Am J Transl Res 2026;18(7):6381-6390
www.ajtr.org /ISSN:1943-8141/AJTR0171787

Original Article

Effects of poly-L-lactic acid combined with acellular dermal matrix in the treatment of abdominal adiposity, skin laxity, and striae gravidarum

Enjun Zhang[1,2*], Yongshu Wang[3*], Qiang Zhou[4], Bangxing Zheng[5], Qinhua Wu[6], Yu Zhang[7], Aidong Chen[8], Chao Chen[1]

[1]Department of Dermatology, The Affiliated Friendship Plastic Surgery Hospital of Nanjing Medical University, Nanjing 210029, Jiangsu, China; [2]Department of Plastic and Aesthetic Surgery, The Air Force Hospital of The Eastern Theater Command of China, Nanjing 210001, Jiangsu, China; [3]Hangzhou Estee Ryan Medical Cosmetology Hospital, Hangzhou 132011, Zhejiang, China; [4]Department of Cosmetic and Plastic Surgery, The Air Force Hospital of The Eastern Theater Command of China, Nanjing 210001, Jiangsu, China; [5]Department of Beauty Surgery, Shanghai Wei Yi Beauty Clinic of China, Shanghai 200060, China; [6]Department of Medical Aesthetics, The Fourth Affiliated Hospital of Nanjing Medical University, Nanjing 211112, Jiangsu, China; [7]Department of Cosmetic and Plastic Surgery, Nanjing Kangmei Beauty Hospital of China, Nanjing 210022, Jiangsu, China; [8]The Key Laboratory of Targeted Intervention of Clinical Disease, Department of Physiology, Nanjing Medical University, Nanjing 211166, Jiangsu, China. [*]Equal contributors.

Received January 30, 2026; Accepted June 10, 2026; Epub July 15, 2026; Published July 30, 2026

Abstract: Objective: To investigate the clinical efficacy and safety of poly-L-lactic acid (PLLA) combined with acellular dermal matrix (ADM) in the treatment of abdominal adiposity, skin laxity, and striae gravidarum. Methods: A total of 206 patients with abdominal skin laxity and striae gravidarum were divided into a control group (n = 97) and an observation group (n = 109) in this retrospective analysis. The control group received conventional treatment, whereas the observation group received PLLA combined with ADM injections. Clinical efficacy, satisfaction, recurrence rate, and adverse reactions were compared, and changes in skin morphology and functional indicators were assessed. Results: The total effective rate (87.16%), satisfaction rate (95.41%), and treatment maintenance rates at 3 and 6 months of follow-up were significantly higher in the observation group than in the control group (all P<0.05), whereas the incidences of skin injury and pigmentation were significantly lower in the observation group (both P<0.05). After treatment, the depth and area of striae gravidarum decreased in both groups, and skin elasticity indicators increased, with more significant improvement in the observation group (all P < 0.05). Conclusion: PLLA combined with ADM can significantly improve abdominal striae gravidarum and skin laxity, enhance skin elasticity and firmness, and has a long-lasting effect with good safety.

Keywords: Poly-L-lactic acid, acellular dermal matrix, striae gravidarum, skin laxity, skin elasticity, aesthetic repair

Introduction

Postpartum abdominal skin laxity, fat accumulation, and striae gravidarum are common cosmetic problems faced by women. This is mainly due to the rupture of elastic fibers and damage to collagen fibers in the dermis of the abdominal wall resulting from uterine expansion during pregnancy. In addition, postpartum fat metabolism disorders and decreased skin retraction ability not only affect the aesthetics of the abdominal contour but also reduce the mother's self-confidence to a certain extent [1, 2]. Traditional treatments such as simple liposuction, abdominoplasty, or laser therapy have limitations in skin retraction and texture improvement [3]. Simple liposuction can only remove excess fat and cannot repair the damaged dermal structure. Abdominoplasty is more invasive and leaves obvious scars after surgery. Laser therapy has limited efficacy for severe atrophic striae gravidarum and requires multiple treatments [4-6]. Therefore, actively exploring safe and efficient treatment options is a hot topic in clinical research. Poly-L-lactic acid (PLLA), as a biodegradable material, has been

https://doi.org/10.62347/QHLT5479

shown to progressively improve skin laxity and texture by stimulating fibroblast proliferation and type I collagen regeneration [7]. Acellular dermal matrix (ADM) is rich in three-dimensional collagen scaffolds and growth factor binding sites, which can guide host cells to grow in and remodel the extracellular matrix [8]. Clinical practice shows that although PLLA alone can effectively improve skin elasticity, its effect on filling depressions in severe striae gravidarum is limited. While ADM alone can provide tissue support, it lacks a continuous collagen regeneration stimulation effect. Neither modality alone can meet the dual needs of abdominal contour reshaping and stretch mark repair [9, 10]. However, evidence is still lacking regarding whether the combined use of the two can synergistically enhance abdominal contour reshaping and stretch mark repair. This study aims to evaluate the effects of PLLA combined with ADM injection on the firmness of postpartum abdominal skin, fat distribution, and the severity of striae gravidarum through a retrospective study, and to explore its potential mechanisms, providing new ideas for minimally invasive and individualized abdominal wall rejuvenation programs.

