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A two-year prospective study of coronally positioned flap with or without acellular dermal matrix graft

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Abstract

Aim: Evaluation of the treatment of gingival recessions with coronally positioned flap with or without acellular dermal matrix allograft (ADM) after a period of 24 months.

Methods: Thirteen patients with bilateral gingival recessions were included. The defects were randomly assigned to one of the treatments: coronally positioned flap plus ADM or coronally positioned flap alone. The clinical measurements were taken before the surgeries and after 6, 12 and 24 months.

Results: At baseline, the mean values for recession height were 3.46 and 3.58 mm for the defects treated with and without the graft, respectively ($p > 0.05$). No significant differences between the groups were observed after 6 and 12 months in this parameter. However, after 24 months, the group treated with coronally positioned flap alone showed a greater recession height when compared with the group treated with ADM (1.62 and 1.15 mm, respectively – $p < 0.05$). A significant increase in the thickness of keratinized tissue was observed in the group treated with ADM as compared with coronally positioned flap alone ($p < 0.05$).

Conclusions: ADM may reduce the residual gingival recession observed after 24 months in defects treated with coronally positioned flap. In addition, a greater gingival thickness may be achieved when the graft is used.

Key words: acellular dermal matrix graft; gingival recession; mucogingival surgery; root coverage

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Surgical procedures designed to achieve root coverage are usually indicated for patients with aesthetic complaints, root hypersensitivity, shallow root caries lesions and cervical abrasions (Wennström & Pini Prato 2003). It is recognized that a careful decision-making process before root coverage procedures would enhance the success rate of these efforts (Bouchard et al. 2001). The evidence for the efficacy of periodontal plastic surgery in reducing gingival recessions and improving attachment levels has been systematically reviewed (Roccuzzo et al. 2002). The coronally positioned flap (CPF) is one of the valid surgical options (Allen & Miller 1989, Harris & Harris 1994, Trombelli et al. 1996, 1997, Wennström & Zucchelli 1996, Pini Prato et al. 1999, Saletta et al. 2001, Roccuzzo et al. 2002) in the treatment of Miller Class I and II gingival recessions (Allen & Miller 1989). The autogenous subepithelial connective tissue graft (SCTG) covered by a CPF is also frequently used due to its good predictability (Langer & Langer 1985, Wennström & Zucchelli 1996, Caffesse et al. 2000, Bouchard et al. 2001, Cordioli et al. 2001, Paolantonio 2002).

Recently, an acellular dermal matrix graft (ADM) has been used as a substitute for the autogenous graft for root coverage procedures (Harris & Harris 1994, Dodge et al. 1998, Henderson et al. 1999, Tal 1999, Aichelmann-Reidy et al. 2001, Novaes et al. 2001, Tal et al. 2002, Côrtes et al. 2004, Gapski et al. 2005). The previous studies comparing ADM and the SCTG showed no significant differences in recession reduction between the procedures (Harris & Harris 1994, Aichelmann-Reidy et al. 2001, Novaes et al. 2001, Paolantonio 2002, Tal et al. 2002). When compared with the CPF, ADM showed no significant difference (Côrtes et al. 2004) or better results (Woodyard et al. 2004) in terms of recession reduction after 6 months. A recent meta-analysis did not demonstrate significant differences between ADM versus SCTG and ADM versus CPF for recession coverage (Gapski et al. 2005).

Limited information is available about the long-term stability of the root coverage achieved with ADM (Harris 2002, 2004). Therefore, the present follow-up study compared the treatment of class I gingival recessions by CPF with or without ADM graft after a period of 24 months.

Material and Methods

Study Population

The study protocol was approved by the Institutional Committee of Ethics in Dental Research of the School of Dentistry at Piracicaba, State University of Campinas (UNICAMP), São Paulo, Brazil. All the risks and benefits involved in the procedures were explained to the patients before they signed an informed consent form. Thirteen patients (seven females and six males – mean age of 32.8 years) with bilateral comparable class I gingival recessions in upper canines or premolars were included in the study.

