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Guided tissue regeneration in human gingival recessions

A 10-year follow-up study

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Abstract

Objective: The aim of the present study was to evaluate the changes of the mucogingival complex of guided tissue regeneration (GTR)-treated gingival recession defects over a 10-year follow-up.

Methods: The study population consisted of 20 patients, 11 males and nine females, mean age: 44.3 ± 10.4 years, each contributing one recession defect treated with a polytetrafluoroethylene membrane. Eight patients were smokers at the time of surgery and at 10 years post-surgery. Recession depth (RD), probing depth clinical attachment level (CAL), and width of keratinized gingiva (KG) were assessed immediately before surgery, at 6 months, 4 years and 10 years post-surgery.

Results: RD was 0.9 ± 0.6 mm at 6 months, 1.0 ± 1.3 mm at 4 years and 1.3 ± 1.6 mm at 10 years. CAL amounted to 1.9 ± 1.0 mm at 6 months and shifted to 2.2 ± 1.4 and 2.6 ± 1.6 mm at 4 years and 10 years, respectively. KG significantly increased following surgery and remained stable thereafter. At 10-year examination, no significant changes from 4-year evaluation were observed. Differences in periodontal parameters between smokers and non-smokers were not statistically significant.

Conclusion: In conclusion, the results of the present study failed to demonstrate changes over time in the clinical outcome achieved following GTR procedure in gingival recession defects over a period between 4 and 10 years post-surgery.

Key words: gingival recession/surgery; guided tissue regeneration; smoking

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Several different techniques have been described in order to cover the exposed root surface and increase the dimensions of the keratinized tissue in gingival recession defects. Ideally, the primary aim of these surgical therapies is the complete restoration of the anatomy of the mucogingival complex and the regeneration of the attachment apparatus of the tooth, including cementum with inserting connective tissue fibres, and alveolar bone on previously exposed root surfaces (Danesh-Meyer & Wikesjö 2001, Trombelli 1998).

Guided tissue regeneration (GTR) consists of the placement of a barrier membrane between the surgical flap and the root surface to prevent the gingival epithelial and connective tissues from contacting the root surface during healing (Gottlow et al. 1986, Nyman et al. 1982). Several studies have shown that the use of both non-resorbable (Pini Prato et al. 1992, Trombelli et al. 1994, 1995, 1997) and resorbable (Harris 1997, Pini Prato et al. 1995, Roccuzzo et al. 1996, Shieh et al. 1997, Trombelli et al. 1998a, Trombelli et al. 1998b, Tatakis & Trombelli 2000) membranes improved the soft-tissue condition of gingival recession defects in terms of clinical attachment gain, recession depth (RD) reduction and keratinized tissue increase. Recently, two systematic reviews have supported the efficacy of GTR procedure in the treatment of gingival recession defects (Al-Hamdan et al. 2003, Roccuzzo et al. 2002).

We have previously demonstrated the long-term stability of treatment outcomes achieved by GTR with non-resorbable membranes when used to correct gingival recession defects (Scabbia & Trombelli 1998). After a 4-year maintenance programme, subjects showed a similar location of the gingival margin and mucogingival junction (MGJ) when compared with 6-month healing period. A slight, not significant, increase in RD and clinical attachment level (CAL) was observed at 4-year examination. Our results confirmed those reported by Pini Prato and co-workers who showed a stability of the periodontal parameters between 18 months and 4 years following GTR treatment of recession defects (Pini

Prato et al. 1996). The aim of the present study was to evaluate the changes of the mucogingival complex of GTR-treated gingival recession defects over a 10-year follow-up period.

Material and methods

Study population

The study population included 20 patients, 11 males and nine females, aged 35–69 years (mean age: 44.3 ± 10.4 years), who had been treated with GTR procedures for Miller's Class I or II, deep (⩾3 mm), buccal gingival recession defects during the period 1991–1993 at the Department of Periodontology, University of Ferrara (Trombelli et al. 1995). Recession defects were selected only when they had revealed RD reduction ⩾2 mm and root coverage ⩾60% at 6 months following GTR treatment. Each patient contributed one recession defect. Recession defects were located at 11 maxillary canine teeth, four mandibular canine teeth, three maxillary premolar teeth, one mandibular premolar tooth, and one mesiobuccal root of maxillary first molar tooth.

