## Gingival Recession Treatment of Maxillary Premolars: Does Acellular Dermal Matrix Meet the Therapy Requirements?

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## Abstract

Predicting root coverage after surgery is the major therapeutic endpoint of gingival recession treatment. Acellular dermal matrix has been used as a substitution to graft connective tissue in such treatment. This clinical study aimed to evaluate the results of treating gingival recession using an acellular dermal matrix of human skin to cover the surface of the premolar root.

Male and female patients aged 23–38 years, presenting with problems due to exposure of recession defects when smiling, were recruited. A total of 13 patients with 42 sites of Miller Class I or II gingival recession were treated by grafting the acellular dermal matrix from January 2018 to June 2020.

In total, 42 maxillary premolar sites with gingival recession were grafted with the acellular dermal matrix. The average levels of coverage were 94.24% and 91.87% at the end of the 3rd and 6th months, respectively.

Acellular dermal matrix can be successfully used to treat gingival recession, as we can predict the full coverage of the exposed root surface.

Dermoid membrane graft surgery to cover gingival recession is highly effective.

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### Introduction

Gingival recession is one of the most common periodontal problems that patients want to improve when they present to dental clinics. It not only affects aesthetics but also causes discomfort when eating or drinking due to the contact of substances with the exposed root surfaces<sup>1-3</sup>. The relationship between periodontal health and the width of attached keratinized gingival tissue has been researched<sup>4</sup>. A variety of periodontal plastic surgical techniques have been proposed to obtain root coverage of gingival recession defects<sup>5</sup>. All available procedures can provide significant root coverage for Miller Class I and II recession-type defects<sup>6-8</sup>. However, only the subepithelial connective tissue graft in conjunction with a coronally advanced flap appears consistently effective across all clinical

\*Corresponding author: Khue Nhut Truong, Dean of Faculty of Odonto – Stomatology Can Tho University of Medicine and Pharmacy, Can Tho, Vietnam. E-mail: tnkhue@ctump.edu.vn parameters and is thus currently considered the gold standard for gingival recession therapy<sup>9, 10</sup>.

The main aims of treatment in gingival mucous membrane surgery are improving the aesthetic issue, sensitivity, and deep trauma to the root canal surface. Some techniques such as concentrated growth factor membrane<sup>11</sup>, free grafts<sup>12-14</sup>, autogenous gingival coronally advanced flaps<sup>15</sup>, and modified coronally advanced flaps were recommended to adjust the deformations of the gingival mucous membrane. Sullivan and Atkins (1968) described a technique to cover the exposed root surface using the free autogenous gingival graft method<sup>16</sup>. However, tissue integration of grafts on the root canal surface was unpredictable, so full root coverage was rarely obtained. Moreover, the surgical position created a large damaged area on the palate, leading to significant postoperative discomfort for the patient. In 1992, dermis allograft tissue matrix was first used in treating burns and subsequently in a variety of plastic surgeries. The first reported use of dermis allograft tissue matrix in gingival grafting for root recoverage was in 1994. The main advantages of

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an acellular dermal allograft were its unlimited supply, its availability in various sizes, and that no second surgery site was needed, thus decreasing patient morbidity, as reported by Fowler and Breault<sup>17</sup>.

Many different surgical techniques have been used for root coverage Agarwal et al. clinically evaluated the efficacy of an acellular dermal matrix (ADM) allograft to increase the width of attached gingiva and the stability of gained attached gingiva<sup>18, 19</sup>. Fowler and Breault corrected gingival defects, negating the requirement for a second palatal surgical procedure, by using ADM as an alternative<sup>17</sup>. Aroni et al. compared clinical findings obtained in the treatment of gingival recession using ADM, subepithelial connective tissue graft (SECT), and enamel matrix proteins. The SECT and ADM groups had a higher proportion of root coverage and a greater reduction in the height and width of gingival recessions<sup>9</sup>.

