision tree takes into consideration the following important influencing factors: identifying and removing the etiology of the problem, establishing the purpose of treatment, and then determining the potential of root coverage by examining the adjacent interproximal bone level and overlying tissue thickness. By adopting this decision-making process, predictable treatment outcomes would increase and unnecessary complications and failures would be reduced. The rationale and evidence in support of this decision-making process are discussed.

**Etiology**

First and foremost, it is of paramount importance to identify the etiology of the soft tissue defect and remove the associated etiology to achieve long-term stability of the treatment outcome. Some common etiologies for gingival recession include toothbrush trauma, tooth malalignment, calculus, gingival inflammation, and orthodontic tooth movement. By addressing these etiologies, one can prevent the problem from recurring. If malaligned teeth or orthodontic treatment led to the gingival recession and mucogingival problems, the dentist or periodontist should communicate with the orthodontist prior to initiation of surgical correction to ensure proper treatment outcomes.

**Treatment purpose**

Next, one should question the purpose of the procedure. Soft tissue grafting can be done for augmenting the zone of keratinized gingiva (KG), increasing tissue thickness, or achieving root coverage.

**Augmenting the zone of KG**

In situations where increasing the zone of KG is desired, procedures such as the apically positioned flap (APF), free soft tissue (FST) grafting, laterally positioned flap (LPF), and two-stage connective tissue (CT) grafts are all feasible, with the possibility of using tissue-engineered or biologic agents as well. When a two-stage CT graft is used, deepithelialization is required at 12 weeks after healing so that the conversion of the overlying tissue to keratinized tissue by the underlying CT can occur. Some studies have used acellular dermal matrix (ADM) as an alternative to an autogenous palatal mucosal graft with a certain degree of success, but the gain in the width of KG and amount of root coverage using these allografts and other biologic agents or tissue-engineered products is generally not as predictable as compared to CT grafts or FST graft.

**Increasing tissue thickness**

On the other hand, if increasing tissue thickness is the ultimate goal of treatment, then procedures using CT grafts, ADM, or bone augmentation techniques may be carried out. Studies have reported that although both CT grafts and ADM produced an increase in gingival thickness, greater improvement was observed when using the CT graft. Other experimental studies comparing a coronally advanced flap (CAF) with or without ADM in the treatment of gingival recessions showed successful outcomes in gaining gingival thickness with the adjunctive use of ADM. However, the long-term stability of both procedures remains to be determined. For CT grafts, deepithelialization is recommended; more studies are needed for ADM because of the lack of capacity of converting to KG. Bone augmentation using nonresorbable bone grafts has also been advocated for this purpose and has shown some success.
Identify etiology

Remove etiology

Purpose of procedure

Increase KG

APF, free soft tissue, LPT, tissue engineering (biologic agents), or CT graft first then deepithelialize at 12 weeks after

Increase tissue thickness

CT, ADM, bone augmentation

Root coverage

Check interproximal bone level

No bone loss (Miller Class I or II)

Bone loss (Miller Class III or IV)

Root coverage is unpredictable

100% root coverage possible

Check tissue thickness

Class III: 70% to 75% root coverage

Class IV: No root coverage

Thin (< 1 mm)

CT graft preferably (deepithelialization at 12 weeks after)

Thick (≥ 1 mm)

Any soft tissue procedures: CT graft, CAF, GTR, ADM, LPF, or combination

New attachment with root coverage

GTRC, tissue engineering (biologic agents)

Fig 1 Decision tree for selecting a soft tissue grafting procedure. CT = connective tissue; CAF = coronally advanced flap; GTR = guided tissue regeneration; ADM = acellular dermal matrix; KG = keratinized gingiva; LPF = laterally positioned flap; APF = apically positioned flap; GTRC = GTR-based root coverage.
Root coverage

If the goal of treatment is to attain root coverage so that esthetics can be improved and hypersensitivity can be reduced, factors to consider that can influence the predictability of root coverage procedures include the interproximal bone level of the involved tooth or teeth as well as gingival tissue thickness (also known as tissue biotype).

To predict the amount of root coverage obtainable, it would be useful to understand the type of gingival recession according to the Miller classification. Based on the Miller classification, one has to assess the adjacent interproximal bone level for any bone loss before any soft tissue grafting procedure. In general, complete root coverage can be achieved in Class I and II defects, only partial root coverage (70% to 75%) can be accomplished in Class III defects, and Class IV defects are not amenable to root coverage. As such, it was the authors’ objective to focus on the management of Miller Class I and II defects, while Miller Class III and IV defects are not described in this paper.

In deciding the soft tissue grafting procedure for root coverage, the next parameter to assess is gingival tissue thickness. In Miller Class I and II recession defects with thin gingival thickness (<1 mm), the treatment of choice would be a CT graft. In the presence of thick tissue (≥1 mm), any soft tissue procedure may be selected, such as a CT graft, CAF, guided tissue regeneration (GTR), ADM, LPF, or a combination of these procedures and materials.