Inclusion Criteria

The following inclusion criteria for participation in the study were used: *non-smoking* patients with good systemic health and no contraindications for periodontal surgery; presence of two bilateral comparable Miller Class I buccal recessions ($\geqslant 3$ mm) in maxillary canines or premolars; probing depth < 3 mm with no bleeding on probing; tooth vitality and absence of caries or restorations in the area to be treated.

Treatments

The pre-surgical evaluation included an analysis of the patient's toothbrushing technique and habits. At the teeth showing gingival recessions, a coronally directed roll technique using a soft toothbrush was indicated to minimize the toothbrushing trauma to the gingival margin (Wennström & Zucchelli 1996). Pre-surgical therapy included scaling and polishing and general oral hygiene instruction. Antiinflamatory (betamethasone, 4 mg) was given 1 h before surgery. All surgical procedures were performed by one operator (A.Q.C.). The pair of recessions was treated in the same surgical session. One defect from each pair was randomly assigned, by the flip of a coin, to one of the treatments:

1- *ADM group*: CPF plus ADM (AlloDerm, LifeCell, Branchburg, NJ, USA) placed as a subepithelial graft (Fig. 1).

2- *CPF group:* coronally positioned flap alone (Fig. 2).

After local anesthesia (Alphacaine – 2% Lidocaine with 1:100.000 Epinephrine, DFL, Rio de Janeiro, RJ, Brazil), an intra-sulcular incision was made at the *buccal* aspect of the involved tooth. Two horizontal incisions were made at right angles to the adjacent interdental papillae, at the level of the cemento-enamel junction (CEJ), without interfering with the gingival margin of the neighbouring teeth. Two oblique vertical incisions were extended beyond the mucogingival junction and a trapezoidal mucoperiosteal flap was raised up to the mucogingival junction. After this point, a split-thickness flap was extended apically, releasing the tension and favouring the coronal positioning of the flap. The epithelium on the adjacent papillae was stripped away. The root surface was instrumented with curettes and washed with saline solution. In the ADM sites, an acellular dermal matrix allograft was adapted after rehydration in sterile saline, according to the manufacturer's instructions. The graft was trimmed to a shape and size designed to cover the root surface and the surrounding bone. The basement membrane side was placed adjacent to bone and tooth, and the connective tissue side was placed facing the flap. The coronal lateral borders of the acellular dermal matrix were sutured to the lingual gingival tissue with resorbable sutures (Vicryl, Johnson & Johnson, Skillman, NJ, USA). The flap was coronally positioned and sutured to completely cover the allograft. In the CPF group sites, the surgical procedures were identical, except for the placement of the graft.

Post-surgical Care

All patients were instructed to discontinue toothbrushing around the surgical sites during the initial 30 days after surgery. During this period, the plaque control was achieved with a 0.12% chlorhexidine solution rinse used twice a day. Systemic antibiotics were prescribed for 7 days post-surgically (amoxicillin, 500 mg, tid).

The sutures were removed after 14 days. One month after the surgeries, the patients were instructed to resume mechanical tooth cleaning of the treated areas using a soft toothbrush and a roll-technique. All patients were recalled for a professional prophylaxis and plaque control, once a week during the first month, fortnightly until the third month, once a month until the sixth month and twice a year until 24 months.

Clinical Assessments

At baseline, 6, 12 and 24 months after the surgeries, the following clinical parameters were recorded at the deepest point of the facial recession (vertical measurements) by one investigator, using a periodontal probe (University of North Carolina probe – Hu-Friedy, Chicago, IL, USA):

1. recession height (RH): distance between CEJ to the most apical point of the gingival margin (GM);
2. recession width (RW): from one border of the recession to another, measured at the CEJ;
3. probing depth (PD): distance between GM and the bottom of the sulcus;
4. clinical attachment level (CAL): calculated as RH+PD;
5. height of the keratinized tissue (HKT): distance between the most apical point of the GM and the mucogingival junction (MGJ), with identification of the MGJ facilitated by staining the tissues with the Shiller's iodine solution.
6. thickness of the keratinized tissue (TKT): measured at a mid-point location between the GM and MGJ, using an endodontic spreader (diameter = 0.3 mm, Dentsply-Maillefer, Tulsa, OK, USA). The spreader was pierced, perpendicularly to the mucosal surface, through the soft tissue with light pressure until a hard surface was felt. The silicone disk stop was then placed in tight contact with the external soft tissue surface. After carefully removing the spreader, penetration depth was measured with a caliper (Mitutoyo Corporation, Kawasaki Kanagawa, Japan) with a 0.05 mm resolution.

