

The Efficacy of Microneedling and Platelet-Rich Plasma in the Treatment of Breast Reduction Scars: A Prospective Study

Buse Çapkınoğlu¹, Sabri Öztürk², Mustafa Durğun³, Meltem Ayhan Oral⁴,
Sosyal Baş¹, Dağhan Işık¹

¹ Private Clinic, Plastic, Reconstructive and Aesthetic Surgery Clinic, Istanbul, Türkiye

² Health Sciences University Şişli Hamidiye Etfal Research and Training Hospital, Istanbul, Türkiye

³ Private Clinic, Plastic, Reconstructive and Aesthetic Surgery Clinic, İzmir, Türkiye

⁴ Izmir Katip Celebi University, Atatürk research and Training Hospital, Department of Plastic, Reconstructive and Aesthetic Surgery, Izmir, Türkiye

Buse ÇAPKINOĞLU
0000-0002-8636-1848

Sabri ÖZTÜRK
0000-0001-6511-9609

Mustafa DURĞUN
0000-0002-0811-9175

Meltem Ayhan ORAL
/0009-0003-6785-1782

Sosyal BAŞ
0000-0002-4657-1613

Dağhan IŞIK
0000-0003-2166-8643

Correspondence: Buse Çapkınoğlu
Private Clinic, Plastic, Reconstructive and Aesthetic Surgery Clinic, Istanbul, Türkiye
Phone: +90 532 701 43 90
E-mail: busecapkinoglu@gmail.com

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ABSTRACT

Background: Incisional scars are among the most critical factors influencing postoperative satisfaction for both surgeons and patients. Although the majority of patients undergoing reduction mammoplasty report high overall satisfaction with the procedure, a significant proportion remain dissatisfied with the appearance of their scars. This study investigates the efficacy of combining platelet-rich plasma (PRP) with microneedling (dermapen) in the treatment of incisional scars.

Methods: A prospective, single-blind study design was employed. Twenty patients who had reduction mammoplasty and presented to the outpatient clinic with complaints related to scarring were divided into two groups. In the first group, microneedling was performed using a dermapen for 15 minutes, moving vertically and horizontally over incisional scars. In the second group, dermapen treatment was applied for five minutes to create microchannels, followed by topical PRP application, then continued for ten more minutes. Procedures were conducted in two sessions, three weeks apart. At six months, objective and subjective evaluations using VAS and statistical analyses were performed.

Results: Both groups demonstrated significant improvement in scar healing; however, the addition of PRP did not provide any additional benefit. No severe complications were observed among the patients, and all resumed their daily activities without disruption. Furthermore, no cases of hypo- or hyperpigmentation were recorded.

Conclusion: Currently, there are limited effective treatment modalities for incisional scar management. Both techniques evaluated in this study were found to be safe and effective for the treatment of both mature and immature incisional scars across all skin types.

Keywords: Incisional Scar, Microneedling, PRP, Scar Treatment

ÖZET

Amaç: İnsizyonel skarlar, ameliyat sonrası memnuniyeti hem cerrahlar hem de hastalar açısından etkileyen en kritik faktörler arasındadır. Redüksiyon mamoplastisi geçiren hastaların büyük çoğunluğu işlemden genel olarak yüksek memnuniyet bildirirse de, önemli bir kısmı skar görünümünden memnun değildir. Bu çalışmada, insizyonel skarların tedavisinde trombositten zengin plazma (PRP) ile mikroigneleme (dermapen) kombinasyonunun etkinliğini araştırmayı amaçlamaktadır.

Yöntemler: Prospektif, tek körlü bir çalışma tasarımı kullanıldı. Redüksiyon mamoplastisi geçirmiş ve skar ile ilişkili şikâyetlerle polikliniğe başvuran yirmi hasta iki gruba ayrıldı. Birinci grupta, dermapen kullanılarak insizyonel skarlar üzerinde dikey ve yatay hareketlerle 15 dakika boyunca mikroigneleme uygulandı. İkinci grupta ise önce beş dakika dermapen ile mikrokanelar oluşturuldu, ardından topikal PRP uygulandı ve işlem 10 dakika daha sürdürüldü. Uygulamalar üç hafta arayla iki seans halinde gerçekleştirildi. Altıncı ayda VAS kullanılarak objektif ve subjektif değerlendirmeler yapıldı ve istatistiksel analizler gerçekleştirildi.

Bulgular: Her iki grupta da skar iyileşmesinde anlamlı düzelleme gözlemlendi; ancak PRP eklenmesi ilave bir fayda sağlamadı. Hastalarda ciddi komplikasyon izlenmedi ve tüm hastalar günlük aktivitelerine kesintisiz olarak döndü. Ayrıca hipo veya hiperpigmentasyon olgusu saptanmadı.