Materials and methods

General information

A retrospective analysis was conducted on the clinical data of 206 patients with abdominal skin laxity and striae gravidarum treated at the Air Force Hospital of the Eastern Theater Command of China from September 2023 to February 2025. Patients were divided into a control group (n = 97) and an observation group (n = 109) based on their treatment regimens. This study was approved by the Ethics Committee of the Air Force Hospital of the Eastern Theater Command of China.

Inclusion and exclusion criteria

(1) Inclusion criteria: Obvious abdominal skin laxity and striae gravidarum; age between 20-60 years; disease duration of 1 year or more; complete clinical and follow-up data; good compliance and cooperation in completing the study. (2) Exclusion criteria: Keloid scarring constitution; pregnancy or lactation; concurrent infectious or allergic skin diseases; allergic constitution; use of cosmetic treatments, cosmetics, or drugs that repair striae gravidarum within the past 6 months; concurrent malignant tumors, severe organ dysfunction, or coagulation disorders.

Methods

The control group received conventional treatment using a 1565 nm non-ablative fractional laser (model: M22, power supply: 220 VAC, 12 A, 50 Hz, equipment type: light and laser system, manufacturer: Lumenis Ltd.). Treatment parameters were set as energy 40-45 mJ/cm^2, and energy density 300 dot/cm^2. The abdominal stretch mark distribution area was used as the target area for uniform scanning. Treatment was performed once every 4 weeks for a total of 6 treatments. Topical medication (Centella asiatica cream) was applied morning and evening, continuously for 6 months. During treatment, patients were instructed to avoid sun exposure and avoid spicy and irritating foods.

In addition to the above, the observation group received PLLA combined with ADM injection. Patients were placed in a supine position, the abdominal skin was cleaned, and areas requiring repair of striae gravidarum and skin laxity were marked. Topical anesthesia with 5% lidocaine cream was applied. ADM [Dongci Dermal Matrix, National Medical Device Approval No. 20103641111] injection: A 30 G sharp needle was used for superficial subcutaneous injection in the target area at a dose of 0.1-0.2 mL/cm^2. For stretch mark depressions, dotted injections were used to fill the depressions. For larger areas of laxity, multiple injection points and a fan-shaped injection pattern were used to form a supporting matrix scaffold. Precise positioning of the injection layer utilized ultrasound-guided technology. This technology enabled the operator to monitor and differentiate between the superficial fascia layer and the subcutaneous fat layer in real time, ensuring accurate drug injection into the target area and avoiding injection into inappropriate tissue layers. PLLA (Avilan®, Changchun Shengboma Biomaterials Co., Ltd., National Medical Device Registration Certificate No. 20213130276, Specification: 340 mg per vial) Injection: After ADM injection, a 27 G blunt needle was used and a subcutaneous mid-layer fan-shaped injection was performed in the same area, at a dose of 0.08-0.12 mL/cm^2, avoiding needle penetration into the muscle layer. The needle was withdrawn during injection to reduce local tissue damage. In the observation group, the dose of polylactic acid injection was "0.08-0.12 mL/cm^2", while the dose of ADM was "0.1-0.2 mL/cm^2". The "square centimeter" unit is calculated based on the area of the stretch mark region, which is obtained through imaging measurement or surface mapping. Immediately after injection, local massage was performed to ensure more even distribution of the material within the tissue and to shape it into a smooth and natural contour. Both groups were treated for 6 months.

To ensure treatment consistency among different operators, all operators received standardized training before treatment, and all treatment parameters and procedures followed the same standardized process to minimize the impact of operational differences on the study results.

Outcome measures

(1) Clinical efficacy [11]. Marked effect: The patient reported symptom relief, the color and roughness of striae gravidarum were close to normal skin, the skin elasticity was significantly improved, with > 75% improvement in skin laxity area. Effective: The color and roughness of the striae gravidarum were significantly improved, the skin elasticity was improved, with 25%-75% improvement in skin laxity area. Ineffective: No improvement in color, roughness, or skin elasticity of striae gravidarum, with < 25% improvement in skin laxity area. The total effective rate was the sum of the marked effect rate and the effective rate.

(2) Satisfaction. After the treatment, a self-made satisfaction questionnaire was used to evaluate the treatment efficacy, comfort and safety. Each item was scored from 0 to 30 points, and the total score was 90 points. Satisfaction was classified based on the total score: 81-90 points indicated very satisfied, 71-80 points indicated moderately satisfied, and 0-70 points indicated unsatisfied. The satisfaction rate was the sum of the average rate and the very satisfied rate.

