

Root Coverage and Pocket Reduction as Combined Surgical Procedures

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Background: One of the main objectives of periodontal reconstructive surgery is the coverage of exposed roots due to gingival recession. A large variety of mucogingival grafting procedures are available that give highly predictable and esthetically acceptable results when treating intact root surfaces. However, these procedures call for a second surgery site in the palate. The present study examines a series of cases in which connective tissue, obtained from the tuberosity during pocket reduction procedures in the posterior region of the maxilla, was used for root coverage.

Methods: Forty-four teeth from 25 patients with gingival recession of 3.30 ± 0.14 mm (mean \pm SEM) were treated with subepithelial connective tissue grafts using connective tissue obtained from the tuberosity area during pocket reduction procedures in the posterior region of the maxilla.

Results: The mean root coverage recession after treatment was 0.16 ± 0.06 mm, with effectiveness of coverage at 95.0% \pm 1.84 and a predictability of 84.1%. Periodontal probing depth reduction at the donor site was 4.08 ± 0.24 mm.

Conclusions: These results indicate that the subepithelial connective tissue graft obtained from the tuberosity area during pocket reduction procedures in the posterior region of the maxilla provides a very predictable and esthetic root coverage without the need for a second surgical site. *J Periodontol* 2001;72:1572-1579.

KEY WORDS

Grafts, connective tissue; grafts, subepithelial; gingival recession/surgery; tooth root.

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The exposure of root surfaces by gingival recession may be due to several etiologic factors, including periodontal disease,^{1,2} mechanical forces such as faulty toothbrushing,³ iatrogenic factors like orthodontic movement,^{4,5} faulty restorations,⁶ and anatomical factors such as tooth malposition and frenum pull.^{7,8} Gingival recession seldom results in tooth loss. However, marginal tissue recession is associated with thermal and tactile sensitivity, esthetic complaints, and a tendency toward root caries.⁹⁻¹²

A large variety of mucogingival grafting procedures exist, and today, these procedures are highly predictable and esthetically acceptable when treating intact root surfaces.¹³ Subepithelial connective tissue gingival grafts have been used for the last 2 decades as an esthetic procedure to cover denuded single and multiple surfaces, primarily of maxillary anterior and bicuspid teeth. The use of bilaminar flaps increases clinical predictability of these grafts.^{14,15} Graft vascularity and a high degree of gingival cosmetics are ensured, and the “tire patch” look often associated with free gingival grafts is avoided.^{16,17}

Subepithelial connective tissue is a predictable source of root coverage grafts. Gingival grafts are usually harvested from the palate using a “trap door” approach.^{18,19} Tuberosity areas are other possible donor sources for connective tissue grafts. These regions are sometimes associated in periodontal diseases with large attachment loss. During the treatment of such a defect on the distal area of the second molar, in the area of the tuberosity, the tissue obtained can be used for root coverage on different teeth in the mouth. The present study

examines a series of cases in which connective tissue obtained from the tuberosity area during pocket reduction procedures in the posterior region of the maxilla was used for root coverage.

MATERIALS AND METHODS

Patient Selection

The patients described in this report were selected from those patients referred to the clinic at Hebrew University Hadassah, Department of Periodontics (Jerusalem, Israel), for treatment of periodontal disease and gingival recession defects. The biographical and historical data of all patients were recorded, including age, gender, smoking history, history of previous periodontal treatment, and patient complaints related to esthetics or tooth sensitivity. All patients received oral hygiene instruction and scaling and root planing as part of their initial phase of periodontal treatment. Patients were selected at periodontal reevaluation based on the following criteria: probing depth >5 mm; absence of the upper third molars, thereby leaving a large band for tissue harvesting; and Miller type I or II²⁰ recession gingival defects in at least 1 tooth, requiring root coverage. Using these criteria, 25 patients were selected, resulting in a total of 44 teeth which needed a root coverage procedure. The patients selected included 17 females and 8 males, aged 23 to 48 (mean age: 32). Sixteen of the patients smoked, and 15 had more than one tooth needing root coverage (Table 1).

