Gingival Recessions: Epidemiologic, Etiologic and Therapeutic Aspects

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Citation

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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 [67] . GRs associated with labially positioned teeth occurred in 40% of the patients, 16 to 25 years of age, and in 80% of the patients 36 to 86 years of age [7] . Susin et al. [8] 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 [9] . Causative factors act on anatomically vulnerable areas (i.e., areas with predisposing factors) to produce coronal displacement of the marginal gingiva [10] . 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 [11] or to a bucco-lingual root thickness that is similar to or exceeds the crestal bone thickness [12] . 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 [1013] .

Vigorous or incorrect tooth-brushing can produce GR [1415] . Recessions occur more frequently in persons with good rather than poor oral hygiene [7] and have been positively associated with the frequency of personal dental care [16] . Tooth-brushing–associated marginal gingival recessions are usually localized to the labial surfaces and frequently associated with cervical abrasions [17] . 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 [18] . The recessions are more frequent on premolars, suggesting that tooth profile and position may contribute to recession [1920] . However, Litonjua et al. [21] 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 [22] . Buccal GRs has been associated with lip piercing [2324] [25] and lingual GRs, with tongue piercing [26272422] . Multiple oral piercing sites have been associated with recessions affecting both lingual and labial surfaces of multiple teeth [2829] .

GRs may also be associated with tobacco-use [3031] . Approximately 25-30% of smokeless tobacco users develop localized GRs [[[[32. 33]]]]), most frequently on facial sites and in the areas where the tobacco is placed [3234] .

Many people with GR seek treatment because they are anxious about tooth loss [5] , 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 [3536] .

Marginal GRs are the most commonly cited reasons for the exposure of dentinal tubules and dentin hypersensitivity [36] . 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 [3738] 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 [39] and in the reviews of Walter [36] and MacCarthy [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 [41] . 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 [42] 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 muco-gingival 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 muco-gingival 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 [43] . The surgeon's skill also affects the success of the procedure [44] . 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 [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) [45] .

The laterally positioned pedicle graft [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 [47] . Even if this technique provides an ideal color match, it is often inadequate for covering multiple defects [43] . In addition, the procedure carries the risk of creating recessions in the donor area [45] .

A CAF may be used in the presence of an adequate quantity of attached gingiva or following a previous FGG [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.

Figure 1

Fig. 1. Class I Miller GR, 2 mm in height and 5 mm in width on a maxillary right canine

Figure 2

Fig. 2. One month after having covering the maxillary right canine GR with a CAF

The double-papilla repositioned flap [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 [5051] 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 [52] , but it tends to produce unacceptable color matches and can heal with a “keloid” appearance. Other authors consider it unpredictable [53] . Two studies reported that the success rate of FGGs was only 43% [54] and 53.15% ± 21.48% [55] . However, other studies reported a success rate of 100% for class I Miller defects, 88% for class II Miller defects [52]), and 70% for recessions less than 3-mm wide [56] .

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 [45] . 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 [57] . 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 [4845] . To increase the success rate of root coverage, many clinicians have attempted to combine different procedures. An SCTG [58] 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 3

Fig. 3. A class II GR, 3 mm in height and 4 mm in width on a mandibular left central incisor.

Figure 4

Fig. 4. Ten days after an FGG used for covering the GR shown in Fig. 3

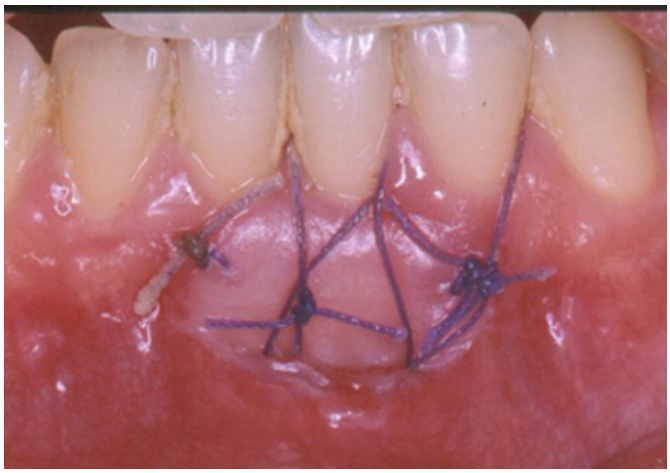

Figure 5

Fig. 5. One year after an FGG for covering the class II GR shown in Fig. 3.

