

Root Coverage With Connective Tissue Grafts: An Evaluation of Short- and Long-Term Results*

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Background: Subepithelial connective tissue grafts have been shown to be effective in obtaining root coverage. However, little is known about the long-term results. The goal of this study was to evaluate and compare the short-term (13.0 weeks) and long-term (27.5 months) root coverage results obtained with subepithelial connective tissue grafts.

Methods: One-hundred patients with 146 Miller Class I or Class II recession defects were treated with subepithelial connective tissue grafts to obtain root coverage. The changes in the clinical measurements were compared between the preoperative and short-term results, between preoperative and long-term results, and between short-term and long-term results.

Results: The mean root coverage at 13.0 weeks was 97.1% and 98.4% at 27.5 months. This difference was statistically significant. There was a statistically significant decrease in recession and probing depth, reduction in attachment loss, and increase in quantity of keratinized tissue between the preoperative and short-term results and between the preoperative and long-term results. There was a statistically significant decrease in recession, increase in the quantity of keratinized tissue, increase in probing depth, and increase in attachment loss between short-term and long-term results.

Conclusions: The results of this study demonstrate that the subepithelial connective tissue graft is an effective method to cover exposed roots. The mean root coverage tended to improve with time. *J Periodontol* 2002;73:1054-1059.

KEY WORDS

Gingival recession/surgery; gingival recession/therapy; grafts, soft tissue; grafts, gingival; tooth root/surgery; surgical flaps; grafts, connective tissue.

The use of connective tissue grafts has made obtaining esthetic root coverage a predictable procedure. Multiple clinical studies have demonstrated high rates of success using connective tissue to obtain root coverage.^{1,2} This has made root coverage procedures commonplace in the clinical practice of periodontics.

When a connective tissue graft is used for root coverage it is combined with an overlying pedicle graft (subepithelial connective tissue graft). The pedicle can be a coronally positioned pedicle, as suggested by Langer and Langer.³ A double pedicle or laterally positioned pedicle can be placed over the connective tissue graft, as suggested by Nelson.⁴ Another design was proposed by Raetzke⁵ when he suggested the use of an envelope flap. Allen^{6,7} reported on the use of a technique where a connective tissue graft is placed in a tunnel. Numerous other authors have provided variations on the techniques and provided support to the original techniques. The result of these studies is that a subepithelial connective tissue graft is a predictable procedure to obtain esthetic root coverage.^{1,2}

Unfortunately, the vast majority of studies have relatively short follow-up periods. In a review of root coverage procedures, in 1996, only 6 had follow-up periods of over 2 years.¹ Certainly, there are many reasons why there are so few long-term studies. However, the importance of longer term evaluations cannot be underestimated. Short-term evaluations document that a procedure will obtain the desired result, which in this case is root coverage. How-

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Figure 1.
Preoperative.



Figure 2.
Incisions.

ever, if the result is not maintained over time, then the procedure is of no value.

The goal of the present study was to evaluate the long-term stability of root coverage results obtained in a private practice environment using a subepithelial connective tissue graft.

MATERIALS AND METHODS

One hundred patients (70 female and 30 male) were included in this retrospective study. There were 146 recession defects: 24 maxillary premolars, 31 maxillary cuspids, 6 maxillary incisors, 7 mandibular molars, 38 mandibular premolars, 17 mandibular cuspids, and 23 mandibular incisors. The mean age was 43.3 years old (range 18 to 70 years; standard deviation [SD] = 11.3 years). To be included in this group a patient had to have had a subepithelial connective tissue graft on a Miller Class I or Class II defect,⁸ an evaluation of the graft at approximately 12 weeks (PO1) (mean, 13.0 weeks; range 9 to 18 weeks; SD = 2.2 weeks), and at least an 18-month follow-up evaluation (PO2) (mean, 27.5 months; range 18 to 61 months; SD = 10.6 months). There were 7 smokers. All patients were from the author's private practice. The 100 patients who met the criteria above were selected from 537 consecutively treated patients with subepithelial connective tissue grafts for root coverage. All patients who met the criteria were included. The goal was to compare the root coverage results achieved between the 2 evaluations (PO1 and PO2).