Statistics

Quantitative data were recorded as mean standard deviation. The repeated measures analysis of variance (ANOVA) was used for the intra-group (baseline *versus* 6 *versus* 12 *versus* 24 months) and inter-

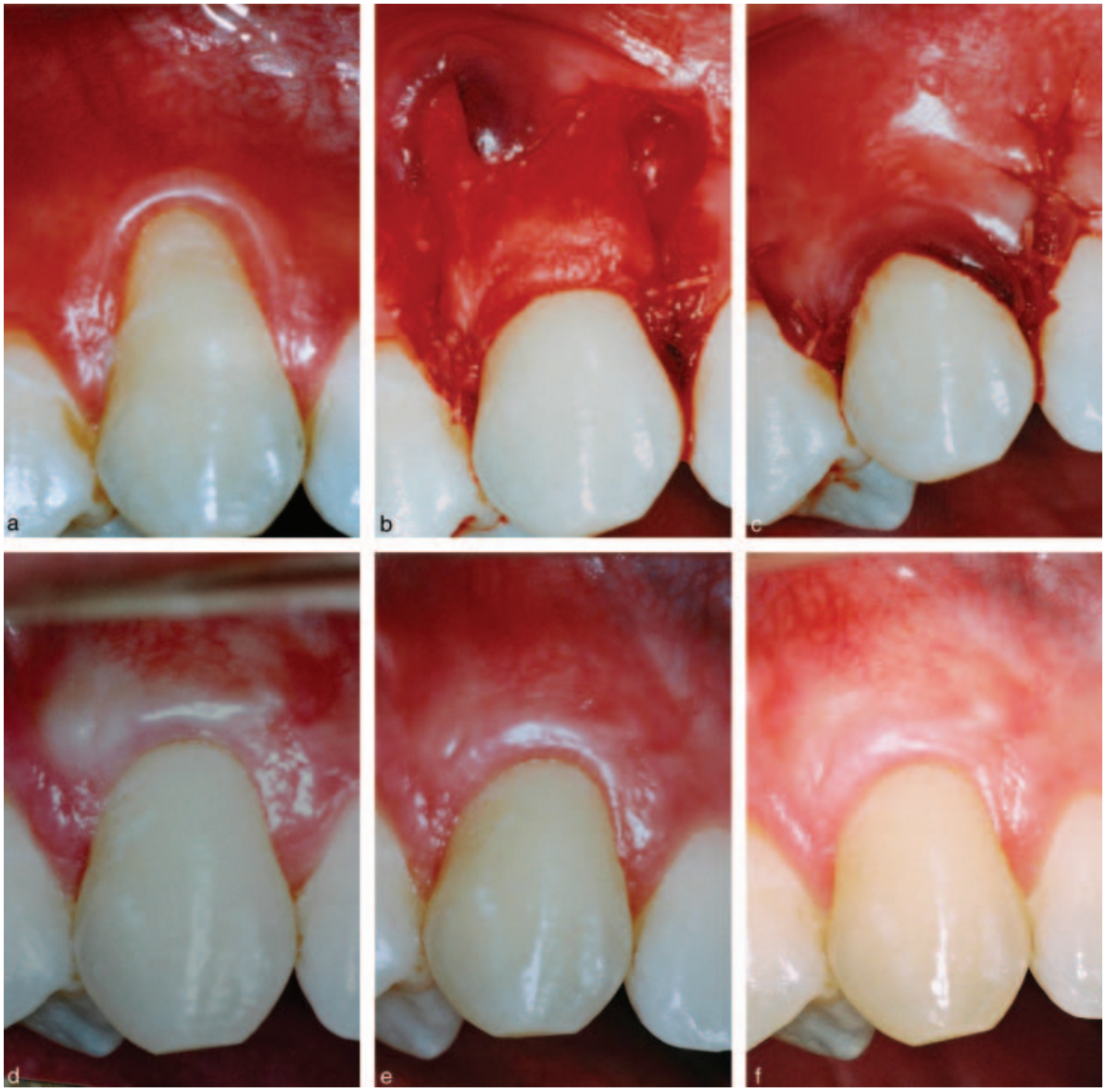

Fig. 1. Site treated with acellular dermal matrix allograft (ADM). (a) Initial clinical view of the gingival recession, (b) ADM sutured in place, (c) suture of the coronally positioned flap, completely covering the graft, (d) 6 months after the surgery, (e) 1 year after surgery, (f) 2 years after the surgery.

group (ADM group *versus* CPF group) comparisons, followed by the Tukey's test (when significant differences were found). The Friedman's test and Wilcoxon's test were used for the parameters that did not show normal distribution of the data. The level of significance of 0.05 was employed in all statistical comparisons.

Results

Healing was uneventful for all patients and none was excluded from the study. Therefore, 13 patients completed the 24 months of follow-up. Table 1 shows the mean values for the clinical parameters in each period for the two groups. After 24 months, both treatments produced significant changes from baseline in the following parameters: PD, CAL, RH and HKT ($p<0.05$). However, for RW in the ADM-group and TKT in the CPF group, no statistically significant difference was observed between the baseline value and the value obtained after 24 months. The TKT in the ADM-group showed the greatest value at 6 months with a tendency to decrease during the following observation periods. The difference between 6 and 12 months was not statistically significant, however, after 24 months a significant decrease in the TKT was observed when compared with the value achieved at 6 months.

The mean values for RH at baseline were 3.46 and 3.58 mm for ADM-group and CPF group, respectively ($p>0.05$). No significant differences between the groups were observed after 6 and 12 months in this parameter. However, after 24 months, the CPF group showed a greater RH when compared with ADM-group (1.62 mm and 1.15 mm, respectively – $p<0.05$). The mean percentage of root coverage obtained at the