Attachment level on the distal side of the second molar was determined, and recession measurements were made at the beginning and end of treatment. Recessions were measured where there was the greatest distance between the marginal gingiva and the cemento-enamel junction (CEJ) in the vertical direction. A periodontal probe,^{||} graduated in 1 mm increments, was used for these measurements. Readings were rounded up (≥ 0.5 mm) or down (< 0.5 mm) to the nearest millimeter.

Treatment Procedures

Therapy included periodontal pocket reduction, tuberosity reduction in the posterior maxilla, and root coverage, all performed during the same surgical session. All surgical procedures were performed at the same time. Surgery was performed sometimes in the same quadrant and sometimes in different quadrants. The only exception was that pocket reduction was not performed on teeth requiring root coverage.

Pocket reduction in the posterior maxilla was achieved as follows. An inverse full flap was elevated buccally, and a double flap was elevated at the palatal area. The tuberosity tissue, which was thick (at least 5 mm), was excised completely in one part using a distal wedge. The roots were planed, the soft tissue was debrided, and osteoplasty was done when indicated. No further root

Table 1.
Patient Profile

	N
Age (years)	32.04 \pm 0.99*
Males (n)	8
Females (n)	17
Time of follow-up (months)	32.68 \pm 1.88*
Non-smoking patients (n)	9
Patients smoking less than 10 cigarettes/day (n)	11
Patients smoking between 10 to 20 cigarettes/day (n)	5
Patients smoking more than 20 cigarettes/day (n)	0
Patients requiring coverage of 1 tooth (n)	10
Patients requiring coverage of 2 teeth (n)	11
Patients requiring coverage of 3 teeth (n)	4

* Mean \pm SEM.

treatment or conditioning was done. The flap was apically positioned, and the area involved was sutured.

The surgical procedure used to prepare and place the subepithelial connective tissue graft was a modification of the method described in detail by Langer and Langer.¹⁹ The thick tissue obtained from the tuberosity was deepithelialized, split, "opened" like a book, placed, and then sutured under a partial-thickness flap.

The postsurgery protocol emphasized wound stability and infection control, including amoxicillin (500 mg tid for 1 week) and 0.2% chlorhexidine rinse (0.5 oz bid for 2 weeks). Gingival sutures were removed 2 weeks postsurgery. Mechanical plaque control in the surgical area was reinstated after suture removal. Patients were recalled for plaque debridement, supragingival scaling, and oral hygiene instruction every 2 weeks during the first month and every 2 months after that for the first year. After the first year, patients were placed on a 3-month maintenance schedule.

Data and Statistical Analysis

Data analysis was performed according to the method recently described by Greenwell et al.²¹ In this method, mean root length is used to quantitate true root coverage. This method also allows for the analysis of

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defect coverage area. Frequency data can also be determined and used to assess the predictability of the surgical technique.

Recession was measured before and after treatment, yielding the residual recession defect. Root coverage was calculated based on the assumption of an average root length. Results were calculated with respect to the individual patient and per treatment site. The 2 data sets were compared by analysis of variance and statistical significance between the data sets determined using Bonferroni's modification of Student's *t* test. *P* values ≤ 0.05 were considered significant.

RESULTS

Case Study

A 32-year-old woman presented with root recession and sensitivity to cold on the buccal aspect of tooth #6 and tooth #5. Periodontal evaluation showed general attachment loss. The patient went through an initial treatment phase, which included oral hygiene instruction and root planing. At reevaluation, a 7 mm deep pocket at the distal area of tooth #15 was found. Gingival recession at tooth #5 was 2 mm, with a 4 mm wide area of keratinized tissue. Recession at tooth #6 was 5 mm, with a 2 mm wide area of keratinized tissue (Fig. 1).

The surgical phase of therapy included periodontal pocket reduction, tuberosity reduction in the left posterior maxilla, and root coverage in the upper right maxilla. All surgical procedures were performed during the same session. Pocket reduction in the posterior maxilla was done between tooth #12 and tooth #15 (Fig. 2). The surgery was performed as follows: an inverse bevel mucoperiosteal flap was elevated buccally, and a double flap was elevated in the palatal area, with a distal wedge in the tuberosity area (Fig. 3). The tuberosity tissue, 10 mm wide and 12 mm

long, was completely excised as one piece (Fig. 4). The roots were planed, the soft tissue was debrided, and osteoplasty was done. The flaps were apically positioned, and the secured area was sutured.