All patients were in good health with no contraindications to surgical periodontal therapy. An informed consent form was signed by all patients. Preoperative (PR) measurements included: marginal tissue recession measured at the deepest point (recession), the quantity of keratinized tissue (measured at the point the recession was measured), and probing depth (mea-

sured at the same point as the recession). Attachment levels were calculated by combining the recession and probing depth. The measurements were rounded to the nearest 0.5 mm. All measurements were made by the author with a standard Williams style periodontal probe.

The surgical procedures were performed by the author, as previously described,^{3,9-11} and preoperative photographs were taken (Fig. 1). After obtaining anesthesia, the exposed root was root planed and treated with a tetracycline solution (125 mg tetracycline in 1 cc of saline). Incisions were made to create a recipient bed and a pedicle graft that would cover the largest portion of exposed root with no tension on the pedicle (Fig. 2). Double pedicles, lateral pedicles, coronally positioned pedicles with vertical incisions, coronally positioned pedicles without vertical incisions, and a combination of 2 or more of these techniques were used. The pedicle was reflected by sharp dissection (Fig. 3). In cases where a double pedicle was used, the pedicles were joined with 5-0 or 6-0 gut or chromic gut sutures (Fig. 4). A connective tissue graft was obtained from the palate with a scalpel with parallel blades,[†] as previously described.⁹ The epithelial border was trimmed and discarded. The connective tissue graft was sutured into the recipient bed with 5-0 or 6-0 gut or chromic gut sutures (Fig. 5). The pedicle graft was then sutured over the connective tissue graft with 5-0 gut or chromic gut sutures (Fig. 6). Isobutyl cyanoacrylate[‡] and a periodontal dressing[§] secured with floss were applied. Verbal and written postoperative instructions were given. Unless contraindicated, all patients were placed on a non-steroidal anti-inflammatory, chlorhexidine rinse and a narcotic preparation (to be taken if needed). No systemic antibiotics were used,

† Harris Double Blade Graft Knife, H & H Company, Ontario, CA.

‡ Isodent, Ellman International, Hewlett, NY.

§ Barricaid, Dentsply, L.D. Caulk Division, Milford, DE.



Figure 3.
Reflected partial thickness pedicle.



Figure 4.
Double pedicles joined with 5-0 gut sutures.



Figure 5.
Connective tissue graft sutured over recession defect.



Figure 6.
Pedicle sutured over connective tissue graft.

except in those cases where antibiotics were used as prophylaxis for a medical condition.

Patients were seen at 1 to 2 weeks, 4 to 6 weeks, and approximately 12 weeks (PO1) postoperatively (Fig. 7) and a final follow-up at least 18 months postoperative (PO2) (Fig. 8). Dressings were removed 1 to 2 weeks postsurgery. Chlorhexidine rinsing was discontinued at 4 to 6 weeks. Patients were returned to normal oral hygiene as soon as the tissue had healed to the point where this was possible. The same measurements recorded at PR were recorded at PO1 and PO2 by the author with a standard Williams style periodontal probe.

All clinical measurements were reported to 2 decimal places; however, it is important to remember that all measurements were accurate only to the nearest 0.5 mm. An alpha of 0.05 was selected for all statistical evaluations. A paired *t* test¹² was used to determine if there were significant differences in the mean changes in clinical parameters between PR and

each of the follow-up exams (PO1 and PO2), between PO1 and PO2, and for mean root coverage from PR to PO1 versus PR to PO2. A computer spreadsheet^{||} was used for the calculations. For all calculations the patient was the unit of measurement. If more than one defect was treated, then a mean of the patient's clinical measurements was used.