(3) Efficacy maintenance rate. All patients were followed up for 6 months after the treatment. The efficacy maintenance was evaluated at 3 months and 6 months of follow-up. The criteria for maintaining efficacy are as follows [12]: During the follow-up period, the severity score of abdominal striae gravidarum and the skin laxity score of the patient did not show obvious regression, that is, the score increased by < 2 points from the lowest score at the end of treatment, and the imaging measurement indicators (average depth, volume or area of striae gravidarum) regressed by < 30% relative to the post-treatment improvement. If the above scores or imaging indicators decreased to or exceeded the threshold, the efficacy was deemed not to be maintained. Efficacy maintenance rate = number of cases with maintained efficacy during the follow-up period/total number of cases in the group × 100%.

(4) Adverse reactions [12]. The occurrences of skin damage, and pigmentation were compared between the two groups.

(5) Abdominal aesthetic score [13]. Scoring criteria: 0 point: no visible striae gravidarum on the abdominal skin; 1 point: light red thin striae gravidarum on both sides of the lower abdomen; 2 points: purplish-red or pink elastic fiber rupture on the abdominal skin; 3 points: brown area and elastic fiber rupture on the abdominal skin; 4 points: skin bulge at the location of elastic fiber rupture. The abdominal aesthetic score used a scoring standard of 0 to 4 points. The scoring was conducted independently by two trained assessors, and the double-blind assessment method ensured the objectivity of the assessment process. Inter-rater reliability was assessed using the intraclass correlation coefficient (ICC), which was 0.85, indicating good consistency.

(6) Changes in the average depth, volume and area of striae gravidarum. The Antera3D skin imaging analysis system was used to collect images and data of striae gravidarum before and after treatment for all patients. The system can display and quantitatively measure components such as depressions, textures, hemoglobin and melanin, and analyze the volume, roughness and average depression score of striae gravidarum [12].

(7) Skin elasticity parameters (R5, R7) and firmness parameters (F4) [14]. Before and after treatment, the CK MPA580 multifunctional skin testing system was used to delineate three cir-

cular areas with a diameter of 3 cm in the same stretch mark area below the navel of the subject's abdomen. Skin elasticity was tested in each area in turn, and the average value of the three measurements was used as the final data.

(8) Subjective/self- assessed improvement score [14]. The subjective self-assessment scale included specific items such as abdominal appearance, skin elasticity, fat distribution, and abdominal firmness. The scale has undergone reliability and validity verification; a test with 50 participants showed an internal consistency (Cronbach's α) of 0.92, indicating good reliability. Furthermore, the scale's validity was compared with standardized assessment methods, demonstrating high diagnostic accuracy. Before and after treatment, the same attending physician scored the depth, number, and skin laxity of the patients' abdominal striae gravidarum, using a total score of 0-9 points, categorized as severe (7-9 points), moderate (4-6 points), mild (1-3 points), and none (0 point). All equipment (such as the Antra 3D imaging system and the CK MPA580 skin testing system) was used in a standardized testing environment to ensure the accuracy and consistency of the results. Specific environmental standards included a temperature set at 22°C ± 2°C and humidity controlled between 40% and 60% to minimize the impact of environmental factors on the test results.

Statistical analysis

Statistical analysis was performed using SPSS 25.0 software. Measurement data were first tested for normality using the Shapiro-Wilk test. Data conforming to a normal distribution were expressed as mean ± standard deviation ($\bar{x}$ ± sd), while non-normally distributed data were expressed as median (interquartile range).

For intergroup comparison of continuous variables, the independent-samples t-test was adopted for data with normal distribution and homogeneous variance; Welch's t-test was used for data with unequal variance; and the Mann-Whitney U test was applied for non-normal data. For intragroup comparisons before and after treatment, the paired t-test was used if the differences followed a normal distribution, otherwise the Wilcoxon signed-rank test was performed. Categorical data were described as cases and percentages [n (%)] and compared via the chi-square test. Fisher's exact test was used when the theoretical frequency failed to meet the requirements of the chi-square test.

Since this study was a retrospective, repeated-measure design, the statistical analysis was mainly based on independent group comparisons at each time point. No repeated-measure variance analysis or generalized estimating equation model was constructed. Therefore, it was impossible to evaluate the trend of the therapeutic effect over time and the interaction between time and groups. All tests were two-tailed, and a P value less than 0.05 was considered statistically significant.

Results

Baseline characteristics

The baseline data (age, maternal type, disease duration, body mass index, clinical classification, Fitzpatrick classification) were comparable between the two groups (all $P > 0.05$). See **Table 1**.

Clinical efficacy

The total effective rate in the observation group was 87.16%, significantly higher than the 69.07% in the control group ($P < 0.05$). See **Table 2**.

Patient satisfaction

The overall satisfaction rate in the observation group reached 95.41%, significantly higher than the 79.38% in the control group ($P < 0.05$). See **Table 3**.

Efficacy maintenance rate

At 3 and 6 months of follow-up, the efficacy maintenance rates in the observation group were 95.41% and 92.66%, respectively, both significantly higher than those in the control group (84.54% and 77.32%, $P < 0.05$). See **Figure 1**.