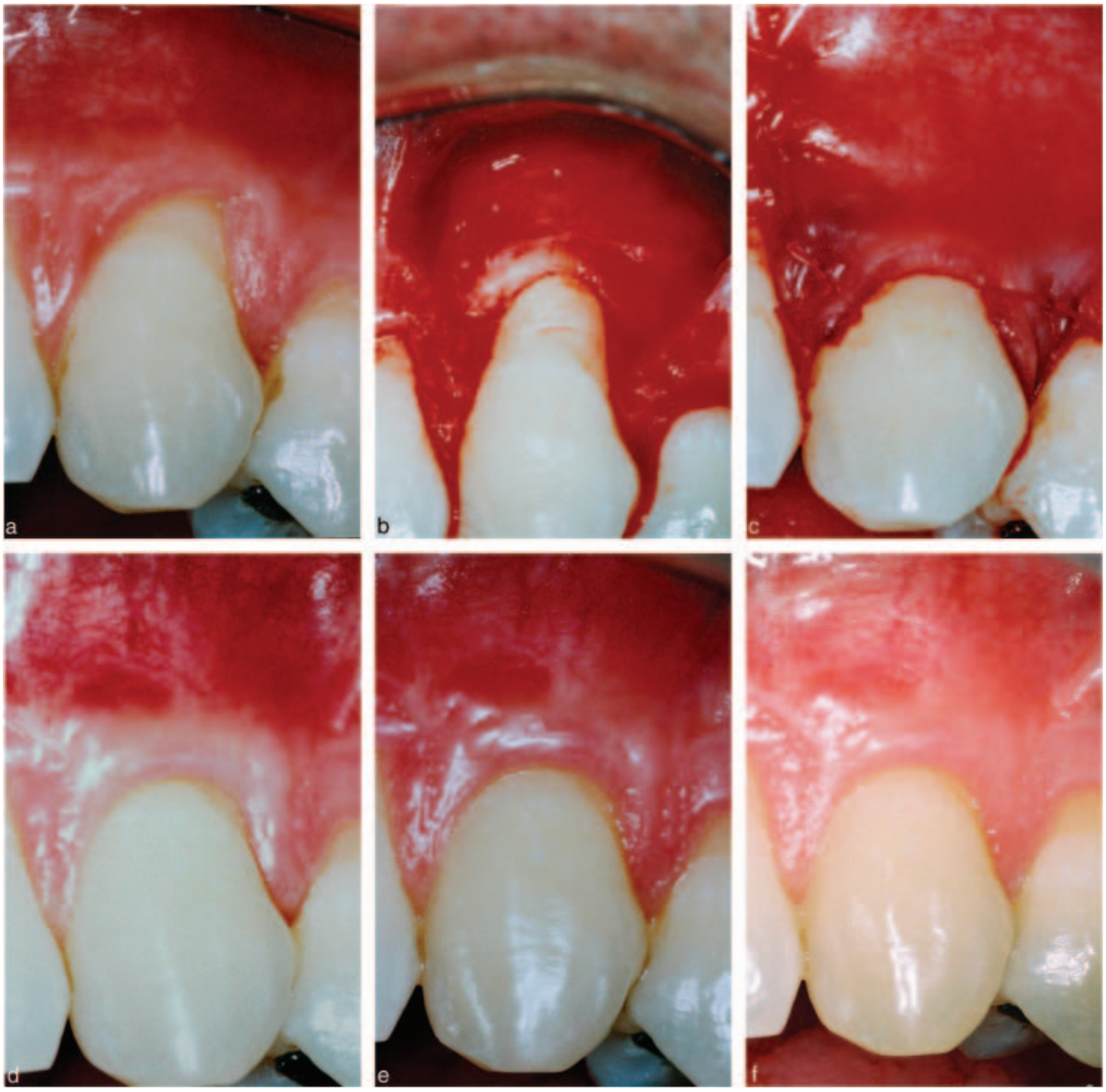

Fig. 2. Site treated by coronally positioned flap in the same patient showed in Fig. 1. (a) Initial clinical appearance, (b) reflection of the flap, (c) suture of the coronally positioned flap, (d) 6 months after the surgery, (e) 1 year after the surgery, (f) 2 years after the surgery.

end of 6 months was $76.18 \pm 20.81\%$ for the ADM-group and $71.19 \pm 20.58\%$ for the CPF group. After 24 months, the mean percentage of root coverage was reduced to $68.04 \pm 17.87\%$ and $55.98 \pm 23.00\%$ for the ADM-group and CPF group, respectively. There were no statistically significant differences between the treatments in PD, CAL and RW. A greater TKT was observed in the ADM-group as compared with the CPF group ($p < 0.05$) after 6, 12 and 24 months.

When considering HKT, a significant difference was observed between the groups ($p < 0.05$) for all periods. Therefore, an analysis of covariance (ANCOVA) was performed considering HKT as a covariate. ANCOVA showed no statistically significant difference in RH between the groups at baseline, 6 and 12 months. After 24 months, a significant difference was observed, favouring ADM-group ($p < 0.05$).

The distribution of sites according to the percentage of root coverage is shown in Table 2.

Discussion

The long-term evaluation of the results achieved after different root coverage procedures is essential to provide a better idea about the advantages and limitations of each technique. It is recognized that the CPF may provide excellent root coverage (>97%) in the treatment of Miller Class I recessions ($\leqslant 4$ mm) (Allen & Miller 1989, Harris & Harris 1994, Wennström & Zucchelli 1996). However, it has also been shown that after this procedure the coronal position of the gingival margin may not be stable, showing 68.2% of mean percentage root coverage at the end of 1 month and 44.8% after 60 months (Gurgan et al. 2004). Considering the studies using ADM, 99% of root coverage was obtained after 6 months (Woodyard

Table 1. Clinical results (mean ± SD; $n = 13$ patients)

