Gingival Recessions: Epidemiologic, Etiologic and Therapeutic Aspects
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Citation

Abstract
The etiology of gingival recessions is considered multi-factorial. The triggering factors act on an anatomically vulnerable area, producing apical displacement of the marginal gingiva. In some clinical situations nonsurgical treatment targeted at the etiology may be used. However, surgical treatment must be considered in cases of objectionable aesthetic alteration, progressive recessions, or increased hypersensitivity. The surgical technique chosen depends on the presence of adequate or inadequate keratinized tissue. If the existing keratinized gingiva is adequate but a gingival recession is present, usually a displacement flap is used to cover the recession. If the keratinized gingival is inadequate, gingival grafting is necessary to cover recession defects. Risk factors, such as noncarious cervical lesions and the tooth type may influence the outcome.

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INTRODUCTION
Gingival recession (GR) can be defined as the exposure of the root surface caused by an apical shift in the gingival margin \[1\], which is normally circumferential and 1 to 3 mm coronal to the cemento-enamel junction (CEJ) \[2\].

Some types of GRs occur in the absence of periodontal disease. Such GRs are considered muco-gingival deformities and included in the category of developmental or acquired deformities and conditions, according to Armitage’s 1999 classification \[3\]. GRs can be localized or generalized, and one or more surfaces may be involved \[4\].

More than 50% of the population exhibit GR \[5\]. Albandar and Kingman \[6\] found that, in the United States, the prevalence of GRs 1-mm or larger in people aged 30 years and older was 58%. The prevalence of GR increased with age, and men were more affected than women \[7\]. GRs associated with labially positioned teeth occurred in 40% of the patients, 16 to 25 years of age \[8\]. Susin et al. \[9\] found a high prevalence of GRs in a Brazilian population, with more than half of the individuals presenting ≥3-mm recession defects. In this study, GRs were associated with a high level of periodontal disease.

REVIEW AND DISCUSSION
The etiology of GR is multi-factorial \[10\]. Causative factors act on anatomically vulnerable areas (i.e., areas with predisposing factors) to produce coronal displacement of the marginal gingiva \[11\]. One such predisposing factor is the prior lack of alveolar bone on the site, in the form of a bone fenestration or dehiscence, which in turn may be due to the buccal placement of the root relative to adjacent teeth \[12\] or to a bucco-lingual root thickness that is similar to or exceeds the crestal bone thickness \[13\]. Another anatomical factor associated with GRs is an insufficient quantity of attached gingiva, meaning the attached gingiva is absent or shallow. In addition, a healthy periodontium can be associated with thin gingiva and thin (or dehiscent) alveolar bone. This type of periodontium has decreased resistance to mechanical or bacterial stress.

The most frequent triggering factors are: local trauma such as vigorous tooth-brushing, aberrant frenal attachments, operative injuries, tobacco chewing, lip or tongue piercing, orthodontic movement of teeth to a position outside the labial or lingual alveolar plate, and local gingival inflammation \[14\].
Vigorous or incorrect tooth-brushing can produce GR\textsuperscript{146}. Recessions occur more frequently in persons with good rather than poor oral hygiene\textsuperscript{14} and have been positively associated with the frequency of personal dental care\textsuperscript{1a}. Tooth-brushing–associated marginal gingival recessions are usually localized to the labial surfaces and frequently associated with cervical abrasions\textsuperscript{1c}. Most people are right-handed, brushing more vigorously the left side of the mouth, so gingival recessions are more frequently observed on the left side\textsuperscript{1a}. The recessions are more frequent on premolars, suggesting that tooth profile and position may contribute to recession\textsuperscript{190}. However, Litonjua et al.\textsuperscript{33} consider that more studies are needed to clarify the causal relationship between tooth-brushing and marginal GR. Recession defects have also been related to the use of a hard toothbrush.

Oral piercing is another traumatic factor that may produce GRs\textsuperscript{22}. Buccal GRs has been associated with lip piercing\textsuperscript{122a,22} and lingual GRs, with tongue piercing\textsuperscript{327,322}. Multiple oral piercing sites have been associated with recessions affecting both lingual and labial surfaces of multiple teeth\textsuperscript{328a}.