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 [6263] . 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

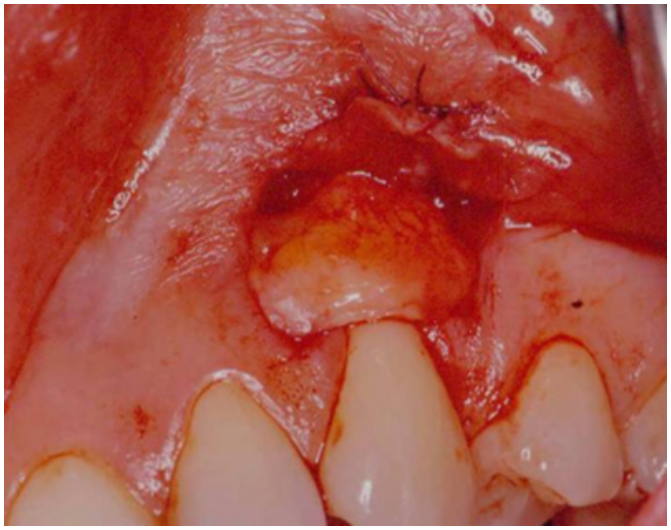

Figure 11

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.

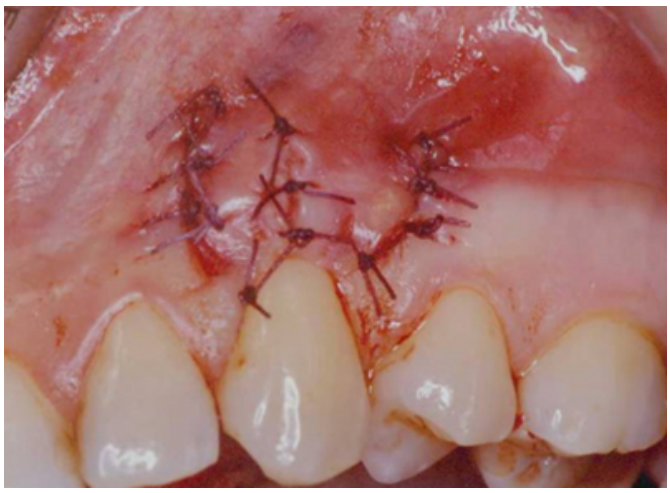

Figure 13

Fig. 13. Ten days after a double pedicle flap and an SCTG for 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 papillar vascularization and the avoidance of vertical incisions.

The STCG has a predictability of 48.5–93% [6763] . 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 [69707172] .

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 [76777879] .

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 deep-wide 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 [8477] .

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 coronary displacement of the flap relative to the CEJ [87] . In addition, avoiding vertical incisions improves the vascularization of the flap and the outcom [82] .

Many authors consider that gingival grafting is less successful in smokers than in nonsmokers [8889] .

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 [90] . An SCTG under the complete coverage of a partial thickness CAF was associated either with complete root coverage and periodontal regeneration [91] or with partial root coverage and a long junctional epithelium, with minimal new attachment and bone formation [92] . 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. [93]).

Periodontal regeneration was also associated with SCTGs with full thickness CAFs (Goldstein et al. [94]). 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 [47959697] . True periodontal regeneration has also been observed in GRs treated with GTR [9899] .

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.