The thick tuberosity tissue was deepithelialized, split, and "opened" like a book (Fig. 5). Afterward, root coverage was approached. A horizontal right-angle incision was made into the adjacent interdental papillae at or slightly coronal to the CEJ of the teeth presenting the defects (#5, #6). Two oblique releasing incisions were made, starting at least 0.5 mm from the gingival margin of the adjacent teeth and extending into the alveolar mucosa (Fig. 6). A trapezoidal, full-thickness flap was raised 3 to 4 mm apical to the bone dehiscence, and a partial-thickness dissection was performed to allow for coronal positioning of the flap and suturing of the connective tissue to the periosteum at the basal area. The dehiscence was 8 mm and 4 mm in tooth #5 and tooth #6, respectively (Fig. 7). The connective tissue graft was trimmed and interposed between the flap and the root surface extending from the CEJ to at least

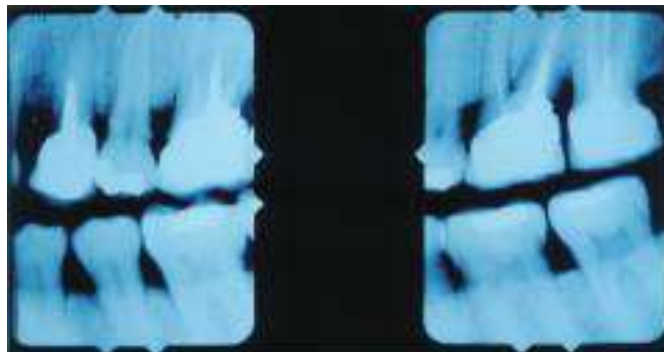


Figure 2.
X-ray of teeth #12 through 15 in the posterior maxilla before surgery.



Figure 1.
A 32-year-old woman presented with gingival recession on the buccal aspects of teeth #5 and #6.



Figure 3.
A full-thickness flap with distal wedge in the area of teeth #12 through 15 in the posterior maxilla.

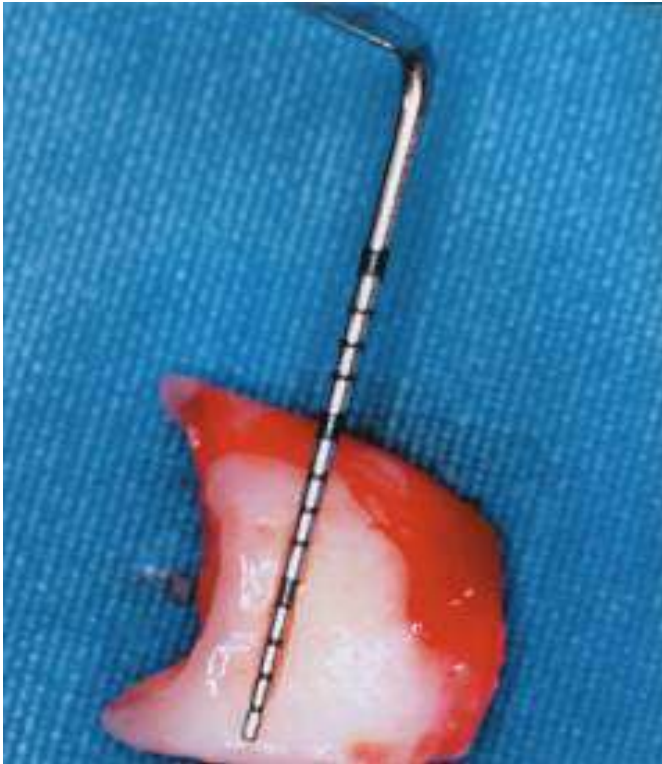


Figure 4.
The tuberosity tissue, 10 mm wide and 12 mm long, excised from the distal area of tooth #15.



Figure 5.
The thick tuberosity tissue was deepithelialized, split, and "opened" like a book.