GRs may also be associated with tobacco-use\textsuperscript{301}. Approximately 25-30% of smokeless tobacco users develop localized GRs\textsuperscript{32,33} , most frequently on facial sites and in the areas where the tobacco is placed\textsuperscript{122a}. Many people with GR seek treatment because they are anxious about tooth loss\textsuperscript{3} , but they may also be concerned about poor aesthetics or dentinal hypersensitivity. Root caries and cervical abrasions, often noted by primary dentists, are signs of GR that may cause people to seek treatment. However, the evolution of recession defects can be stopped. With minimal lesions that do not require specific aesthetic treatment, a nonsurgical treatment that targets the etiology of GR may be effective. The two major causative factors of GR are plaque-induced, local gingival inflammation and traumatic tooth-brushing. Therefore, controlling these factors will usually prevent further progression of the defects. Eliminating the causative factor is necessary to prevent the development of additional lesions or the recurrence of a surgically covered recession. Furthermore, monitoring of the lesions is necessary to assess disease activity over time\textsuperscript{335a}.

Marginal GRs are the most commonly cited reasons for the exposure of dentinal tubules and dentin hypersensitivity\textsuperscript{3a}. If dentin hypersensitivity is the only symptom, a noninvasive approach to treatment is a good choice. Such treatment is usually designed to decrease the tubular liquid flow, block the nerve response in the pulp, or both. The fluid flow can be reduced by agents that lock the dentinal tubules; such agents include composite resins, bonding agents, glass ionomers, aluminum oxalates, potassium oxalates, and nitrates. Desensitizing toothpastes do provide benefits in such cases\textsuperscript{123a} and can be used as a first line treatment. If the pain persists, more complex or invasive treatments may be appropriate, such as the application of resins for sealing dentinal tubules or pulpectomy. Data on this subject have been reported by the Canadian Advisory Board on Dentin Hypersensitivity\textsuperscript{3a} and in the reviews of Walter\textsuperscript{36} and MacCarthy\textsuperscript{40}.

If one can stabilize the recessions by identifying and avoiding causative factors, and by eliminating hypersensitivity, this treatment may be sufficient.

In cases of objectionable aesthetic alterations, progressive recessions, or increased hypersensitivity, surgical treatment to cover the exposed areas must be considered\textsuperscript{3a}. Treating GRs is a challenge for the dental practitioner who must consider the objective clinical signs, subjective symptoms, and the patient’s expectations regarding the treatment outcome.

Miller’s classification\textsuperscript{33} is probably the most widely used in describing the clinical features of GRs. According to this system, in class I Miller defects, the recessed marginal gingiva does not extend to the muco-gingival junction and there is no loss of interproximal periodontium; thus mucogingival surgery often results in full coverage. Total root coverage can also be anticipated for class II Miller defects, which differ only in that they extend to or beyond the mucogingival junction, with intact interproximal tissues. Partial root coverage could be obtained for class III Miller recessions, where there is a moderate loss of interproximal periodontal tissue. In class IV Miller defects, full root coverage cannot be expected due to the severe loss of interproximal tissue.

The rate of the coverage depends on several factors, including the type of the recession and the technique used\textsuperscript{1a}. The surgeon’s skill also affects the success of the procedure\textsuperscript{1a}. Other factors that influence the outcome are discussed below.

The surgical technique is chosen based on the presence of adequate or inadequate keratinized tissue. GRs in which the
existing keratinized gingiva is adequate are not very common. In such cases, a displacement flap (a coronally advanced flap [CAF], a laterally positioned pedicle flap, or a semilunar flap) is usually performed to cover the recession \cite{45}. More common clinical situations combine the presence of the recession defect and a poorly keratinized attached gingiva. For covering these cases, procedures require gingival grafting. Free gingival grafts (FGGs), lateral displaced flaps, submerged connective tissue grafts (SCTGs), or, more recently, guided tissue regeneration (GTR) is used for this purpose.

The outcome of a surgical technique can be expressed as a success rate (i.e., the average percentage of root that is covered) and as a predictability (i.e., the percentage of treated teeth in which complete root coverage is achieved) \cite{45}.

The laterally positioned pedicle graft \cite{46} is an effective coverage technique but cannot be performed unless there is a significant amount of attached gingiva lateral to the recession site. A shallow vestibule may also jeopardize outcomes \cite{47}. Even if this technique provides an ideal color match, it is often inadequate for covering multiple defects \cite{46}. In addition, the procedure carries the risk of creating recessions in the donor area \cite{45}.