While gingival thickness was not considered an influencing factor in achieving 100% root coverage with the CT procedure, it proved to be so for the CAF and GTR procedures. In a recent systematic review, a critical threshold flap thickness of >1.1 mm was found to be associated with complete root coverage for GTR and CT grafting.

For a CAF procedure, an average thickness of 0.8 to 1.2 mm has been suggested as the minimal tissue thickness to achieve complete root coverage. The thickness of the marginal tissue (eg, ≥0.8 mm) has been credited as a primary attribute for the success of root coverage for a CAF procedure. Another study investigating the factors affecting the outcomes of CAF procedures reported that an initial gingival thickness >1.2 mm was highly associated with complete root coverage. When the criteria mentioned previously were adhered to or when a CT graft was placed under a CAF, the amount of mean defect coverage was almost 100%. Therefore, if the gingival biotype is thick, root coverage can be achieved with a CAF alone or other types of grafting procedures (eg, GTR, ADM). On the other hand, defects should be treated in combination with a CT graft at sites with a thin gingival biotype. This is in agreement with a recent multicenter, randomized, double-blind clinical trial that showed that additional placement of a CT graft beneath a CAF increased the probability of achieving complete root.
coverage in Miller Class I and II defects in maxillary teeth.\textsuperscript{29}

Using GTR, sites with a tissue thickness of > 0.5 mm obtained a mean root coverage of 95.6%; at thin areas of \(\leq 0.5\) mm, a mean root coverage of only 26.7% was obtained.\textsuperscript{26} This may lead one to speculate that the membrane placed between the bone and full-thickness flap may have acted as a barrier preventing blood circulation. This is especially detrimental for a thin flap.

Techniques used for root coverage include CT grafts, FST grafts, pedicle autografts (rotational and advanced flaps), GTR, and, more recently, acellular dermal matrix. The use of a CT graft for root coverage has been shown to be a highly predictable and successful procedure. Studies have shown a mean defect coverage of 84\%\textsuperscript{30–32} and a predictability of achieving \(\geq 90\%\) defect coverage 68\% of the time.\textsuperscript{30,33,34} The CAF is another technique often used alone or in combination\textsuperscript{26} with other soft tissue grafting procedures to cover exposed roots. However, the results can only be predictable under specified conditions\textsuperscript{27,28}: Miller Class I recession defect, shallow recession \(\leq 4\) mm, keratinized tissue width \(\geq 3\) mm, gingival thickness \(\geq 0.8\),\textsuperscript{22,24,27} and overcorrection of the defect.\textsuperscript{23,35} The LPF technique has been advocated for coverage of localized recession defects. In general, clinical studies on humans have reported a range of 61\% to 74\% reduction in recession depth\textsuperscript{10,36,37} representing a mean 67\% defect coverage for these studies.\textsuperscript{34} GTR procedures using both absorbable and nonresorbable membranes have been performed for root coverage, with no apparent significant differences in treatment outcome.\textsuperscript{38}

The mean root coverage has been found to be approximately 72\% to 73\%, with a 35\% to 39\% predictability of achieving \(\geq 90\%\) root coverage.\textsuperscript{34,39,40} Some factors affecting the success of root coverage include the initial recession depth,\textsuperscript{41} gingival thickness,\textsuperscript{25,26} and membrane exposure.\textsuperscript{42}

In a recent systematic review comparing CT grafts, ADM, and GTR with absorbable membranes, results showed that CT grafts can be considered the “gold standard” in treating Miller Class I and II recession defects with respect to obtaining substantial root coverage, clinical attachment, and keratinized tissue gain.\textsuperscript{41} Similar results in favor of CT grafts were also reported in other systematic reviews.\textsuperscript{44,45}

Another factor that may influence the final treatment outcome is the final position of the gingival margin. It has been demonstrated that the more coronal the level of the gingival margin postsuturing, the higher the probability of achieving complete root coverage.\textsuperscript{35} Huang and Wang\textsuperscript{23} introduced a “sling and tag” technique in 2007 for the CAF procedure, and in the study, the flap was repositioned coronally beyond the cementoenamel junction by at least 1 mm. At 1 year postsurgery, a mean root coverage of 93\% \pm 15\% was obtained, indicating very successful results.
Therefore, to increase the predictability of complete root coverage with a CAF procedure, it is generally recommended that the flap be repositioned at least 1 mm beyond the cementoenamel junction.

If the objective of root coverage is to obtain new attachment, procedures such as GTR-based root coverage and use of tissue-engineered or biologic agents may be considered. GTR and other techniques, such as root surface conditioning procedures and root biomodification with biologic agents (eg, enamel matrix derivatives), have shown varying results with uncertain predictability in obtaining new attachment and root coverage. However, more studies are warranted in this area to ascertain the effectiveness and predictability of attaining new attachment with various biologic agents.

Conclusion

The decision tree proposed serves as a guide for clinicians to select the most appropriate and predictable soft tissue grafting procedure to minimize unnecessary mistakes while providing the ultimate desired treatment outcome.

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References