Safety

Regarding safety, the incidences of skin injury (3.67%) and pigmentation (2.75%) in the observation group were significantly lower than those in the control group (12.37% and 13.40%, respectively) (both $P < 0.05$). See **Table 4**.

Table 1. Comparison of baseline data between the two groups

Data	Control group (n = 97)	Observation group (n = 109)	t/χ^2	*P*
Age (years)	32.41 ± 4.77	32.85 ± 5.04	0.641	0.522
Course of disease (years)	4.22 ± 1.60	4.56 ± 1.53	1.558	0.121
Body mass index (kg/m^2)	22.14 ± 2.12	22.36 ± 2.05	0.757	0.450
Type of mother (first-time mother/experienced mother)	30/67	39/70	0.542	0.461
Clinical classification (red stretch marks/white stretch marks)	44/53	51/58	0.042	0.837
Fitzpatrick classification (type III/type IV)	67/30	76/33	0.010	0.919

Table 2. Comparison of clinical efficacy between the two groups [n (%)]

Group	Markedly effective	Effective	Ineffective	Total effective rate
Control group (n = 97)	27 (27.84)	40 (41.24)	30 (30.93)	67 (69.07)
Observation group (n = 109)	48 (44.04)	47 (43.12)	14 (12.84)	95 (87.16)
χ^2				9.993
P				0.002

Table 3. Comparison of satisfaction between the two groups [n (%)]

Group	Very satisfied	Moderately satisfied	Unsatisfied	Overall Satisfaction
Control group (n = 97)	42 (43.30)	35 (36.08)	20 (20.62)	77 (79.38)
Observation group (n = 109)	65 (59.63)	39 (35.78)	5 (4.59)	104 (95.41)
χ^2				12.371
P				< 0.001

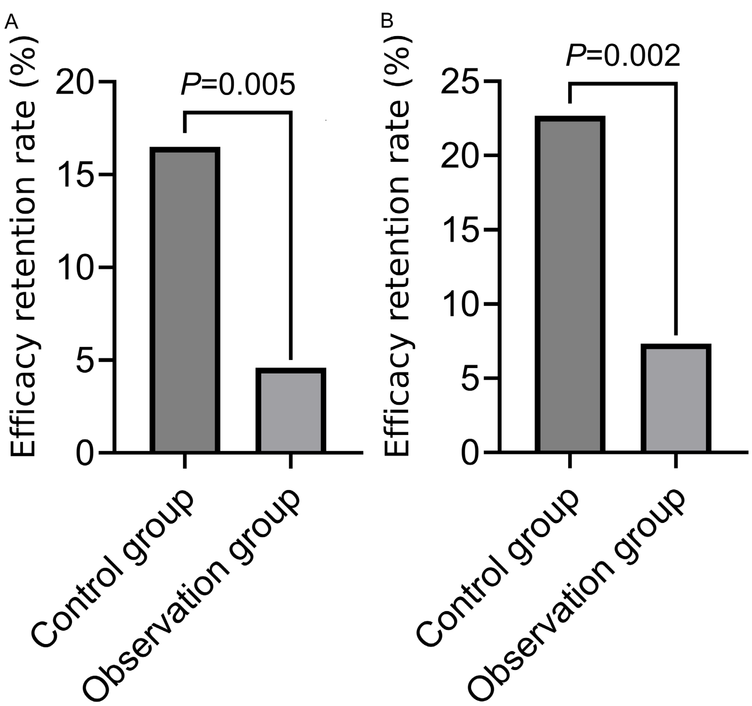

Figure 1. Comparison of efficacy maintenance rates between the two groups. A. Efficacy maintenance rate after 3-month follow-up. B. Efficacy maintenance rate after 6-month follow-up.

Abdominal aesthetic score

The abdominal aesthetic score in the control group was (3.90 ± 0.30) before treatment and (1.95 ± 0.44) after treatment; the score in the observation group was (3.92 ± 0.35) before treatment and (1.09 ± 0.29) after treatment. The abdominal aesthetic scores of both groups decreased significantly after treatment compared to before treatment, and the score in the observation group was significantly lower than that in the control group ($P < 0.05$). See **Figure 2**.