A CAF may be used in the presence of an adequate quantity of attached gingiva or following a previous FGG \cite{48}. Fig. 1 presents a 2-mm high and 5-mm wide class I Miller recession on a maxillary right canine. The keratinized tissue was created beforehand by an FGG. Fig. 2 shows the outcome of the treatment one month after covering the GR with a CAF.

The double-papilla repositioned flap \cite{49} may be used to cover defects in which an insufficient amount of gingiva is present; the only advantages of this technique are the dual blood supply and the limitation of denudation to the interdental bone.

An FGG \cite{50,51} requires the preparation of the recipient site with supraperiosteal dissection and of the donor site (usually the palate). A FGG is considered a predictable root coverage procedure associated with an ample gain in attached gingiva.
and vestibular depth \([\delta]\), but it tends to produce unacceptable color matches and can heal with a “keloid” appearance. Other authors consider it unpredictable \([\xi]\). Two studies reported that the success rate of FGGs was only 43% \([\zeta]\) and 53.15% ± 21.48% \([\eta]\). However, other studies reported a success rate of 100% for class I Miller defects, 88% for class II Miller defects \([\zeta]\), and 70% for recessions less than 3-mm wide \([\delta]\).

As mentioned above, FGGs have advantages over SCTGs when the apicoronal dimension of the gingival unit must be increased, for example, in areas where the recession is associated with decreased vestibular depth. The treatment of such cases with an SCTG results in small apical increases of attached gingiva and the overall result is thicker but still movable mucosal tissue. The vestibular depth remains inadequate, even if the recession defect is covered \([\alpha]\). An FGG is also recommended for treating mandible incisives with recessions and a very fine gingiva which makes it almost impossible to create a resistant flap that will sustain an SCTG \([\epsilon]\). Fig. 3 shows a class II Miller recession defect on a mandibular left central incisor that was completely covered by an FGG (Fig. 4). The gain of attached gingiva for the involved and adjacent teeth was important (Fig. 5).

A two-step procedure, as mentioned above, has also been proposed for severe recessions associated with minimal vestibular depth \([\alpha]\). To increase the success rate of root coverage, many clinicians have attempted to combine different procedures. An SCTG \([\epsilon]\) uses a connective tissue graft collected from the palate; the graft may then be covered by a partial-thickness CAF. A class I Miller GR on a maxillary left canine was covered using this technique, where the graft was completely covered by the flap (Figs. 6 and 7). At the 3-month follow-up examination, the defect was completely covered (Fig. 8).
Figure 6
Fig. 6. A class I GR, on a maxillary left canine, 2 mm in height and 5 mm in width.

Figure 7
Fig. 7. A CAF completely covering the SCTG and the recession defect on a maxillary canine

Figure 8
Fig. 8. Three months after the SCTG and CAF depicted in Fig. 7. The exposed root on a maxillary left canine is completely covered.

Bruno [59] modified this technique by eliminating vertical incisions and introducing sulcular incisions on adjacent teeth. Raetzeke [60] suggested an “envelope technique” for coverage of an isolated root.

Allen [61] presented a supraperiosteal envelope which allows conservation of the existing gingiva for treating multiple, adjacent recessions. Clinical trials of a tunnel procedure for covering multiple defects provided good results [62,63]. The tunnel techniques are time consuming and, in the case of thin gingiva, can be performed in two steps [64]. Nelson [65] used a connective tissue graft with a double pedicle graft and achieved a success rate of 88–100%, depending on the dimensions of the defects. Figs. 9–13 show sequential photographs from such an approach.
Figure 9
Fig. 9. A class II GR, 6 mm in height and 4 mm in width, on a maxillary left canine.

Figure 10
Fig. 10. The connective tissue graft placed on the recessed area the maxillary left canine shown in Fig. 9

Figure 11
Fig. 11. The prepared double pedicle flap for covering the SCTG and the GR on the maxillary left canine.

Figure 12
Fig. 12. The double pedicle flap and the connective tissue graft in place, covering the GR on the maxillary left canine.
Lafargue et al. [66] had good results with an SCTG inserted in a high buccal position (“kangaroo graft”). Two advantages of this technique are the persistence of the papillary vascularization and the avoidance of vertical incisions.