References

1. Caranza FA, Takey HH. Muco-gingival surgery. In: Caranza FA, Newman MG (ed). Clinical Periodontology, cpt.59, pgs. 651-671, 8th WB Saunders Company, Philadelphia 1996.
2. Caudill RF, Oringer RJ, Langer L et al. Esthetic Periodontics (periodontal plastic surgery), In: Wilson TG, Kornman KS eds. Fundamentals of Periodontics, cpt. 26, pgs. 497-518, Quintessence Publishing Co.Inc 1996,
3. Armitage GC. Development of a classification system for periodontal diseases and conditions. Ann Periodontol 1999; 4(1): 1-6
4. Smith RG.Gingival recession: reappraisal of an enigmatic condition and a new index for monitoring. J Clin Periodontol 1997; 24: 201: 205
5. Kassab MM, Cohen RE. The etiology and prevalence of gingival recession. JADA 2003; 134: 220-225
6. Albandar JM, Kingman A. Gingival recession, gingival bleeding and dental calculus in adults 30 years of age and older in the United States, 1988-1994. J Periodontol 1999; 70(1): 30-43
7. Gornman WJ. Prevalence and etymology of gingival recession. J Periodontol 1967; 38: 316-322
8. Susin C, Haas AN, Oppermann RV et al. Gingival recession: epidemiology and risk indicators in a representative urban brazilian population. J Periodontol 2004; 75: 1377-1386
9. Addy M, Hunter ML. Can Tooth brushing damage your health? Effects on oral and dental tissues. Int Dent J 2003; 53(suppl3): 177-186.
10. Borghetti A, Monnet Corti V. Les recessions tissulaires marginales, cpt. 4, In: Borghetti A, Monnet Corti V. (edts). Chirurgie plastique parodontale, pgs. 102-126, Edition Cdp 2000,
11. Lost C. Depth of aalveolar bone dehiscences in relation to gingival recessions. J Clin Periodontol 1984; 11: 583-589
12. Olsson M. Lindhe J. Periodontal characteristics in individuals with varying form of the upper central incisors. J Clin Periodontol 1991; 18(1): 78-82
13. Wennstrom, Lindhe J , Sinclaire F, Thilander B. Some periodontal tissue reactions to orthodontic tooth movement in monkeys. J Clin Periodontol 1987; 14(3): 121-129
14. Bergstrom J, Eliasson S. Cervical abrasion in relation to tooth-brushing and periodontal health. Scand J Dent Res 1988; 96: 405-411
15. Proceedings of the World Workshop in Periodontics. Consensus report on mucogingival therapy. Ann Periodontol 1996; 1:702-706
16. Valhkalahti M. Occurrence of gingival recession in adults. J Periodontol 1989; 60: 599-603
17. Gillette WB, Van House TL. The effects of improper oral hygiene procedures. JADA 1980; 10(1): 476-480
18. Addy M, Mostafa P, Newcombe RG. Dentine hypersensitivity: the distribution of recession, sensitivity and plaque. J Dent 1987; 15: 242-248
19. Checchi L, Daprile G, Gatto MRA et al. Gingival recession and toothbrushing in an Italian school of dentistry: pilor study. J Clin Periodontol 1999; 26: 276-280
20. Kleber BM. Localized periodontal recession-only caused by chronic trauma? Parodontol 1991; 2: 235-243
21. Litonjua LA, Andreana S, Bush O, Cohen R. Toothbrushing and gingival recession. Int Dent J 2003; 53(2): 67-72.
22. Chambrone L, Chambrone LA. Gingival recessions caused by lip piercing: case report. Journal of Canadian Dental Association 2003: 69(8): 505-508
23. Soileau KM. Treatment of a muco-gingival defect associated with intraoral piercing. J Am Dent Assoc 2005; 136(4): 490-494
24. Campbell A, Moore A, Williams E et al. Tongue piercing: impact of time and barbell stem length on lingual gingival recession and tooth chipping. J Periodontol 2002; 73(3): 289-297
25. Er N, Ozkavaf A, Berbeglu A, YAmalik N. An unusual cause of gingival recession: oral piercing. J Periodontol 2000; 71(11): 1767-1769
26. Boardman R, Smith RA. Dental implications of oral piercing. J Calif Dent Assoc 1997; 25(3): 200-207
27. De Moor RJ, De Witte AM, De Bruyne MA. Tongue piercing and associated oral and dental complications. Endodont Dent Traumatol 2000; 16(5): 232-237
28. Brooks JK, Hooper KA, Reynolds MA. Formation of muco-gingival defects associated with intraoral and perioral piercing. J Am Dent Assoc 2003; 134(7):837-843
29. Dibart S, De Feo P, Surabian G et al. Oral piercing and gingival recession : review of the literature and a case report. Quintessence Int 2002; 33(2):110-112
30. Taybos G. Oral changes associated with tobacco use. Am J Med Sci 2003; 326(4): 179-182
31. Winn DM. Tobacco use and oral disease. J Dental Education 2001; 65(4):306-312
32. Robertson PB, Walsh M, Green J et al. Periodontal effects associated with smokeless tobacco. J Periodontol 1990; 61: 438-443
33. Greer RO Jr, Poulson TC. Oral tissue alteration