3 to 4 mm coronal to the dehiscence area, and secured in place with 5-0 resorbable sutures (Fig. 8). Prior to positioning the graft, the adjacent interdental papillae were de-epithelialized. The flap was positioned coronally



Figure 6.
A full-thickness flap with mesial and distal vertical releasing incisions was elevated.

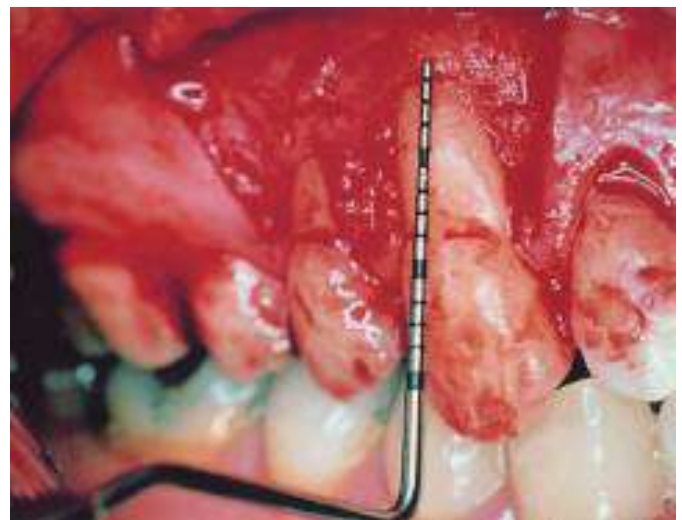


Figure 7.
After reflecting the flap, recessions of 8 mm on #6 and 4 mm on #5, respectively, were found.

without tension to cover the connective tissue graft and secured with 4-0 silk sutures.

The postsurgical protocol emphasized wound stability and infection control. After 6 months, healing was uneventful, including the tuberosity donor area, with no aberrant tissue reaction. After 3 years of follow-up, the pocket on the distal area of tooth #15 was 2 mm, and there was no recession on either tooth #5 or tooth #6 (Fig. 9).

Analysis of Patient Population

The results of 44 consecutively treated gingival recession defects in 25 patients are summarized in Table 2. Partial and complete defect coverage was obtained in



Figure 8.

The connective tissue graft, which was obtained from the tuberosity, was placed to cover the exposed roots and stabilized by sutures.



Figure 9.

Three years postoperatively, full root coverage was obtained on both teeth #5 and #6.

all patients and at all sites. Defect coverage of 100% was achieved in 37 of the 44 gingival defects treated, with an effectiveness of 95.0% and a predictability rate of 84.1%. Initial gingival recession depth was 2 to 6 mm (mean 3.30 ± 0.14 mm), while final recession depth was 0 to 1 mm (mean 0.15 ± 0.06 mm). Defect coverage was 98.9%, with a predictability rate of 100%.

Whether the different clinical measurements were calculated per site or per patient did not alter the outcome (Table 3). The mean initial marginal tissue recession per site was 3.30 mm, while final mean tissue recession was 0.16 mm. Attachment gain after a mean of 32.6 months was a mean of 3.95 mm. The mean keratinized tissue preoperatively was 2.18 mm, while postoperatively (after a mean of 32.6 months), keratinized tissue was 4.63 mm, resulting in a mean gain in keratinized epithelium of 2.45 mm. Periodontal probing depth (PD) reduction at the donor sites on distal upper second molars was registered as a mean of 4.08 ± 0.24 mm (PD reduction from 5 to 8 mm to 2 to 3 mm).

Of the 25 patients, 10 had esthetic concerns, and the final results were acceptable to them. Fifteen of the patients had presented with tooth sensitivity. At follow-up, tooth sensitivity remained in only 1 patient, but at a lower level. There were no significant differences in root coverage between smokers and non-smokers.

DISCUSSION

Subepithelial connective tissue grafts have already been described to be clinically successful.^{19,22-24} Moreover, we have recently shown that this procedure may result in the regeneration of the attachment apparatus, which includes new bone, cementum, and periodontal ligament.²⁵ Here, we show that subepithelial connective tissue grafts can be used to provide root coverage at the same surgical appointment during which

posterior maxillary pocket reduction is performed by taking advantage of the tissue obtained during reduction of the tuberosity.