Recently, an acellular biocollagen graft has been used as an alternative to donor sites to increase the width of peridental keratinized tissue and dental implants to treat deformities of the alveolar border. Treatment of the dermis obtained from the donor removes all cells, leaving a connective tissue matrix with an intact structure including collagen type I. Harris (1998) reported on the use of this multi-frame graft (three-dimensional construction) with a coronally advanced flap to treat gingival recession. The acellular epidermal scaffold continuously integrated into the host tissue, maintained the integrity of the tissue structure. and revascularized through the preserved vascular channels. The obtained color was also reported to be similar to that of the connective tissue graft.

We conducted a study from 2018–2020 at the Hospital of Can Tho University of Medicine and Pharmacy to evaluate the outcomes of treating gingival recession of maxillary premolars using a biofilm allograft.

## Materials and methods

The clinical results of a biofilm graft (Puros Dermis Allograft) for covering the surface of open roots with gingival recession were evaluated at the Hospital of Can Tho University of Medicine and Pharmacy.

Patients with aesthetic problems due to the exposure of receding gingiva while smiling

attended the Hospital of Can Tho University of Medicine and Pharmacy for examination and treatment from January 2018 to June 2020. The patients consented to the study protocol, and we obtained their permission before starting the treatment. The inclusion criteria were at least one open single-rooted tooth in the maxillary premolar position with Class I or II recession according to the Miller classification. The exclusion criteria were patients with systemic disease, those with acute or chronic gingivitis or periodontitis, and current smokers. (Figure 1A)

This was a non-controlled clinical intervention study to evaluate intervention outcomes according to the before–after model.

The sampling method was convenience sampling. A total of 42 positions of gingival recession of maxillary premolars were included.

The patients were aged from 23 to 38 years, with an average age of approximately 27 years. Quantitative data were recorded using Microsoft Excel 2003 software and analyzed by SPSS 18.0 software. Paired comparisons were performed using the t-test and Fisher's exact test. Alpha was considered 0.05, and P< $\alpha$  was considered statistically significant.

### Procedures

Dermoid membrane, or allograft collagen biofilm derived from human skin, is a cell-free collagen membrane. It is a safe alternative to natural soft tissue transplantation in a wide range of soft tissue transplantation indications. The dermis membrane undergoes a multi-step cleaning process, removing all non-collagenous proteins and cells, as well as immune, bacterial, and viral genes. The resulting threedimensionally stable membranes are composed of collagen types I and III that have a natural collagen structure similar to human connective tissue. After implantation, the dermis membrane was further regenerated into the patient's soft tissue. It was produced by Pham Ngoc Thach University of Medicine, Ho Chi Minh City, Vietnam. The size of the dermis membrane was 20x30 mm per pack. (Figure 1B)

The surgical procedure used to treat gingival recession in this study was according to the method of collagen biofilm grafting combined with creating a coronally advanced flap, initiated by Zucchelli<sup>20</sup>.

Step 1: Disinfect and numb the area of surgical gums.

- Disinfect the outside of the mouth with 10% povidone–iodine solution.

- Anesthetize the apex in the surgical tooth area with 2% lidocaine anesthetic, 1:100,000 epinephrine vasoconstrictor, 1.8 mL/1 tube of local anesthetic, manufactured in Korea.

Step 2: Area receiving organization.

- Incision and division of the flap:

+ Use knife handle and 15c blade to make incisions:

+ 2 incisions across the papillae

+ 2 longitudinal incisions to reduce tension about 30 degrees towards the corridor.

- Use the 15c blade to split the partial flap (the blade goes between the subepithelial connective tissue area) to the end of the subepithelial part of the adhesive gingiva. If the flap has not been stretched, further dissecting the lining of the corridor area would have been possible.

- Treatment of root surface: Gracey 15/16 scraper treats the surface of open roots.

- The pump rinses the root surface with sterile saline to remove the dentin from the root surface.