RESULTS

Recession significantly decreased by a mean of 3.68 mm (SD = 1.01 mm) by PO1. Although small, there was a significant decrease between PO1 and PO2. The 0.06 mm (SD = 0.26 mm) improvement was statistically significant. Similarly, there was a significant increase in the amount of keratinized tissue by PO1 (mean, 2.43 mm; SD = 1.20 mm). Once again, the small increase in keratinized tissue (mean 0.58 mm;

^{||} Excel 2000, Microsoft, Redmond, WA.



Figure 7.
Postoperative 12 weeks (PO1).



Figure 8.
Postoperative 43 months (PO2).

SD = 0.71 mm) between PO1 and PO2 was statistically significant (Table 1).

The probing depth decreased by PO1 (mean 1.01 mm; SD = 0.44 mm). This difference from PR to PO1 was statistically significant. However, there was a statistically significant increase in probing depth between PO1 and PO2 (mean 0.30 mm; SD = 0.39 mm). The gains in attachment levels were similar to the probing depth changes. Attachment levels improved by a statistically significant amount between PR and PO1 (mean 4.69 mm; SD = 1.13 mm). However, there was a statistically significant attachment level loss between PO1 and PO2 (mean 0.24 mm; SD = 0.53 mm) (Table 1).

The mean root coverage between PR and PO1 was 97.1%. The mean root coverage between PR and PO2 was 98.4%. This difference was statistically significant (Table 2).

Complete root coverage was obtained in 83 (83%) of the patients at PO1. At PO1 there was complete

root coverage in 128 (87.7%) of the 146 defects treated. The mean root coverage for the 17 patients with less than complete root coverage at PO1 was 83.0% (range, 71.4% to 92.9%; SD = 7.2%). In these 17 patients, the following changes occurred between PO1 and PO2: 9 obtained complete root coverage; 4 had an increase in root coverage, but not 100%; 3 remained the same; and 1 had a decrease in root coverage.

Complete root coverage was obtained in 89 (89%) of the patients at PO2 and in 135 (92.5%) of the 146 defects. Of the 11 patients who did not have complete root coverage, 3 patients had complete root coverage at PO1 and 8 patients did not. The mean root coverage for these 11 patients at PO2 was 87.2% (range 71.4% to 94.4%; SD = 8.1%).

DISCUSSION

The results of this study demonstrate that a subepithelial connective tissue graft is an effective method to obtain root coverage. The mean root coverage at PO1 was 97.1% and there was complete root coverage in 83% of the patients (87.7% of the defects). At PO2 the mean root coverage was 98.4% and there was complete root coverage in 89% of the patients (92.5% of the defects). Both of these results compare well with those of others. Wennström¹ reported an average mean root coverage of 89.3% and complete root coverage in 20% to 89% of the studies when connective tissue was used to obtain root coverage. Bouchard et al.² suggested a mean root coverage of 70% to 80% and complete root coverage in 50% of the cases was an average for root coverage studies.

Probably the most significant and interesting finding of this study is that the mean root coverage improved with time. Obtaining a successful clinical result is of little value if it is not retained. In this study, the mean root coverage increased from 97.1% to 98.4% from PO1 to PO2. It is unknown whether this finding will continue with time. However, at this point the results are compatible with a good long-term result.

The results of this study are different than previous studies examining long-term results with an acellular dermal matrix¹³ and guided tissue regeneration.¹⁴ In the acellular dermal matrix study¹³ the short-term results (12 weeks) had a mean root coverage of 91.7% and the long-term results (18.6 months) had a mean root coverage of 87.0%. The difference was not statistically significant. In the guided tissue regeneration study¹⁴ the short-term results (6 months) had a mean root coverage of 92.3% and the long-term results (25.3 months) 58.8%. This difference was statistically significant. In the present study, there was a statistically significant increase in the mean root coverage between the short-term follow-up (97.1%) and the long-term follow-up (98.4%).