Parameter	ADM	CPF
PD		
Baseline	1.27 ± 0.44 Ab	1.27 ± 0.33 Ab
6 months	1.73 ± 0.39 Aa	1.85 ± 0.43 Aa
12 months	1.81 ± 0.38 Aa	1.85 ± 0.38 Aa
24 months	1.69 ± 0.33 Aa	1.69 ± 0.43 Aa
CAL		
Baseline	4.73 ± 0.81 Aa	4.85 ± 0.63 Aa
6 months	2.62 ± 0.74 Ab	2.92 ± 0.95 Ab
12 months	2.73 ± 0.67 Ab	3.04 ± 0.95 Ab
24 months	2.77 ± 0.67 Ab	3.31 ± 1.16 Ab
RH		
Baseline	3.46 ± 0.85 Aa	3.58 ± 0.57 Aa
6 months	0.88 ± 0.89 Ab	1.08 ± 0.84 Ab
12 months	1.00 ± 0.84 Ab	1.19 ± 0.80 Ab
24 months	1.15 ± 0.80 Bb	1.62 ± 1.00 Ab
RW		
Baseline	4.19 ± 0.56 Aa	4.54 ± 0.75 Aa
6 months	2.73 ± 1.74 Ab	3.08 ± 1.89 Ab
12 months	2.88 ± 1.56 Ab	3.19 ± 1.55 Ab
24 months	3.15 ± 1.30 Aab	3.46 ± 1.25 Ab
HKT		
Baseline	3.15 ± 0.75 Ab	2.73 ± 0.78 Bb
6 months	3.85 ± 0.75 Aa	3.19 ± 0.75 Ba
12 months	3.96 ± 0.59 Aa	3.35 ± 0.75 Ba
24 months	3.77 ± 0.60 Aa	3.04 ± 0.85 Ba
TKT		
Baseline	1.05 ± 0.27 Ac	1.05 ± 0.22 Ab
6 months	1.75 ± 0.33 Aa	1.29 ± 0.20 Ba
12 months	1.65 ± 0.25 Aab	1.23 ± 0.21 Ba
24 months	1.56 ± 0.27 Ab	1.18 ± 0.21 Bab

Distinct capital letters in line denote intragroups statistical differences ($p \leqslant 0.05$).
Distinct lower cases letters in column denote intragroup stastical differences ($p \leqslant 0.05$).
ADM, acellular dermal matrix allograft; CPF, coronally positioned flap; PD, probing depth; RH, recession height; RW, recession width; CAL, clinical attachment level; HKT, height of the keratinized tissue; TKT, thickness of the keratinized tissue.

Table 2. Frequency of recession coverage with CPF and ADM

Treatment	100%	50–99%	0–49%
CPF			
6 months	3	9	1
12 months	2	10	1
24 months	1	6	6
ADM			
6 months	3	9	1
12 months	2	10	1
24 months	1	11	1

ADM, acellular dermal matrix allograft; CPF, coronally positioned flap.

et al. 2004). Harris (2004) reported the short-term (mean 12.3–13.2 weeks) and long-term (mean 48.1–49.2 months) root coverage results after treatment with ADM and a sub-epithelial connective tissue graft. The mean root coverage for the short-term ADM (93.4%), short-term sub-epithelial graft (96.6%), and long-term sub-epithelial graft (97.0%) were statistically similar. However, the long-term ADM mean root coverage (65.8%) was statistically smaller than the other three results. These observations are in accordance with the results of the ADM-group in the present study showing that the mean root coverage achieved at 6 months was 76.2% and was reduced to 68.04% after 24 months. It is important to note that ADM was compared with the CPF in the present study and not to the autogenous graft. The root coverage showed by the CPF alone changed from 71.2% (6 months) to 55.98% (24 months). These observed percentages of root coverage are in accordance with the values previously reported after the use of CPF, ranging from 56.1% (Amarante et al. 2000) to 98.8% (Harris & Harris 1994). However, the recession height at 24 months was significantly smaller in the ADM-group (1.1 mm) when compared with CPF group (1.6 mm). Therefore, on a long-term basis, it can be assumed that some recurrence of the recession should be expected with both techniques but the final recession height would be smaller with the inclusion of ADM. The frequency of recession coverage by both procedures (Table 2) may reinforce this observation. The number of defects with insufficient root coverage (less than 50%) changed from 1 to 6 (after 6 and 24 months, respectively) in the CPF group while no change was observed in the ADM-group, showing only one defect in this situation in the same period. In the present study, the toothbrushing habits of the patients were evaluated before the surgeries and they were instructed on the use of a soft toothbrush with a non-traumatic brushing technique. In spite of the reinforcements of these instructions during the maintenance visits, it is not possible to assure that all the patients performed a perfect non-traumatic brushing technique during the entire course of the study. This fact could help to explain the loss of part of the initially achieved root coverage in both groups (additional loss of 8% with ADM and 15% with CPF, between 6 and 24 months). The difference between the percentage of root coverage found in the present study with CPF (55.9%) and the good result (97.1%) previously reported with this technique (Wennström & Zucchelli 1996) emphasizes the need for more randomized controlled clinical trials including patients from different populations.