Changes in mean depth, volume, and area of striae gravidarum

Before treatment, there were no statistically significant dif-

Table 4. Comparison of safety between the two groups [n (%)]

Group	Skin damage	Pigmentation
Control group (n = 97)	12 (12.37)	13 (13.40)
Observation group (n = 109)	4 (3.67)	3 (2.75)
χ^2	5.425	8.126
P	0.020	0.004

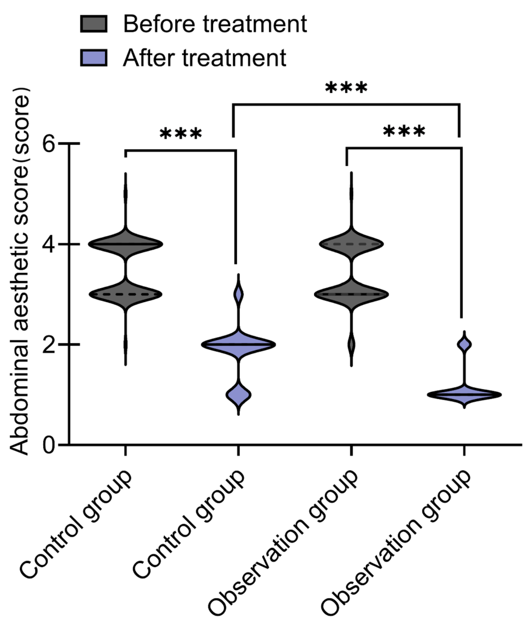

Figure 2. Comparison of aesthetics beauty scores between the two groups. Gray indicates before treatment, and blue indicates after treatment. ***P < 0.001.

ferences in the mean depth, volume, and area of striae gravidarum between the two groups (all P > 0.05). After treatment, the above indicators in both groups were significantly lower than baseline values, with the observation group showing lower values than the control group (all P < 0.05). See **Table 5**.

Skin elasticity and firmness parameters

Before treatment, there were no statistically significant differences in skin elasticity and firmness parameters between the two groups (all P > 0.05). After treatment, the skin elasticity parameters R5 and R7 in both groups were significantly higher than baseline values, with the observation group showing higher values than the control group (P < 0.05), while the firmness parameter F4 was significantly lower than baseline values, with the observation group showing lower values than the control group (all P < 0.05). See **Table 6**.

Subjective/self-assessment improvement scores

Before treatment, there were no statistically significant differences in the subjective/self-assessment improvement scores for the depth, number, and skin laxity of abdominal striae gravidarum between the two groups (all P > 0.05). After treatment, the subjective/self- assessment improvement scores for the depth, number, and skin laxity of abdominal striae gravidarum in both groups were significantly lower than baseline values, with the observation group showing a lower score than the control group (all P < 0.05). See **Figure 3**.

Discussion

After delivery or significant weight fluctuations, the abdominal wall often exhibits a sagging apron-like appearance, dermal atrophy, and striae gravidarum. These pathological changes are closely associated with elastic fiber rupture, collagen fiber degradation, and disordered subcutaneous fat distribution [15]. Conventional treatments are broadly categorized into surgery, phototherapy, and fillers, but they only target a single pathological aspect and fail to simultaneously supplement the scaffold, induce new collagen production, and restore the three-dimensional conformation of elastic fibers. Moreover, their efficacy is short-lived, and the recurrence rate after treatment is high, affecting patient satisfaction. Therefore, a safer and more effective new strategy is urgently needed in clinical practice.

ADM retains the natural three-dimensional porous structure of the dermis, with pore sizes of 50-200 μm. Its type I and III collagen bundles, elastin, and glycosaminoglycans can form a dermal-like template, which acts as a mechanical support after injection, resisting abdominal wall shear forces and reducing wound contracture [16]. Meanwhile, its porous mesh structure can provide adhesion sites and migration channels for endogenous fibroblasts and endothelial progenitors, promoting cell homing and orderly matrix remodeling [17].

Table 5. Comparison of average depth, volume and area of stretch marks between the two groups ($\overline{x} \pm s$)

Indicators	Time	Control group (n = 97)	Observation group (n = 109)	*t*	*P*
Average depth of striae gravidarum (mm)	Before treatment	0.031 ± 0.008	0.032 ± 0.006	1.022	0.308
	After treatment	0.022 ± 0.007*	0.018 ± 0.007*	4.094	< 0.001
Pregnancy stretch mark volume (mm^3)	Before treatment	0.355 ± 0.113	0.362 ± 0.105	0.461	0.646
	After treatment	0.233 ± 0.074*	0.198 ± 0.055*	3.879	< 0.001
Area of striae gravidarum (mm^2)	Before treatment	10.311 ± 2.104	10.404 ± 1.874	0.336	0.738
	After treatment	6.572 ± 1.440*	5.420 ± 1.115*	6.456	< 0.001

Note: Compared with before treatment within the group, $^*P < 0.05$.

Table 6. Comparison of skin elasticity parameters and firmness parameters between the two groups ($\overline{x} \pm s$)

Indicators	Time	Control group (n = 97)	Observation group (n = 109)	*t*	*P*
Skin elasticity parameter R5	Before treatment	0.841 ± 0.054	0.847 ± 0.047	0.853	0.395
	After treatment	0.873 ± 0.047*	0.901 ± 0.065*	3.505	< 0.001
Skin elasticity parameter R7	Before treatment	0.733 ± 0.055	0.728 ± 0.054	0.658	0.512
	After treatment	0.767 ± 0.045*	0.787 ± 0.055*	2.285	0.023
Tightness parameter F4	Before treatment	13.355 ± 1.745	13.381 ± 1.502	0.115	0.909
	After treatment	12.933 ± 0.722*	12.722 ± 0.556*	2.364	0.019

Note: Compared with before treatment within the group, $^*P < 0.05$.