- Use a 15c blade to remove the epithelium of the gingival papilla in the surgical area.

Step 3: Area for organization: The dermis collagen biofilm was soaked in physiological saline for 10–20 minutes.

Step 4: The graft-receiving area was prepared to receive the graft.

- Measure the height and width of the graft-receiving area with a Williams periodontal meter (after completing the preparation of the graft-receiving area).

- Adjust the dermoid membrane graft to suit the graft-receiving area.

- Place the dermis membrane in the graftreceiving area. (Figure 1C)

- Slide flap-closure stitches towards the crown with O stitches, single hanging stitch. (Figure 1D)

- Monitor for 30 minutes after surgery, making sure the area was no longer bleeding because a stable blood clot prepares for good healing.

The evaluation of the surgical results after 1, 3, and 6 months was based on clinical and subclinical changes in gingivitis parameters, characteristics of keratinized gingiva, attached gingiva, gingival sulcus depth, and recession depth. The most important criterion was the vertical root recovery rate of the gingival recession positions 1, 3, and 6 months after surgery. (Figure 1E, 1F, 1G)

The criteria for evaluating success after 1, 3, and 6 months<sup>18</sup> were the same, considering root recovery (%) and abscess: ≥80% with no abscess for good success, ≤60%-<80% with no abscess for average success, and any root recovery proportion (<60%, ≤60%–<80%, ≥80%) with the presence of an abscess for poor success. Additionally, the appearance of gingivitis was examined after 3 and 6 months. The results were classified as good or average with no gingivitis and poor with gingivitis. In addition, the success of the procedure after 6 months was based on the probe depth of the gingival margin (mm). If this index was  $\leq 3$  mm, the case was assessed as good or average based on other criteria, and if it was  $\geq$ 3 mm, the result was considered poor.



**Figure 1.** (A) Before surgery; (B) An acellular dermal matrix; (C) Put the acellular dermal matrix to the receiving-area; (D) Fixed suture the acellular dermal matrix; (E) One month after surgery; (F) Three months after surgery; (G) Six months after surgery.

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## Results

## Overview

A total of 13 patients aged 23 to 38 years, with a total of 42 positions of maxillary premolars receding (34 sites of Miller I gingival recession and 8 sites of Miller II gingival recession) were treated with biofilm. The 5 most important criteria in our study were gingival sulcus depth, attached gingiva height, keratinized gingiva height, recession depth before surgery compared to after surgery (1, 3, and 6 months), and vertical root recovery rate before surgery compared to after surgery (3 and 6 months).

| Time                   | Gingival sulcus depth<br>(mm) | р     |
|------------------------|-------------------------------|-------|
|                        | Average ± SD                  |       |
| Before surgery         | 1.05 ± 0.22                   |       |
| 1 month after surgery  | 1.00 ± 0.00                   | 0.066 |
| 3 months after surgery | 1.00 ± 0.00                   | 0.066 |
| 6 months after surgery | 1.00 ± 0.00                   | 0.066 |

**Table 1.** Gingival sulcus depth before and 1, 3 and 6 months after surgery. Paired Samples T-test.

Gingival sulcus depth at 1, 3 and 6 months after surgery decreased compared to before surgery but was not statistically significant.

| Time                   | Attached gingiva height (mm) | P (1)   | P (2)   | P (3)   |
|------------------------|------------------------------|---------|---------|---------|
|                        | Average ± SD                 |         |         |         |
| Before surgery         | 1.33 ± 0.73                  |         |         |         |
| 1 month after surgery  | 3.12 ± 0.92(a)               |         |         |         |
| 3 months after surgery | 3.02 ± 0.90(b)               | <0.0001 | <0.0001 | 1       |
| 6 months after surgery | 2.98 ± 0.91(c)               |         | NU.0001 | <0.0001 |

**Table 2.** Change of attached gingiva height before and 1, 3 and 6 months after surgery. Paired Samples T-test: (a) p<0.0001, 1 month after compared to before surgery, (b) p<0.0001, 3 months after compared to before surgery, (c) p<0.0001, 6 months after compared to before surgery.