Data of the present study derived from the re-evaluation of the 20 patients included in a previous 4-year follow-up study (Scabbia & Trombelli 1998). Out of 20 patients, eight patients were re-evaluated at 10 years, 11 patients at 11 years and one patient at 12 years following surgery. For simplicity, we will refer to the last evaluation as ''10-year examination''.

Therapy

Surgical procedure was described in detail in previous reports (Trombelli et al. 1994, 1995). Briefly, prior to surgery patients were treated with initial therapy including periodontal debridement and oral hygiene instructions. Surgical treatment consisted of full-partial thickness flap elevation and root debridement. Expanded polytetrafluoroethylene membranes (Gore-Tex Periodontal Material, W.L. Gore & Associates Inc., Flagstaff, Arizona, USA) were placed to cover the defects extending 3 mm apically over the adjacent alveolar crest and 1 mm coronal to the cemento–enamel junction, and were secured in this position with teflon sutures (Gore-Tex Suture; CV-5, W.L. Gore & Associates Inc.). Sharp periostium dissections were performed in order to passively adapt the flap without any tensions and to obtain a primary closure over the membrane. Patients were prescribed tetracycline, 250 mg q.i.d. for 7 days, and were instructed to rinse with a 0.12% chlorhexidine solution, twice daily for 8 weeks. Six weeks after the surgical procedure the membrane was removed. The newly formed tissue was protected by the readapted flap. Two weeks later, the patients reinstituted mechanical oral hygiene procedures, and were monthly recalled for maintenance periodontal therapy during the 6 months post-surgery.

All surgical procedures were performed by one operator (L.T.).

Recordings and maintenance

Immediately before surgery (pre-surgery examination), at 6 months, 4 years and 10–12 years post-surgery a calibrated probe (UNC 15, Hu-Friedy, Chicago, IL, USA) was used to assess RD, probing depth (PD), CAL, and width of keratinized gingiva (KG) at the midbuccal aspect of the defect. KG was assessed by using the visual method (Guglielmoni et al. 2001). All probing measurements were rounded to the nearest 0.5 mm. Two trained and calibrated examiners performed the recordings: one examiner (A.S.) performed the 6-month and 4-year recordings, while a different examiner (L.M.) performed the 10-year recordings. Inter-examiner reproducibility was not assessed.

Following the 6-month evaluation, the frequency of the maintenance appointments was determined on the basis of the efficiency of each patient's plaque control performance until 4-year examination (Scabbia & Trombelli 1998). Thereafter, all patients were referred to their dentist for regular supportive therapy based on a 6-month recall programme.

Smoking status

At the time of the surgical procedure, nine patients (seven male) mean age 33.2 years (range 23–57 years), were smokers, and 11 patients (four males) mean age 38.5 years (range 27–57 years) were non-smokers. Patients were considered as smokers if they smoked at least 10 cigarettes/day (Trombelli & Scabbia 1997). Smokers were not asked to change their smoking habit before or after surgery, nor did they do so to our knowledge until 4-year follow-up (Scabbia & Trombelli 1998). However, after 4-year examination one smoker had quit smoking. Therefore, at 10-year examination non-smokers amounted to 12 patients.

Statistical analysis

Data were expressed as mean ± standard deviation (S.D.). The statistical significance of mean differences between recordings from 6-month to 10-year examination and from 4- to 10-year examination was analysed using paired Student's *t*-test. Inter-group (smokers *versus* non-smokers) differences were analysed using Student's *t*-test for independent observations. The level of significance was set at 5%. Under $\alpha = 0.05$, the study had statistical power to reveal a true difference in CAL change when the observed difference between smokers and non-smokers was 1.1 mm.