The STCG has a predictability of 48.5–93% [67,63]. The success rate has been reported at 69.2–98.9% [68], 80% [54], and 85.23% ± 17.86% [55].

SCTG with a double pedicle graft, an envelope flap, or a CAF result in similar success rates, but the first two procedures produce a greater increase in keratinized tissue [69,70,71,72].

Acellular dermal matrix may be placed as a graft material under a CAF, but the success rates with this method have been worse than those with a CAF without acellular dermal matrices. Enamel matrix derivatives in conjunction with CAF increase the success rate and predictability [73].

To reduce morbidity at the donor site and promote real regeneration at the graft site, GTR has been proposed for root coverage [74]. Pini-Prato et al. [75] reported that success rates with GTR were 72.73% at 18 months and 73.07% at 4 years. This technique is time consuming and its success depends on the surgeon’s expertise. In addition, complications, when they occur, are difficult to treat.

Conventional muco-gingival surgery, however, results in higher success rates and width of keratinized gingiva [76,77,78,79].

We have already mentioned that the type of recession according to Miller’s classification influences the outcome of the surgical procedure. Other characteristics of the GR defect influence surgical results. A wider recession negatively influences the predictability [80]. Predictability is lower with a wide-deep recession than with a shallow-narrow one, because of the large avascular area that impedes graft survival. The tooth type and location in the arch may also influence the predictability. For example, predictability is lower with recessions of canines and molars than with other teeth [80].

Noncarious cervical lesions associated with GRs negatively influence predictability, and surgical results depend on the location and size of the cervical lesion and on the relationship of the lesion to the CEJ [81]. When the pulpal depth of the lesion is severe and root coverage is attempted, enameloplasty of the sharp edges and planning of the CEJ are indicated [82]. An error in localizing the CEJ may lead to incomplete coverage, and the patient may be disappointed, based on the erroneous conclusion that the treatment has failed [83]. Initial recession depth also influences the outcome of the clinical procedure [84].

Other factors related to the technique may influence the success rate. The recession reduction is less important when the flap is put under tension before suturing [82]. The flap thickness is also a significant predictor of the clinical outcome for a root coverage procedure: the thicker the flap, the greater the root coverage [85]. For bilaminar techniques, the thickness of the graft should be less than 1 mm [86]. Furthermore, the position of the gingival margin of the flap influences the outcome. Greater reductions in the recession defect are associated with greater coronal displacement of the flap relative to the CEJ [87]. In addition, avoiding vertical incisions improves the vascularization of the flap and the outcome [82].

Many authors consider that gingival grafting is less successful in smokers than in nonsmokers [88,89].

If the standard clinical indicator used to quantify results after periodontal plastic surgery is considered the mean root coverage (i.e., success rate), then the microscopically determined gold standard for assessing outcome is evidence of true periodontal regeneration. Only the histological examination can reveal cellular events at the grafted tissue–root surface interface and the nature of the clinically
observed attachment.

Histological examinations of root coverage after an SCTG with a double pedicle flap have revealed long or short junctional epithelia, long connective tissue attachments, but no regeneration of bone or cementum \([a]\). An SCTG under the complete coverage of a partial thickness CAF was associated either with complete root coverage and periodontal regeneration \([a]\) or with partial root coverage and a long junctional epithelium, with minimal new attachment and bone formation \([a]\). An SCTG with a partial thickness CAF plus Emdogain® (Enamel Matrix Derivative) was associated with 33% root coverage and periodontal regeneration (1.87 mm of new bone, and 2.25 mm of connective tissue anchored in 0.06 mm of new cementum) (Rasperini et al. \([a]\)).

Periodontal regeneration was also associated with SCTGs with full thickness CAFs (Goldstein et al. \([a]\)). The laterally positioned flap, the CAF, the laterally positioned flap combined with the connective tissue graft, and the FGG all provided periodontal regeneration after having covered marginal gingival recessions \([a]\). True periodontal regeneration has also been observed in GRs treated with GTR \([a]\).

In daily clinical practice, periodontologists must advise patients with GRs on which procedure is best suited to meet the patients’ goals and achieve complete root coverage.

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