The results showed statistically significant increases in attached gingiva height after surgery 1 month compared to before surgery; statistically significant decreases after 3 months compared to after 1 month; statistically significant decreases after 6 months compared to after 3 months with p<0.0001.

| Time                   | Keratinized gingiva height (mm) | P (1)   | P (2)         | P (3)    |
|------------------------|---------------------------------|---------|---------------|----------|
|                        | Average ± SD                    |         |               |          |
| Before surgery         | 2.38 ± 0.83                     |         |               |          |
| 1 month after surgery  | 4.12 ± 0.92(a)                  |         |               |          |
| 3 months after surgery | 4.02 ± 0.91(b)                  | <0.0001 | <0.0001       |          |
| 6 months after surgery | 3.98 ± 0.92(c)                  |         | <b>\U.UUU</b> | < 0.0001 |

**Table 3.** Change of keratinized gingiva height before and 1, 3 and 6 months after surgery. Paired Samples T-test: (a) p<0.05, before compared to 1, 3 and 6 months after surgery, (b) p<0.05, 1 month compared to 3 and 6 months after surgery, (c) p<0.05, 3 months compared to 6 months after surgery.

The results showed statistically significant increases in keratinized gingiva height at 1 month after surgery compared to before surgery; statistically significant decreases after 3 months compared to after 1 month; statistically significant decreases after 6 months compared to after 3 months with p<0.05.

| Time                   | Recession depth (mm)<br>Average ± SD |         | P (2)   | P (3)    |
|------------------------|--------------------------------------|---------|---------|----------|
| Before surgery         | 1.81 ± 0.53                          |         |         |          |
| 1 month after surgery  | 0.00 ± 0.00(a)                       |         |         |          |
| 3 months after surgery | 0.10 ± 0.08(b)                       | <0.0001 | <0.0001 |          |
| 6 months after surgery | 0.14 ± 0.10(c)                       |         | <0.0001 | < 0.0001 |

**Table 4.** Change of recession depth before and 1, 3 and 6 months after surgery. Paired Samples T-test: (a) p<0.05, before compared to 1, 3 and 6 months after surgery, (b) p<0.05, 1 month compared to 3 and 6 months after surgery, (c) p<0.05, 3 months compared to 6 months after surgery.

The results showed statistically significant decreases in recession depth at 1 month after surgery compared to before surgery; statistically significant increases after 3 months compared to after 1 month; statistically significant increases after 6 months compared to after 3 months with p<0.05.

| Time           |    | Vertical root recover | n       |  |
|----------------|----|-----------------------|---------|--|
|                |    | Average ± SD          | μ       |  |
| Poforo ourgony | mm | 0.00 ± 0.00           |         |  |
| Delore surgery | %  | 0.00 ± 0.00           |         |  |
| 3 months after | mm | 1.71 ±0.51(a)         | <0.0001 |  |
| surgery        | %  | 94.24 ± 5.01          | <0.0001 |  |
| 6 months after | mm | 1.67 ± 0.51(b)        | <0.0001 |  |
| surgery        | %  | 91.87 ± 6.00          | ~0.000T |  |

**Table 5.** Vertical root recover rate of gingival recession positions before and 3 and 6 months after surgery.Paired Samples T-test: (a) p<0.05, compared to 3 months after surgery, (b) p<0.05, compared to 6 months after surgery.

The vertical root recover rates at 3 and 6 months after surgery compared to before surgery had statistically significant differences with p<0.05.

## Discussion

Autogenous connective tissue grafts have been widely used for procedures covering open roots in teeth and implants with severe receding gingiva.