The effectiveness of defect coverage using this procedure was very high (95%). These results are similar to the effectiveness of root coverage of intact roots presented by Greenwell et al.²¹ These results are also similar to our previous observations using palatal subepithelial connective tissue grafts.²⁵ We found that the predictability frequency of root coverage when treating with subepithelial connective tissue grafts was 89% for defects with caries and 100% for defects with fillings. These predictability frequencies achieved using subepithelial connective tissue grafts are the highest in the published literature.^{15,24,26}

The results of the current study confirm the usefulness and efficiency of the combined surgical periodontal procedures: posterior maxillary pocket reduction with tuberosity reduction and root coverage. Not only can root coverage and pocket reduction be achieved in the same surgical session, but reduction of the tuberosity and splitting of the tissue graft harvested from the tuberosity area as described in this study provide sufficient connective tissue graft to cover numerous exposed roots.

Free connective tissue grafting is intended to create a broader band of attached gingiva and/or root coverage. Using subepithelial connective tissue from the palate or from the saddle regions between standing teeth, Edel¹⁸ successfully achieved this goal. However, Edel did not specify the benefit of tuberosity reduction in pocket reduction and maintenance of retromolar regions.

The results obtained in the present study using subepithelial connective tissue grafts from the tuberosity region compare favorably with results in the literature using other free gingival graft approaches. We

Table 2.
Results of Defect Coverage and Its Effectiveness and Predictability in 44 Teeth (analysis was done according to Greenwell et al.²¹)

Recession Data (mm)			Defect Coverage		Defect Elimination	
Initial Recession Defect	Final Recession Defect	Recession Defect Coverage	Effectiveness Percent Defect Coverage (mean)	Predictability Frequency $\geq 90\%$ Defect Coverage (frequency)	Effectiveness Percent Root Coverage (mean)	Predictability Frequency $\geq 90\%$ Root Coverage (frequency)
2	1	1	50	0	93	1
3	0	3	100	1	100	1
3	0	3	100	1	100	1
2	0	2	100	1	100	1
3	1	2	67	0	93	1
3	1	2	67	0	93	1
4	1	3	75	0	93	1
3	0	3	100	1	100	1
2	0	2	100	1	100	1
3	0	3	100	1	100	1
4	1	3	75	0	93	1
4	0	4	100	1	100	1
3	0	3	100	1	100	1
2	0	2	100	1	100	1
3	0	3	100	1	100	1
3	1	2	67	0	93	1
4	0	4	100	1	100	1
3	0	3	100	1	100	1
3	0	3	100	1	100	1
3	0	3	100	1	100	1
5	0	5	100	1	100	1
5	0	5	100	1	100	1
2	0	2	100	1	100	1
3	0	3	100	1	100	1
3	0	3	100	1	100	1
4	0	4	100	1	100	1
3	0	3	100	1	100	1
3	0	3	100	1	100	1
5	1	4	80	0	93	1
3	0	3	100	1	100	1
2	0	2	100	1	100	1
3	0	3	100	1	100	1
3	0	3	100	1	100	1
4	0	4	100	1	100	1
3	0	3	100	1	100	1
5	0	5	100	1	100	1
3	0	3	100	1	100	1
3	0	3	100	1	100	1
3	0	3	100	1	100	1
3	0	3	100	1	100	1
5	0	5	100	1	100	1
3	0	3	100	1	100	1
3	0	3	100	1	100	1
3	0	3	100	1	100	1
5	0	5	100	1	100	1
3	0	3	100	1	100	1
3	0	3	100	1	100	1
6	0	6	100	1	100	1
Mean (SE)	Mean (SE)	Mean (SE)	Mean (SE)	Frequency	Mean (SE)	Frequency
3.30 (0.14)	0.15 (0.06)	3.14 (0.15)	95.00 (1.84)	37 of 44 (84.1)	98.9 (0.39)	44 of 44 (100.00)

Table 3.**Summary of Clinical Results**

	Initial Recession (mm)	Final Recession (mm)	% Defect Coverage	Attachment Gain (mm)	Pocket Reduction at Molar Area
Per site	3.30 ± 0.14	0.16 ± 0.06	95.0 ± 1.8	3.95 ± 0.15	N/A
Per patient	3.32 ± 0.21	0.16 ± 0.07	94.7 ± 1.9	3.76 ± 0.27	4.08 ± 0.24