associated with the use of smokeless tobacco by teen-agers. Part I. Clinical findings. Oral Surg Oral Med Oral Pathol 1983; 56: 275-284
34. Johnson GK, Slach NA. Impact of tobacco use on periodontal status. J Dent Educ 2001; 65(4): 313-321
35. Tugnait A, Clerehugh V. Gingival recession-its significance and management. J Dent 2001; 29(6): 381-394
36. Walters PA. Dentinal hyepersensitivity: a review. The Journal of Contemporary Dental Practice, 2005; 6(2): 107-117
37. Nagata T, Ishida H, Shinohara H et al. Clinical evaluation of a potassium nitrate dentifrice for the treatment of dentinal hypersensitivity. J Clin Periodontol 1994; 21(3):217-221
38. Poulsen S, Errboe M, Hovgaard O et al. Potassium nitrate toothpaste for dentine hypersensitivity (Review). The Cohrane Collaboration 2004; Issue 4, Wiley Publisher 1-11.
39. Canadian Advisory Board on Dentin Hypersensitivity. Consensus-Based Recommendations for the Diagnosis and Management of Dentin Hypersensitivity. J Can Dent Assoc 2003; 69(4): 221-226
40. MacCarthy D. Dentine hypersensitivity: a review of the literature. J Ir Dent Assoc 2004; 50(1): 36-41
41. Pasquinelli KL. Periodontal plastic surgery as an adjunctive therapeutic modality for esthetic restorative dentistry. CDA Journal 2005; 33(3): 217-221
42. Miller PD Jr. A classification of marginal tissue recession. Int J Periodontics Restorative Dent 1985; 5(2): 9-13
43. Kassab MK, Cohen RE. Treatment of gingival recession. JADA 2002; 133: 1499-1506
44. Lovegrove J, Leichter J. Exposed root surface: a review of aetiology, management and evidence-based outcomes of treatment. New Zealand Dental Journal 2004; 100(3): 72-81
45. Camargo PM, Lagos RA, Lekovic V, Wolinsky LE. Soft tissue root coverage as treatment for cervical abrasion and caries. General Dentistry 2001; 49(3): 299-304
46. Grupe HE, Warren RF. Repair of gingival defects by a sliding flap operation. J Periodontol 1956; 27: 92-95
47. Mattout P, Mattout C. Recouvrement radiculaire. Etude histologique de la cicatrisation 5 ans apres un lambeau postioné latéralament. J Parodontol Implantol Orale 2005; 24(3): 179-184
48. Bernimoulin JP, Luscher B, Muhleman H. Coronally repositioned periodontal flap. J Clin Periodontol 1975; 2: 1-13
49. Cohen DW, Ross SE. The double papillae repositioned flap in periodontal therapy. J Periodontol 1968; 39: 65-70
50. Sullivan HC, Atkins JH. Free autogenous gingival grafts, part III: utilization of grafts in the treatment of gingival recession. Periodontics 1968; 6(4): 152-161
51. Miller PD. Root coverage using the free soft tissue autograft following acid citric application. Part I: Technique. Int J Periodontics Restor Dent 1982; 2: 60-70
52. Miller PD. Root coverage using the free soft tissue autograft following acid citric application. III. A successful and predictable procedure in area of deep-wide recession. Int J Periodontics Restor Dent 1985; 5: 14-37
53. Sedan CL, Breault LG, Covington LL, Bishop BG. The subepithelial connective tissue graft: Part I. Patient selection and surgical techniques. J Contemp Dent Pract 2005b; 6(1): 146-162.
54. Janke PV, Sandifer JB, Gher ME et al. Thick free gingival and connective tissue autografts for root coverage. J Periodontol 1993; 64(4): 315-322
55. Paolantinio M, di Murro C, Cattabriga A et al. Subepithelial connective tissue graft versus free gingival graft in the coverage of exposed root surfaces. A 5-year clinical study. J Clin Periodontol 1997; 24(1): 51-56