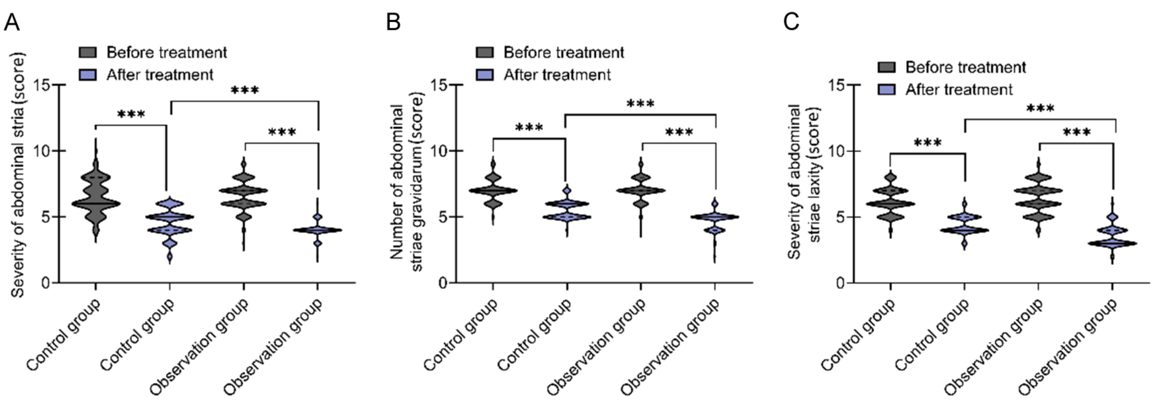

Figure 3. Comparison of subjective/self- assessment improvement scores of the two groups ($\overline{x} \pm s$, points). A. Depth and severity of abdominal striae gravidarum. B. Number of abdominal striae gravidarum. C. Degree of relaxation of abdominal striae gravidarum. $^{***}P < 0.001$.

PLLA microspheres (20-70 μm in diameter) can form a secondary scaffold in the subcutaneous fat-reticular dermis. Their surface slowly degrades and releases L-lactic acid, stimulating the secretion of local transforming factor-β1 and insulin-like growth factor-1, inducing type I collagen regeneration for more than six months, and achieving a gradual increase in dermal thickness [18]. Previous studies have also confirmed the important role of ADM in tissue repair from the basic experimental level, that is, ADM combined with adipose-derived mesenchymal stem cell exosomes can significantly promote the healing of deep second-degree burn wounds. The main mechanisms include promoting collagen fiber regeneration, inhibiting inflammatory response and reducing cell apoptosis, while enhancing angiogenesis [19].

This study further supports the biological advantages of ADM in tissue reconstruction at the cellular and molecular level. The results of this study are consistent with the above reports, suggesting that ADM plays a key role in promoting skin structure repair and functional recovery by providing a 3D scaffold and regulating the local microenvironment.

In this study, the total effective rate of the observation group was 87.16%, which was significantly higher than that of the control group (69.07%); the increase in the left-right abdominal score difference from baseline was significantly greater in the observation group than in the control group. This suggests that the application of PLLA combined with ADM on the basis of routine treatment can further improve the efficacy and promote the recovery of the abdominal condition. The reason is that PLLA and ADM have a complementary mechanism in terms of spatial scale. ADM provides macroscopic three-dimensional scaffold to achieve immediate support, whereas PLLA initiates long-term collagen regeneration through microscopic molecular stimulation. The combination can form a three-dimensional network of macroscopic template and microscopic stimulation, which jointly promotes the repair of abdominal swelling, laxity and striae gravidarum [20].

The results of this study demonstrated that the recurrence rate and the incidence of adverse reactions after treatment in the observation group were lower than those in the control group. This suggests that PLLA combined with ADM can effectively avoid recurrence and has high safety. The reasons for this may be: (1) PLLA combined with ADM can reshape the dermal structure through synergistic effect, and build new tissue with high elasticity and anti-tension properties. There is no need for repeated treatment stimulation, so the risk of natural recurrence is lower and the skin damage is less [21]; (2) ADM can provide mechanical support immediately and reduce skin tension after treatment, while PLLA can induce collagen for 18 months without significant thermal damage. The risk of melanocyte activation is significantly reduced and the incidence of pigmentation decreases accordingly [22]. The results of this study also showed that the average depth, volume and area of striae gravidarum after treatment in the observation group were lower than those in the control group, and the skin elasticity parameters and firmness parameters were better than those in the control group. This suggests that PLLA and ADM can effectively reduce or alleviate striae gravidarum and improve skin elasticity and firmness. This may be because: ADM can re-support and fill the broken dermal tissue through a three-dimensional scaffold structure, while PLLA further stimulates collagen deposition to achieve "structural reinforcement". The abdominal striae gravidarum naturally become narrower and shallower, and the skin's elasticity is significantly enhanced [23]. Additionally, the observation group demonstrated higher subjective/self- assessment improvements in the depth, number, and skin laxity of abdominal striae gravidarum after treatment compared to the control group, and higher patient satisfaction. This suggests that patients had a higher subjective evaluation and satisfaction with PLLA and ADM. This further supports the efficacy of this combined therapy from a subjective perspective.