Data shown are means ± SEM for 44 teeth (sites) or 25 patients.
N/A = not applicable.

treated 44 teeth and obtained complete root coverage 84.1% of the time, and mean root coverage was 95%. In comparison, Harris²⁷ used partial-thickness, double pedical grafts on 100 defects, obtaining 100% root coverage 89% of the time, with a mean root coverage of 98%. Miller²⁰ obtained 100% root coverage in 90% of Class I and II defects. Additionally, Miller reported mean root coverage of 92.2%. Holbrook and Ochsenbein²⁸ reported 100% root coverage in 44% of their cases. Raetzke²⁹ obtained 100% root coverage in 41.7% of their cases and mean root coverage of 80%, and Nelson¹⁴ reported 100% root coverage in 62% of his cases and mean root coverage of 91%. Langer and Langer¹⁹ reported an increase in root coverage of 2 to 6 mm. This result is in accordance with our report; initial marginal gingival recession was 2 to 6 mm, while final recession depth was 0 to 1 mm. Pini Prato et al.³⁰ obtained a mean root coverage of 72.7% using guided tissue regeneration to treat mucogingival defects. Additionally, guided tissue regeneration procedures used to treat gingival recessions achieved a mean root coverage of 77%, as reported by Trombelli et al.,³¹ 77% reported by Tinti et al.,³² 74% reported by Tinti and Vincenzi,³³ and 76% reported by Waterman.³⁴

Creeping attachment as described by Borghetti and Gardella³⁵ may further improve the results of this study. They documented that creeping attachment may continue for a year postoperatively when thick gingival grafts are used. It is not yet known whether this type of creeping attachment occurs in root coverage by connective tissue harvested from tuberosity areas.

Reduction of probing depth using the tuberosity tissue is comparable to the use of partial-thickness double pedical grafts as reported by Harris.²⁷ Probing depth reduction was a mean of 0.8 mm using tuberosity grafts and 0.9 mm using the double pedical grafts. There are differences in the 2 techniques, however. We observed a mean gain of 2.45 mm in keratinized epithelium, whereas Harris noted a mean gain of 4.8 mm. This apparent difference may be a consequence of the method used by Harris to analyze his results. In his report, the range of keratinized tissue preoperatively was 0 to 7 mm, and postoperatively, 2 to 10

mm. This range shift is very close to the 2.45 mm mean gain reported here.

Probing depth reduction at the tuberosity donor area measured a mean of 4.1 mm. The preoperative measurements in this area were 5 to 8 mm, while the postoperative measurements were 2 to 3 mm. These results may provide a favorable maintenance and healthy stability at the tuberosity retromolar region.

Smoking has been mentioned as a possible negative factor in defect coverage. Miller³⁶ reported a 100% correlation between heavy smoking (>10 cigarettes per day) and failure to obtain root coverage. Light or occasional smokers did as well as non-smokers. Tolmie et al.³⁷ and Harris²⁷ did not notice adverse effects with cigarette smoking. Our report concerning cigarette smoking presented no significant differences in defect coverage treatment between smokers and non-smokers. This may be attributed to the low number of patients who smoked >10 cigarettes per day.

The final esthetics were acceptable to the patients in all cases. In one case, root sensitivity was present, but at a lower level. These results are in accordance with Harris²⁷ and Tolmie et al.³⁷

Marginal tissue recession treatment using the combined procedure of defect coverage with subepithelial connective tissue graft harvested from the tuberosity area, and probing depth reduction performed at the same time and in the same procedure, is an effective, efficient, and predictable method of treating gingival recessions and periodontal pockets in posterior maxillary regions. The defect coverage obtained is esthetic and answers the demands of patients. At the donor tuberosity area, a maintainable zone is provided after the connective tissue graft is harvested, with minimal postoperative complications and a favorable wound-healing repair. These results are consistent from patient to patient. Moreover, the combined procedure provides enough graft to treat multiple sites, with comparable results.

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