Sonuçlar: Günümüzde insizyonel skar yönetimi için etkili tedavi seçenekleri sınırlıdır. Bu çalışmada değerlendirilen her iki tekniğin de tüm cilt tiplerinde, hem olgun hem de olgunlaşmamış insizyonel skarların tedavisinde güvenli ve etkili olduğu gösterilmiştir.

Anahtar kelimeler: İnsizyonel skar, Mikroigneleme, PRP, Skar tedavisi

Scar tissue is a consequence of the physiological wound healing cascade for plastic surgeons. However, it causes functional, aesthetic, and emotional problems in patients. In reduction mammoplasty, postoperative dissatisfaction is largely driven by scar-related aesthetic concerns, making scar quality a key determinant of both patient-perceived and surgeon-assessed outcomes (2). It has been demonstrated that treating and preventing undesirable scars not only improves objective aesthetic outcomes but also significantly enhances postoperative patient satisfaction and quality of life (3).

In scar treatment, the first step is to determine the scar type through physical examination. There are both surgical and conservative treatment methods for scars. Surgery is generally preferred after the maturation process is complete. The maturation period lasts approximately 18 months; however, this duration can be shorter or longer, and evaluation is not always straightforward (4). Generally, conservative treatments are applied until revision surgery is required, and the necessity for surgery is assessed based on the results. A wide range of scar treatment modalities including massage, silicone gel or sheeting, pressure garments, intralesional steroid injections, antimetabolic agents, laser therapy, cryotherapy, and radiotherapy have been described in recent clinical reviews (5). Dermapen is a high-speed microneedling system. Today, it is frequently used for scar treatment, skin rejuvenation, acne scars, and striae treatment. By creating microchannels extending to the dermis in the existing scar tissue, it induces controlled damage, breaks collagen cross-links, and activates the remodeling phase.

Platelet-rich plasma (PRP) is a plasma component with a high concentration of autologous platelets per unit volume.

Although the satisfaction rates of patients undergoing breast reduction surgery are very high, a significant majority complain about their scars. In this study, 'Inverted T Scar' was used to represent incisional scars, and treatment was applied to the horizontal and vertical scars remaining after breast reduction. The study compared the use of Dermapen alone and in combination with PRP for the treatment of incisional scar tissue. It was hypothesized that better results could be achieved by combining microneedling and PRP, both of which have been separately proven effective in previous studies (6, 7).

Material and Methods

This study was designed as a prospective and single-blind study and was approved by the hospital ethics committee following the principles of the Helsinki Declaration (01.04.2015/79 decision). Twenty patients who presented to the plastic, reconstructive, and aesthetic surgery outpatient clinic for their six-month postoperative follow-up after breast reduction surgery and reported dissatisfaction with their surgical scars, but had no abnormal wound healing, were included. These patients had undergone breast reduction with the superomedial pedicle 'Inverted T Scar' technique, and dermal sutures were applied during surgical closure. Staplers were used for skin approximation, and all staplers were removed on the 14th postoperative day. Before the procedure, each patient's age, body mass index (BMI), time elapsed since surgery, Fitzpatrick skin type, history of postoperative infection, smoking status, scar type, any preventive measures or treatments received for scar formation, and any pre-procedural itching/burning sensations were recorded in patient forms. Since surgical scar maturation may continue for up to 18 months, the time elapsed since surgery was recorded for all patients and considered a potential confounding variable in the analysis. Patients included in the study presented at different postoperative time points, ranging from 8 to 28 months. To account for this variability, the relationship between postoperative time and treatment outcomes was evaluated using correlation analysis. No statistically significant association was found between the time since surgery and VAS scores, suggesting that treatment response was not influenced by scar age within the studied time range.

The patients were randomly divided into two groups of ten. In Group 1, only Dermapen-induced remodeling was applied, whereas in Group 2, PRP obtained from the patient was applied to the scar area before Dermapen treatment, and Dermapen was then applied over the PRP. Each group received two treatment sessions at three-week intervals. Standardized clinical photographs were obtained for all patients before treatment and at the six-month follow-up visit. All images were captured using the same digital camera, under identical lighting conditions, patient positioning, and camera distance. The scar areas were photographed in a consistent orientation to allow reliable comparison between baseline and follow-up images. These standardized photographs were used for both clinical evaluation and blinded assessment by independent evaluators. The results were scored objectively and subjectively using the Visual Analog Scale (VAS).