The depth of the gingival sulcus together with the size of the keratinized gingiva is an important indicator to evaluate the adhesion of the graft and the local flap to the receding gingival site, thereby evaluating the effectiveness of biofilm grafting to cover the gingiva. In gingival recession, if after biofilm grafting, the root of the tooth is no longer open but the gingival tissue does not stick to the root surface, the surgery cannot be considered successful; this will increase the examination depth of the gingival sulcus. Based on Table 1, the gingival sulcus depth did not change at 1, 3, and 6 months after surgery compared to before surgery (p>0.05). At 3 and 6 months after surgery, no significant change occurred; the gingival sulcus depth slightly decreased and stabilized at 1 mm in the 3rd and 6th months after surgery. Some authors have reported that the gingival sulcus depth was significantly reduced after surgery, such as Mahn (2015)<sup>21</sup>, Esteves et al. (2015)<sup>22</sup>, and Aroca S. et al. (2010). Others have reported that the gingival depth was unchanged or not statistically significantly changed after surgery, such as Godavarthi et al. (2016)<sup>23</sup> and Ahmedbeyli et al. (2019)<sup>24</sup>. According to our experience, many factors affect the depth of the gingival sulcus after surgery. One is whether the root surface was clean of bacteria and foreign factors. Treating the root surface to remove the dentin will help soft tissue adhere more easily. The gum tissue will be traumatized during the healing process by hard foods or toothbrushes that strip the gum line from the tooth surface. If chronic gingivitis occurs after surgery, it will also increase gingival sulcus depth.

Attached gingiva are considered by many orthodontists to play an important role in protecting the health of the gingiva, helping to prevent the gingival margin from falling off when the mucosa of the vestibular gland moves during chewing, speaking, and swallowing. Gingival

recession causes gingival adhesion to reduce or disappear. The change of gingival adhesion after surgery to treat receding gums has been an important evaluation factor. According to Table 2, at 1 month after surgery, the average height of attached gingiva was  $3.12\pm0.92$  mm compared to the preoperative average of  $1.33\pm0.73$  mm. This change was statistically significant (p<0.005). At 6 months, this figure was  $2.98\pm0.91$  mm, decreasing compared with 3 months after surgery ( $3.02\pm0.90$  mm), which was statistically significant (p<0.0001).

Gingival recession reduces the height of or even loses the keratinized gingiva. In cases of lost keratinized gingiva, the mucosal margin on the root surface will be a moving mucosa that is often pulled when chewing, creating conditions for bacteria to penetrate. This makes the gingival margin red and swollen, with symptoms of inflammation. Biofilm tissue graft surgery was considered by many authors to be highly effective in restoring the size of keratinized gingiva. According to Table 3, at 1 month after surgery, the mean gingival keratinization was 4.12±0.92 mm, an increase compared to before surgery (2.38±0.83 mm). This change was significant (p<0.0001). At 6 months, the average height of gingival keratinization was 3.98±0.92 mm, a decrease from 4.02±0.91 mm at 3 months, but still increased compared to the initial time, with statistical significance (p<0.0001). By comparison, Esteves et al. (2015)<sup>22</sup> reported results after 6 months of monitoring 21 gingival graft sites, and the average keratinized gingiva increased by 1.33 mm. Ozenci et al. (2015)<sup>25</sup> reported an average increase of 1.25 mm in keratinized gingiva after biofilm graft surgery. Vincent et al. (2018)<sup>26</sup> showed an increase from 2.63 mm before surgery to 3.55 mm after 12 months of follow-up. Many other studies have also concluded that after surgery, the height of keratinized gingiva increased. The height of keratinized gingiva after surgery with a dermal membrane graft depends on the level of gingival recession before surgery, the amount of attached gingiva, and whether the flap fully covers the receding position. In our experience, when closing the flap in place, pulling the flap to cover the whole graft without exposing any parts of the graft was advisable. If the graft was exposed in the oral environment and dissolved before the epithelium has differentiated, it will cause postoperative failure. Therefore, covering the

graft helps the height of the keratinized gingiva increase to the maximum.