56. Matter J. Creeping attachment of free gingival grafts. A five-year follow-up study. J Periodontol 1980; 51(12): 681-685
57. Romagna-Genon C, Genon P. Esthetique et parodontie: les cles du succes, cpt.3-Les recessions gingivales et leur traitement, pgs.17-48, Editions CdP 2001,
58. Langer B, Langer L. Subepithelial connective tissue graft technique for root coverage. J Periodontol 1985; 56: 715-720
59. Bruno JF. Connective tissue graft technique assuring wide root coverage. Int J Periodontics Restorative Dent 1994; 14: 127-137
60. Raetzke P. Covering localized area of root exposure employing the “envelope” technique. J Periodontol 1985; 56: 397-402
61. Allen AL. Use of the supraperiosteal envelope in soft tissue grafting for root coverage. II. Clinical results. Int J Periodontics Restorative Dent 1994; 14(4): 302-315
62. Tozum TF. A promising periodontal procedure for the treatment of adjacent gingival recession defects. J Can Dent Assoc 2003; 69;(3): 155-159
63. Tozum TF, Dini FM. Treatment of adjacent gingival recessions with subepithelial connective tissue grafts and modified tunnel technique. Quintessence Int 2003; 34(1): 7-13
64. Terry DA, McGuire MK, McLaren E et al. Perioesthetic approach to the diagnosis and treatment of carious and noucarious cervical lesions: part I. J Esthet Restor Dent 2003; 15: 217-232
65. Nelson S. The subpedicle connective tissue graft: a bilaminar reconstructive procedure for the coverage of denuded root surfaces. J Periodontol 1986; 58: 95-102
66. Laffargue P, Soliveres S, Fleming M, Bousquet P. Subepithelial connective tissue grafts inserted in a high buccal position, or “kangaroo graft”: a preliminary study. J Parodontol Implantol Orale 2006; 25(4): 301-307
67. Bouchard P, Etienne D, Ouhayoun JP et al. Subepithelial connective tissue grafts in the treatment of gingival recessions. A comparative study of 2 procedures. J Periodontol 1994; 65(10): 929-936
68. Wennstrom JL, Zucchelli G. Increased gingival dimensions. A significant factor for successful outcome of root coverage procedures. A 2-year prospective clinical study. J Clin Periodontol 1996; 23(8):770-777
69. Harris RJ. Connective tissue grafts combined with either double-pedicle grafts or coronally positioned pedicle grafts: results of 266 consecutively treated\defects in 200 patients. Int J Periodontics Restaurat Dent 2002; 22(5): 663-471
70. Cordioli G, Mortarino C, Chierico A. et al. Comparison of 2 techniques of subepithelial connective tissue graft in the treatment of gingival recessions. J Periodontol 2001; 72(11): 1470-1476
71. Karring T, Lang NP, Loe H. The role of gingival connective tissue in determining epithelial differenciation. J Periodontal Res 1975; 10: 1-11
72. Ketata N, Turki S, Mattout C. Traitement des récessions parodontales. Recouvrement total ou partiel du greffon conjonctif. L’information dentaire 2006 ; 41 : 2627-2633.
73. Cairo F, Pagliaro U, Nieri M. Treatement of gingival recession with coronally advanced flap procedures: a systematic review. J Clin Periodontol 2008; 15 (suppl 8): 136-162)
74. Tinti C, Vincenzi GP. The treatment of gingival recession with “guided tissue regeneration” procedures by means of Gore-Tex membranes. Quintessence Int 1990; 6: 465-468
75. Pini Prato G, Clauser C, Cortellini P et al. Guided tissue regeneration versus mucogingival surgery in the treatment of