A statistical significant difference favoring the ADM-group for the mean thickness of keratinized tissue was detected after 24 months. This result is in agreement with the observations of Woodyard et al. (2004) showing that the marginal soft-tissue thickness was increased by 0.4 mm for the ADM-group. In spite of the difference between the two studies regarding the method of obtaining gingival thickness (piercing the tissue versus ultrasonic metering), the present study showed a similar increase in this parameter (0.5 mm). The mean TKT in the ADM-group after 24 months (1.56 mm) was significantly smaller than the mean observed after 6 months (1.75 mm), however, both were greater than the baseline value (1.05 mm). In the CFP-group, the TKT after 24 months (1.18 mm) was no longer different from baseline (1.05 mm). It has been considered that a gingival phenotype with thin and delicate marginal tissues could be a relevant factor in increasing the risk for gingival recession (Muller & Eger 1997, Muller et al. 1998). In such cases, chronic trauma

from injuries during inadequate toothbrushing or inflammatory reactions may be easily followed by gingival recession. This could help to explain the greater RH in the CPF group after 24 months.

The PD results were similar between the groups in all the periods evaluated and both procedures produced significant changes from baseline. In the same way, both procedures showed significant changes in the CAL, with no significant differences between groups in all the periods, The histological healing pattern after the use of ADM graft has not been fully elucidated however there are some histological data indicating that the material does not contribute to new cementum formation and may produce a fibrous tissue apposition on the root surface (Richardson & Maynard 2002).

A significant increase in the height of keratinized tissue was observed in both groups of the present study. The increase in this parameter in the CPF group could be the result of the influence of the granulation tissue derived from the periodontal ligament (Karring et al. 1975) or the tendency of the mucogingival line to regain its original position (Ainamo et al. 1992). The possible effect of the ADM graft, increasing the amount of keratinized tissue needs further investigations. It was suggested that the non-vital dermal matrix of ADM allograft lacked the capability of directing cyto-differentiation of the covering epithelium (Wei et al. 2002). Comparing the two groups, significant differences in the HKT were observed in all the periods. It should be noted that a significant difference was observed in the baseline values. Therefore, an ANCOVA was performed considering HKT as a covariate. ANCOVA showed no statistically significant difference in RH between the groups at baseline, 6 and 12 months. After 24 months, a significant difference was observed, favouring ADM-group ($p < 0.05$). It should be considered that there is a lack of information about the specific pre-surgical height of keratinized tissue necessary to influence the maintenance of the final gingival position. The narrow zone of keratinized tissue is most often the result and not the cause of the defect (Wennström 1987).

In conclusion, the present findings indicated that root coverage can be achieved in class I gingival recessions with or without the use of ADM, however, the inclusion of the graft can provide greater thickness of the gingival tissue with less recurrence of the recession over time.

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Clinical Relevance

Scientific rationale for the study: Gingival recessions are generally associated with aesthetic complaints and root hypersensitivity. This study aims to compare the treatment of gingival recession by coronally positioned flaps, with or without the acellular dermal matrix allograft (ADM), after a period of 24 months.

Principal findings: Coronally positioned flap alone resulted in significantly greater recession height (1.62 mm) when compared with the group treated with the graft (1.15 mm). A thicker keratinized tissue was observed when the graft was used.

Practical implications: The inclusion of ADM may reduce the residual gingival recession observed in the defects treated with coronally positioned flap.