The present results revealed that combined PLLA and ADM treatment significantly improved abdominal striae appearance, skin elasticity and tightness, with several indicators superior to those in the control group, suggesting promising clinical application prospects of this combined regimen. However, this study only evaluated therapeutic efficacy through clinical observational indicators, without conducting examinations concerning skin histopathology, molecular biology and material characteristics. Hence, definite synergistic mechanisms between PLLA and ADM cannot be fully confirmed. Theoretically, ADM may provide a three-dimensional scaffold to enhance local tissue support, while PLLA facilitates skin structural remodeling by stimulating collagen neogenesis. Their combination may exert complementary effects in tissue filling, mechanical support and collagen repair, which remains speculative based on previous evidence and inherent material properties.

This study failed to detect pathological parameters including dermal thickness, density of collagen and elastic fibers, as well as collagen-related molecular markers such as TGF-β1 and IGF-1. Accordingly, it remains unclear whether

PLLA hydrolysates regulate relevant cytokines during treatment. Besides, correlations between material properties including ADM porosity and PLLA microsphere size and clinical outcomes were not explored.

Further prospective studies integrating skin histological examination, collagen and elastic fiber staining, molecular biomarker detection, and correlation analysis between material characteristics and efficacy are required to elucidate the exact mechanisms of this combined therapy for abdominal skin laxity and striae gravidarum.

This study still has several limitations. First, as a retrospective analysis, although there were no statistically significant differences in baseline data between the two groups, it remains difficult to completely exclude the influence of potential confounding factors such as age, disease duration, and body mass index. Moreover, no further multivariable regression analysis was performed for adjustment; therefore, the results primarily reflect apparent intergroup differences. Second, although this study included data from multiple time points, the statistical analyses were mainly based on independent comparisons at each time point, and no longitudinal data analysis model (e.g., repeated-measures ANOVA or generalized estimating equations) was constructed. Consequently, the dynamic trend of efficacy over time and its interaction with treatment factors could not be systematically assessed. Future prospective studies combined with multivariable and longitudinal analytical methods are needed to further validate the conclusions.

In summary, PLLA and ADM effectively improve the appearance of loose abdominal skin and striae gravidarum, enhance skin elasticity and firmness, reduce recurrence rates, and improve patient satisfaction, with good safety profiles, making it suitable for clinical application.

Acknowledgements

This study was supported by the National Natural Science Foundation of China (31571168).

Disclosure of conflict of interest

None.

Address correspondence to: Chao Chen, Department of Dermatology, The Affiliated Friendship Plastic Surgery Hospital of Nanjing Medical University, No. 146, Hanzhong Road, Gulou District, Nanjing 210029, Jiangsu, China. Tel: +86-13584037034; E-mail: Geminiluna1985@163.com; Aidong Chen, The Key Laboratory of Targeted Intervention of Clinical Disease, Department of Physiology, Nanjing Medical University, No. 101 Longmian Avenue, Jiangning District, Nanjing 211166, Jiangsu, China. Tel: +86-18051076556; E-mail: aidongchen@njmu.edu.cn

References

[1] Xiong L, Yang L, He H, Chen J, Wang Y, Dong X, Li L and Han Y. Striae gravidarum in the Han Chinese pregnant population: identifying genetic markers and risk factors through a prospective cohort study. BMC Pregnancy Childbirth 2025; 25: 1075.

[2] Shu X, Huo W, Zou L, Li Z, Tang Y, Li L and Wang X. Treatment of stretch marks using a new formulation combining nanofractional radiofrequency plus magnetic nanofractional radiofrequency. Dermatol Ther (Heidelb) 2023; 13: 1277-1288.

[3] Jaiswal S and Jawade S. Microneedling in dermatology: a comprehensive review of applications, techniques, and outcomes. Cureus 2024; 16: e70033.

[4] Ebrahim MRY, Darwish HMA and Galal SA. Efficacy of dermapen combined with topical insulin versus dermapen combined with topical hyaluronic acid in treatment of stretch marks: comparative study. Arch Dermatol Res 2024; 317: 54.

[5] Kaur T, Kaur S, Bagga PK, Sidhu S and Raj RT. Comparative study of microneedling monotherapy versus microneedling with autologous platelet-rich plasma for the treatment of stretch marks (striae distensae) and post-surgical scars: clinical and dermoscopy outcomes. J Cutan Aesthet Surg 2024; 17: 307-314.