human buccal recessions. A 4-year follow-up study. J Periodontol 1996; 67: 1216-1223
76. Al-Hamdan K. Eber R, Sarment D et al. Guided tissue regeneration-based root coverage : meta-analysis. J Periodontol 2003; 74(10):1520-1533
77. Danesh-Meyer MJ, Wikesjo UM. Gingival recession defects and guided tissue regeneration: a review. J Periodontol Res 2001; 36(6): 341-354
78. Oates TW, Robinson M, Gunsolley JC. Surgical therapies for the treatment of gingival recession. A systematic review. Ann Periodontol 2003; 8(1): 303-320
79. Roccuzzo M, Bunito M, Needleman I, Sanz M. Periodontal plastic surgery for treatment of localized gingival recessions: a systematic review. J Clin Periodontol 2002; 29(suppl 3): 178-194.
80. Al-Zahrsni MS, Bissada NF. Predictability of connective tissue grafts for root coverage: clinical perspectives and a review of the literature. Quintessence Int 2005; 36: 609-616
81. Thery L, Micheletti AM. Greffe de tissue conjonctif tunnelisée et tractée coronairement. L'information Dentaire 2007; 3 : 61-64
82. Pini Prato GP, Franceschi D, Cairo F, Rotundo R. Pronostic factors in the treatment of gingival recessions. J Parodontol Implantol Orale 2006; 25(3): 175-190
83. Zucchelli G, Testori T, De Sanctis M. Clinical and anatomical factors limiting treatment outcomes of gingival recession : a new method to predetermine the line of root coverage. J Periodontol 2006; 77: 714-721
84. Clauser C, Nieri M, Franceschi D et al. Evidence-based muco-gingival therapy. Part 2. Ordinary and individual patient data meta-analyses of surgical treatment of recession using complete root coverage as the outcome variable. J Periodontol 2003; 74: 741-756
85. Baldi C, Pini Prato GP, Pagliaro U et al. Coronally advanced flap procedure for root coverage. Is flap thickness a relevant predictor to achieve root coverage? A 19-cqse series. J Periodontol 1999; 70: 1077-1084
86. Zucchelli G, Amore C, Sforza NM et al. Bilaminar techniques for the treatment of recession-type defects. A comparative clinical study. J Clin Periodontol 2003; 30: 862-870
87. Pini Prato GP, Baldi C, Rotundo R et al. The treatment of gingival recession associated with deep corono-radicular abrasions (CEJ step)- a case series. Periodontics 2004; 1: 57-66
88. Miller PD Jr. Root coverage with the free gingival graft: factors associated with incomplete root coverage. J Periodontol 1987; 58: 674-681
89. Zucchelli G, Clauser C, De Sanctis M, Calandirello M. Mucogingival versus guided tissue regeneration procedures in the treatment of deep recession type defects. J Periodontol 1998; 69: 138-145
90. HarrisRJ. Succesful root coverage: a human histologic evaluation of a case. Int J Periodontics Restorative Dent 1999; 19(5):439-447
91. Harris RJ. Human histologic evaluation of root coverage obtained with a connective tissue with partial thickness double pedicle graft. A case report. J Periodontol. 1999; 70(7):813-21
92. Majzoub Z, Landi L, Grusovin MG, Cordioli G. Histology of connective tissue graft. A case report. J Periodontol. 2001; 72(11):1607-15.
93. Rasperini G, Silvestri M, Schenk RK, Nevins ML. Clinical and histologic evaluation of human gingival recession treated with a subepithelial connective tissue graft and enamel matrix derivative (Emdogain): a case report. Int J Periodontics
Restorative Dent. 2000;20(3):269-75.
94. Goldstein M, Boyan BD, Cochran DL, Schwartz Z. Human histology of a new attachement after root coverage using subepithelial connective tissue graft. J Clin Periodontol 2001; 28: 657-662
95. Sugarman EF. A clinical and histological study of the attachment of grafted tissue to bone and teeth. J Periodontol 1969 ; 40(7) : 381-387
96. Pasquinelli KL. The histology of new attachement utilizing a thick autogenous soft tissue graft in an area of deep recession: a case report. Int J Period Restorat Dent 1995; 15(3): 248-257
97. McGuire MK, Cochran DL. Evaluation of human recession defects treated with coronally advanced flaps and either enamel matrix derivative or connective tissue. Part 2: Histological evaluation. J Periodontol. 2003; 74(8):1126-35.
98. Cortellini P, Clauser C, Prato GP. Histologic assessment of new attachment following the treatment of a human buccal recession by means of a guided tissue regeneration procedures. J Periodontol 1993; 64(5): 387-391
99. Parma-Benfenati S, Tinti C. Histologic evaluation of new attachment utilizing a titanium-reinforced barrier membrane in a mucogingival recession defect. A case report.J Periodontol. 1998; 69(7):834-9.

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