Results

Table 1 shows the clinical recordings (RD, PD, CAL, KG) as assessed at pre-surgery, 6-month, 4- and 10-year examination.

At 6 months, RD was 0.9 ± 0.6 mm, RD reduction being 3.6 ± 0.9 mm which represented a root coverage of 80%. RD increased to 1.0 ± 1.3 mm at 4 years and 1.3 ± 1.5 mm at 10 years. When compared with the 4-year examination, at the 10-year examination 10 defects showed stable RD, five defects presented a more coronal location of the gingival margin, five defects presented RD increase of 1 mm. Ten-year RD was not significantly different from 6-month and 4-year recordings.

PD varied from 1.0 ± 0.5 mm at 6-month evaluation to 1.2 ± 0.4 and 1.4 ± 0.5 mm at 4- and 10-year examination, respectively. The difference between 6-month PD and 10-year PD was statistically significant ($p = 0.042$).

At 6 months, CAL amounted to 1.9 ± 1.0 mm. With respect to pre-surgery recording CAL gain was 4.2 ± 1.3 mm, 60% of the defects showing CAL gain ⩾4 mm. CAL increased to 2.2 ± 1.4 mm at 4 years, and 2.6 ± 1.6 mm at 10-year examination. At the 10-year examination, 15 defects showed CAL change ± 1 mm, four defects revealed CAL loss ⩾2 mm,

Table 1. Clinical recordings as assessed at pre-surgery examination (0), 6 month (6 m), 4 year (4y) and 10 year (10y) evaluation

Pt.	Tooth	Smoker	RD_0	PD_0	CAL_0	KG_0	Smoker	RD_{6m}	PD_{6m}	CAL_{6m}	KG_{6m}	Smoker	RD_{4y}	PD_{4y}	CAL_{4y}	KG_{4y}	Smoker	RD_{10y}	PD_{10y}	CAL_{10y}	KG_{10y}
1	#1.4	Y	4.0	1.0	5.0	1.0	Y	1.0	1.0	2.0	3.0	Y	0.5	1.0	1.5	4.0	Y	0.0	1.0	1.0	4.5
2	#2.4	Y	4.0	2.0	6.0	1.0	Y	0.0	1.0	1.0	3.0	Y	1.0	1.0	2.0	3.5	Y	0.0	2.0	2.0	5.0
3	#2.6	Y	5.0	1.0	6.0	1.0	Y	1.0	1.0	2.0	3.0	Y	2.0	1.0	3.0	1.0	N	4.0	2.0	6.0	2.0
4	#3.3	Y	4.0	2.0	6.0	1.0	Y	1.0	1.0	2.0	3.0	Y	3.0	1.0	4.0	4.0	Y	2.0	1.0	3.0	3.0
5	#4.3	Y	5.0	1.0	6.0	0.0	Y	2.0	1.0	3.0	2.0	Y	3.0	1.0	4.0	3.0	Y	2.0	1.0	3.0	2.0
6	#1.4	N	6.0	2.0	8.0	0.0	N	2.0	2.0	4.0	1.0	N	4.0	2.0	6.0	2.0	N	5.0	1.0	6.0	1.0
7	#3.3	N	5.0	2.0	7.0	2.0	N	2.0	1.0	3.0	3.0	N	2.0	1.5	3.5	3.0	N	2.0	1.0	3.0	3.0
8	#4.3	N	3.0	2.0	5.0	3.0	N	1.0	1.0	2.0	3.0	N	0.5	2.0	2.5	4.0	N	0.0	1.0	1.0	3.0
9	#2.3	N	4.0	2.0	6.0	5.0	N	0.0	1.0	1.0	4.0	N	0.0	1.0	1.0	3.5	N	0.0	1.0	1.0	4.0
10	#1.3	Y	5.0	1.0	6.0	3.0	Y	1.0	1.0	2.0	5.0	Y	0.0	1.0	1.0	4.0	Y	0.0	1.0	1.0	4.0
11	#2.3	Y	5.0	1.0	6.0	1.0	Y	1.0	2.0	3.0	4.0	Y	0.0	1.0	1.0	4.0	Y	0.0	1.0	1.0	3.0
12	#2.3	Y	4.0	2.0	6.0	3.0	Y	0.0	1.0	1.0	3.0	Y	1.5	1.0	2.5	3.0	Y	4.0	1.0	5.0	2.0
13	#1.3	N	4.0	1.0	5.0	2.0	N	1.0	0.0	1.0	2.0	N	0.0	1.0	1.0	3.0	N	0.0	2.0	2.0	3.0
14	#2.3	N	4.0	1.0	5.0	1.0	N	1.0	1.0	2.0	3.0	N	0.0	1.0	1.0	3.0	N	0.0	2.0	2.0	3.0
15	#1.3	Y	4.0	3.0	7.0	2.0	Y	0.0	0.0	0.0	3.0	Y	0.0	1.0	1.0	3.0	Y	0.0	1.0	1.0	2.0
16	#1.3	N	4.0	1.0	5.0	3.0	N	1.0	1.0	2.0	3.0	N	0.0	1.0	1.0	2.5	N	1.0	2.0	3.0	4.0
17	#3.4	N	4.0	1.0	5.0	2.0	N	1.0	1.0	2.0	3.0	N	2.0	1.0	3.0	1.5	N	2.0	1.0	3.0	2.0
18	#1.3	N	6.0	2.0	8.0	3.0	N	1.0	1.0	2.0	4.0	N	0.0	1.0	1.0	4.0	N	2.0	2.0	4.0	3.0
19	#2.3	N	6.0	1.0	7.0	2.0	N	0.0	0.0	0.0	4.0	N	0.0	2.0	2.0	3.0	N	0.0	2.0	2.0	5.0
20	#2.3	N	4.0	1.0	5.0	2.0	N	1.0	1.0	2.0	3.0	N	1.0	1.0	2.0	3.5	N	1.0	1.0	2.0	5.0
Mean			4.50	1.50	6.00	1.90		0.90	0.95	1.85	3.10		1.03	1.18	2.20	3.13		1.25	1.35	2.60	3.18
S.D.			0.83	0.61	0.97	1.21		0.64	0.51	0.99	0.85		1.25	0.37	1.38	0.86		1.50	0.49*	1.60†	1.16