Table 1.
Clinical Changes

	Mean	SD	Range	P Value
Recession				
PR	3.82	1.22	2.00-9.00	
PO1	0.14	0.38	0.00-2.00	
PR vs. PO1	3.68	1.01	0.00-4.00	<0.00001
PO2	0.08	0.29	0.00-2.00	
PR vs. PO2	3.73	1.13	2.00-8.00	<0.00001
PO1 vs. PO2	0.06	0.26	-1.00-1.00	0.02977
Keratinized tissue width				
PR	1.07	1.01	0.00-4.00	
PO1	3.50	1.25	1.50-7.00	
PR vs. PO1	2.43	1.20	0.00-6.00	<0.00001
PO2	4.08	1.19	1.50-7.50	
PR vs. PO2	3.01	1.23	-.25-6.00	<0.00001
PO1 vs. PO2	0.58	0.71	-1.50-2.50	<0.00000
Probing depth				
PR	2.04	0.41	1.00-3.50	
PO1	1.03	0.50	0.50-3.00	
PR vs. PO1	1.01	0.44	0.00-2.50	<0.00001
PO2	1.33	0.43	0.50-2.50	
PR vs. PO2	0.72	0.49	-.50-2.50	<0.00001
PO1 vs. PO2	0.30	0.39	-1.00-1.00	<0.00000
Attachment levels				
PR	5.86	1.36	3.50-11.5	
PO1	1.17	0.74	0.50-4.00	
PR vs. PO1	4.69	1.13	2.75-7.50	<0.00001
PO2	1.41	0.58	0.50-4.00	
PR vs. PO2	4.45	1.20	2.00-8.00	<0.00001
PO1 vs. PO2	0.24	0.53	-2.00-2.00	0.00002

PR = Preoperative measurement.

PO1 = Postoperative measurement at PO1.

PO2 = Postoperative measurement at PO2.

P value = probability of t value based on paired t test. All values rounded to 5 decimal places.

Table 2.
Comparison of Mean Root Coverage (%) PR to PO1 versus PR to PO2

	PR to PO1	PR to PO2
Mean root coverage	97.1	98.4
Range	71.4-100.0	71.4-100.0
Standard deviation	7.0	5.2
P value	0.03951	

PR = Preoperative measurement.

PO1 = Postoperative measurement at PO1.

PO2 = Postoperative measurement at PO2.

P value = probability of t value based on paired t test.

This study supports others suggesting that creeping attachment occurs when autogenous soft tissue grafts are used. The mean change in recession depth between PO1 and PO2 in the 17 patients without complete root coverage at PO1 was 0.4 mm (range -0.25 to 1.0 mm; SD = 0.4). This was less than reported in several other studies (0.43 mm to 0.89 mm).¹⁵⁻²⁰ While in absolute terms the amount is minimal, it was enough to achieve complete root coverage in 9 of 17 patients (52.9%) and improve the amounts of root coverage in 4 of 17 additional patients (23.5%).

There was a statistically significant increase in the quantity of keratinized tissue (3.50 mm to 4.08 mm), increase in probing depth (1.03 mm to 1.33 mm), and loss of attachment (1.17 mm to 1.41 mm) between PO1 and PO2. The magnitude of the changes, while statistically significant, may not be clinically significant. Longer-term follow-ups will be needed to determine if these changes continue, reach a certain point and level off, or reverse. In the future, it will also be important to design studies to evaluate root coverage results on different tooth types.

The major problems associated with this study relate to the fact that it was completed in a private practice setting, so there were no blinded evaluations, examiner calibration, evaluation of the reproducibility of the measurements, or pressure sensitive probes or stents to serve as fixed reference points. There was no method to factor out the possibility that the evaluations were biased. However, every attempt was made to be objective in all evaluations. It is important to note that these patients were from a single private practice done by one clinician. Therefore, it is not possible to know if the results are applicable to a larger population. Certainly, a controlled prospective blinded clinical study may produce different results.

Within its limitations, the results of this study demonstrate that a subepithelial connective tissue graft is an effective technique to obtain root coverage. The procedure will produce high levels of mean root coverage in the early healing. The mean amounts of root coverage do not decrease, but tend to improve, with time. The subepithelial connective tissue graft should be considered when root coverage is desired.

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