The change in the height of the receding gingiva after surgery is an important indicator to evaluate the success of the surgery to cover gingival recession. If after surgery the tooth root is no longer open, the surgery is considered a 100% success. Many factors affect the surgical results, such as blood supply to the graft, graft size, whether the damaged root surface is clean and smooth, and local suturing technique (if the knot squeezes the tissue on the root surface too much, circulation in the tissue is difficult, and it may dissolve part of the graft). Postoperative care is also very important; the wound needs to be fixed for at least 12-14 days for the vascular bridges to be completely formed. Control of dental plaque after surgery is important to avoid local inflammation. According to Table 4, no postoperative gingival recession occurred at 1 month compared to before surgery, using the paired samples t-test to compare each pair of mean values to determine the difference between postoperative and preoperative values, which was statistically significant (p<0.0001). The rate of gingival recession after surgery at 6 months was 0.14±0.1 mm, down from 0.1±0.08 mm at 3 months, a statistically significant difference (p<0.05). Mahn et al.  $(2015)^{21}$  studied the method of biofilm grafting to cover the roots; after 3 months, the average gingival recession was 0.2 mm compared with 3.8 mm before surgery, close to our results. However, because the follow-up period was only 6 months, instability may occur. Further follow-up is needed to determine whether the gingival height in 9 or 12 months after surgery is stable.

Healthy gingiva are an important part of a wonderful smile and color of the gingiva is an indispensable evaluation criterion in dental health surveys in general, as well as gingival health in particular.<sup>27</sup> Therefore, another criterion to evaluate the success of gingival recession treatment is the color of the gingiva after treatment, which is another defect of this study. We had no standards to appraise whether the colors of grafted and host tissue were matching. The described similarity in obtained color was completely based on our objective vision while doing this study. However, research by Harris (1994)<sup>23</sup> reported that the use of multiple grafts improved gingival color, reduced recurrence rates, provided uniform thickness of the material,

and eliminated the need for multiple surgeries because of the limit. Harris further reported that the results obtained for the treatment of gingival recession with AlloDerm were comparable to those obtained from connective tissue transplantation. The surgical protocol used in the present study closely resembles previous studies performed with dermal membranes. The uniformly good root coverage achieved in this study is consistent with previous reports and confirms the potential of dermoid membranes as reliable alternative to connective tissue а transplantation. The selected patients were characterized by moderate melanin pigmentation of the gingiva and hard palate. Although racial differences in gingival pigmentation have been previously noted, their effect on color matching after soft tissue transplantation has not been extensively studied. It has been reported that AlloDerm does not support gingival hyperepithelialization. However, its ability to induce melanin is not known. Henderson et al. reported that AlloDerm-treated cases resulted in coverage reaching 95%, with ≥90% obtained 80% of the time. The mean root coverage in the present study using dermal membrane grafting was 91.66%. No significant differences occurred in any of the clinical parameters measured between months 3 and 6. The results indicate that the range of gingival recession treatment achieved with dermoid membranes can be maintained with success, provided the long-term patient demonstrates good plaque control.

# Conclusions

At 6 months after surgery, the proportion of teeth with a high recovery efficiency was 100%. There was no good ratio and the least. The recovery of the vertical receding position at 6 months was on average  $91.87\pm6.00\%$ , with the maximum value being 100% and the minimum value being 80%. The results after surgery were significantly different from those before surgery (p<0.05).

# **Clinical Significance**

Connective tissue transplantation is the gold standard for the treatment of gingival recession, but the downsides are the second surgical position and the lack of graft availability. Therefore, biofilm graft is the most successful and predictable procedure in the treatment of receding gingiva due to adequate open root

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coverage without the need for a second surgical position. The results of this study showed that dermoid membrane graft surgery to cover gingival recession was highly effective.

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#### **Declaration of Interest**

The authors report no conflict of interest.

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