Pt, patient; RD, recession depth; PD, probing depth; CAL, clinical attachment level; KG, keratinized gingiva; Y, yes. N: no.
*Statistically significant from PD_{6m} value.
†Statistically significant from CAL_{6m} value.

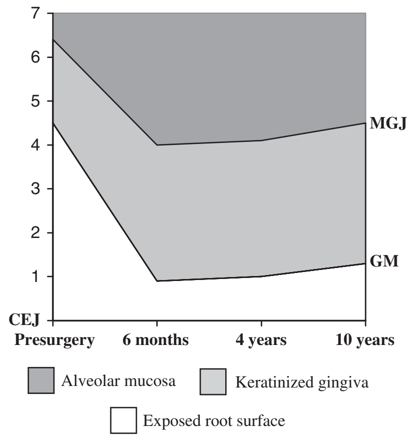

Fig. 1. Mean location (in millimeter) of the gingival margin (GM) and mucogingival junction (MGJ) immediately pre-surgery, 6 months, 4 and 10 years post-surgery (CEJ, cemento–enamel junction).

one defect gained 1.5 mm of attachment as compared with the 4-year examination. 10-year CAL was significantly different from 6-month CAL ($p = 0.044$).

KG amounted to 3.1 ± 0.9 mm at 6 months following surgery, and remained stable at 4- and 10-year examination. At the 10-year examination, a KG loss of 1 mm was observed in eight defects, five defects showed KG increase of at least 1 mm as compared with the 4-year examination.

Figure 1 illustrates the extent of root exposure, the location of the gingival margin and the MGJ over time. The MGJ appeared displaced coronally at 6 months post-surgery, and remained stable thereafter.