[6] Kurniawati Y, Yahya YF, Fadhila A, Rahmanda MR, Nursyarifah N and Alisa NS. Effectiveness of fractional CO2 laser and topical centella asiatica combination therapy in striae distensae (Stretch Marks). J Lasers Med Sci 2024; 15: e56.

[7] Christen MO. Collagen stimulators in body applications: a review focused on Poly-L-Lactic Acid (PLLA). Clin Cosmet Investig Dermatol 2022; 15: 997-1019.

[8] Glynou SP, Sousi S, Cook H, Zargaran A, Zargaran D and Mosahebi A. A comparison of acellular dermal matrices (ADM) efficacy and complication profile in women undergoing im-

plant-based breast reconstruction: a systematic review and network meta-analysis. BMC Cancer 2024; 24: 1598.
[9] Haddad A, Avelar L, Fabi SG, Sarubi J, Somenek M, Coimbra DD, Palm M, Durairaj KK, Somji M, Vasconcelos-Berg R, Hanseok L, Morlet-Brown K, Huang J, Fitzgerald R, Hexsel D, Mao C, Weinberg F, Prygova I and Bråsäter D. Injectable Poly-L-Lactic Acid for body aesthetic treatments: an international consensus on evidence assessment and practical recommendations. Aesthetic Plast Surg 2025; 49: 1507-1517.
[10] Ao YJ, Yi Y and Wu GH. Application of PLLA (Poly-L-Lactic acid) for rejuvenation and reproduction of facial cutaneous tissue in aesthetics: a review. Medicine (Baltimore) 2024; 103: e37506.
[11] Shen SZ, Wang PR, Fan R, Zhou ZX and Wang XL. Clinical efficacy of bipolar multichannel radiofrequency combined with negative pressure therapy in improving abdominal skin laxity with pregnancy striae. Chin J Aesthetic Med 2018: 27; 53-56.
[12] Wei JH, Wei LY, Jiang L and Qi YH. Clinical efficacy of low-frequency neuromuscular electrical stimulation combined with hyaluronic acid dressing and olive oil for postpartum abdominal striae repair. Chin J Aesthetic Med 2021: 30; 23-26.
[13] Amal AY, Putra IB, Jusuf NK and Nasution K. Evaluation of the severity of striae distensae using the new scoring system. Bali Med J 2023; 12: 1287-1290.
[14] Wen S, Wu LS, Yi Z, Xian XS, Fu XY, Zhang BH, Liang JY and Ye L. Application of anti-wrinkle skincare products in the improvement of postpartum striae distensae. China Deterg Cosmet 2025: 48; 123-126.
[15] Ahmed AEM, Mahmoud WA and El-Komy FBY. Microneedling with autologous platelet rich fibrin versus microneedling with autologous platelet rich plasma in treatment of abdominal stretch marks: a randomized comparative study. Arch Dermatol Res 2025; 317: 602.
[16] Sun X, Jia X and Huang L. Microneedling therapy for striae distensae: systematic review and meta-analysis. Aesthetic Plast Surg 2024; 48: 2915-2926.
[17] Wang A, Kwon D, Kim E, Oleru O, Seyidova N and Taub PJ. Statistical fragility of outcomes in acellular dermal matrix literature: a systematic review of randomized controlled trials. J Plast Reconstr Aesthet Surg 2024; 91: 284-292.
[18] Fabi S, Hamilton T, LaTowsky B, Kazin R, Marcus K, Mayoral F, Joseph J, Hooper D, Shridharani S, Hicks J, Brasater D, Weinberg F and Prygova I. Effectiveness and safety of sculptra Poly-L-Lactic Acid injectable implant in the correction of cheek wrinkles. J Drugs Dermatol 2024; 23: 1297-1305.
[19] He JL, Huang Q, Dong HF, Chen L, Zhong FY and Li XH. Decellularized dermal matrix combined with adipose-derived stem cell exosomes promote wound healing in burn patients. Chin J Tissue Eng Res 2026; 30: 1699-1710.
[20] Wu X, Cen Q, Wang X, Xiong P, Wu X and Lin X. Microneedling radiofrequency enhances Poly-L-Lactic Acid penetration that effectively improves facial skin laxity without lipolysis. Plast Reconstr Surg 2024; 154: 1189-1197.
[21] Heshemipour Y, Rehman U, Adebayo O, Sarwar MS, Neves S, Kamel Y and Brennan PA. Use of human acellular dermal matrix in rhinoplasty: a systematic review of the literature and meta-analysis. Br J Oral Maxillofac Surg 2024; 62: 105-112.
[22] Stec E, Lombardi J, Augustin J and Sandor M. Acellular dermal matrix susceptibility to collagen digestion: effect on mechanics and host response. Tissue Eng Part A 2023 29: 269-281.
[23] Vasconcelos-Berg R, Real J, Wenz F and Avelar LET. Safety of the immediate reconstitution of poly-l-lactic acid for facial and body treatment-a multicenter retrospective study. J Cosmet Dermatol 2024; 23: 3918-3923.