At 10-year examination, as compared with the 4-year examination, RD, CAL and KG changes were -0.1 ± 1.2, 0.0 ± 1.1 and -0.4 ± 1.0 mm, respectively, in smokers, and 0.5 ± 0.8, 0.7 ± 1.4 and 0.3 ± 1.0 mm, respectively, in non-smokers. No significant differences were found for the changes between the 4- and the 10-year examination between groups. The inclusion/exclusion of the smoker patient who had quit smoking after the 4-year evaluation did not significantly influence the results.

Discussion

The results of the present study indicate that clinical outcome of gingival recession defects achieved following GTR procedure can be maintained between 4

and 10 years following surgery. At most defects, RD, CAL and KG changes between 4- and 10-year examination did not exceed 1 mm. However, significant CAL loss and PD increase were detected at 10 years when compared with early post-surgery examination (6 months).

Selection of defects that presented substantial root coverage at 6 months evaluation has allowed to observe alterations in soft-tissue gain and CAL over the portion of root surface which had been successfully covered. In our material, a limited apical shift of the gingival margin was recorded over time. Moreover, the variation in probing recordings observed after 4-year examination is clinically and statistically not significant as well as compatible with the measurement error of such recordings (Isidor et al. 1984, Guglielmoni et al. 2001), thus indicating the stability of treatment outcome at 10 years.

In contrast, a significant increase of CAL and PD was observed from 6-month to 10-year examination. Subjects were enrolled in a regular supportive programme until 4 years post-surgery, and referred to their dentist for regular maintenance thereafter. Unfortunately, data regarding the level of compliance to oral hygiene instructions and recall visits were not available following the 4-year examination. Although statistically significant, the magnitude of the recorded variation from 6-month evaluation may be regarded as clinically compatible with that reported in long-term (10–12 years) longitudinal studies of periodontal attachment loss and pocket depth in healthy adults with regular maintenance (Ship & Beck 1996) and high standard of oral hygiene (Serino et al. 1994).

In the present study, MGJ appeared displaced coronally at 6 months post-surgery, and remained stable over 10-year follow-up. These findings are consistent with those reported at 12 months following treatment of deep and wide recession defects by means of coronally advanced flap with or without non-resorbable membrane (Trombelli et al. 1997). Other short-term pre-clinical (Karring et al. 1975) and clinical (Fagan 1975) studies showed a displacement of the MGJ either in an apical or coronal direction following mucogingival surgery. Overall, these observations did not support the hypothesis that regression of the MGJ to its genetically determined location may contribute to time–related changes in the mucogingival complex following surgery (Trombelli 1998). However, previous studies on apically repositioned flap procedure failed to show a permanent shift of MGJ at 18 years post-surgery (Ainamo et al. 1992). In this perspective, evidence exist that MGJ location remains stable with age as related to fixed skeletal points (Ainamo 1978, Ainamo & Talari 1976). Therefore, the possibility for MGJ to revert to its original position may not be excluded over a longer observation period.

Clinical studies have suggested that cigarette smoking adversely affects short-term outcome of GTR procedures in gingival recession defects (Trombelli & Scabbia 1997). In contrast, our previous results failed to demonstrate significant differences in 4-year periodontal stability in GTR-treated recession defects between smokers and non-smokers (Scabbia & Trombelli 1998). Consistently, a limited impact of smoking status on periodontal condition was confirmed at 10-year evaluation. This may reflect the minimal detrimental effect of smoking exposure on the occurrence and progression of gingival recessions observed following active and maintenance phase of periodontal therapy (Ah et al. 1994, Kaldahl et al. 1996).

In conclusion, the results of the present study failed to demonstrate changes over time in the clinical outcome achieved following GTR procedure in gingival recession defects over a period between 4 and 10 years post-surgery. Neither augmentation of apico-coronal dimension of the gingiva nor apical shift of MGJ location to its original location has been observed at 10-year examination. Finally, smoking status did not affect the stability of treatment outcome on a long-term basis.

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