An electrically powered Dermapen system, capable of 0–90 insertions per second, penetrating the skin at a 90-degree angle, and equipped with 11 titanium needles of 33 gauge, was used. Since the needles were to be used on the body and scar tissue, they were adjusted to a deeper penetration level of 2.5 mm rather than the standard depth used on the face (6). The PRP used in this study was prepared based on scientifically proven methods from previous studies. A topical local anesthetic agent was applied to both patient groups 30 minutes before the procedure.

Group 1: Microneedling was applied with Dermapen for 15 minutes in vertical and horizontal directions over the incisional scars to induce remodeling in the irregularly healed areas. After the application, a saline dressing was applied, and the area was kept covered for one day.

Group 2: First, Dermapen was applied for five minutes over the incisional scars to create microchannels. Then, PRP was spread over the skin, and Dermapen treatment continued for another ten minutes. After the application, a saline dressing was applied, and the area was kept covered for one day.

Before and after treatment, standardized photographs taken at the sixth month were shown to the patients themselves, a plastic surgeon, a general surgeon, and a medical secretary, who were asked to rate them on a scale of 0–4. Independent raters were blinded to the patient groups. The scoring scale was as follows:

0 = No change 1 = Improvement present but not good 2 = Moderate improvement 3 = Good improvement 4 = Very good improvement

Statistical Methods

Statistical analysis was performed using SPSS 17.0 (IBM Corporation, Armonk, New York, United States). Categorical variables were described using frequency and percentage, while continuous variables were presented as mean and standard deviation or median and minimum-maximum values. Categorical variables were compared using the Chi-square test or Fisher's Exact test, while group means were compared using the Mann-Whitney U test. Median values were compared using the Median test. Correlations between numerical variables were analyzed using Spearman correlation analysis. The study was conducted at a 95% confidence level ($p < 0.05$ was considered statistically significant).

Results

In both groups a visible reduction in incisional scars was observed (Figures 1-2-3). However, no significant difference was found between the two groups.



Figure 1: 1(A) Pretreatment photograph of a 36-year-old female with an inverted-T breast reduction scar.
1(B) Clinical appearance three weeks after the second session of microneedling combined with topical PRP application.



Figure 2: Figure 2(A) Pretreatment photograph of a 41-year-old female presenting with a postoperative breast reduction scar.
2(B) Clinical appearance three weeks after the second session of microneedling treatment.



Figure 3: 3(A) Pretreatment photograph of a 38-year-old female with a reduction mammoplasty scar.
3(B) Clinical appearance three weeks after the second session of microneedling combined with topical PRP.

No complications were observed in the patients. After the procedure, patients continued their daily activities. The most common side effect was tolerable pain. No cases of hypopigmentation or hyperpigmentation were detected in any patient.

Patient characteristics such as age, body mass index (BMI), time elapsed since surgery, Fitzpatrick skin type, history of postoperative infection, smoking status, preventive measures or treatments for scars, and postoperative symptoms like itching or stinging are presented in Table 1. The groups were found to be homogeneous in terms of demographic data. Contrary to common knowledge, smoking and a history of postoperative wound infection did not negatively affect treatment outcomes. Additionally, previous scar treatment did not provide a significant benefit to the patients.

Table 1. Baseline Patient Characteristics

Variable	Total (n = 20)	Group 1 (n = 10)	Group 2 (n = 10)	p value
Age (years), mean ± SD	41.0 ± 11.8	43.8 ± 11.6	38.2 ± 11.9	0.224
BMI (kg/m ²), mean ± SD	24.7 ± 2.2	25.4 ± 2.1	24.1 ± 2.2	0.545
Postoperative time (months), median (min–max) ^a	15 (8–28)	15.5 (8–18)	14.5 (8–28)	0.650
Skin type, n (%) ^b				0.837
Type II	8 (40.0)	3 (30.0)	5 (50.0)	
Type III	8 (40.0)	5 (50.0)	3 (30.0)	
Type IV	4 (20.0)	2 (20.0)	2 (20.0)	
Postoperative infection, n (%)				0.474
Yes	2 (10.0)	2 (20.0)	0 (0.0)	
No	18 (90.0)	8 (80.0)	10 (100.0)	
Previous scar prevention, n (%) ^c				0.303
Yes	15 (75.0)	9 (90.0)	6 (60.0)	
No	5 (25.0)	1 (10.0)	4 (40.0)	
Smoking status, n (%)				0.350
Yes	13 (65.0)	5 (50.0)	8 (80.0)	
No	7 (35.0)	5 (50.0)	2 (20.0)	
Preoperative pain/itching, n (%)				>0.999
Yes	10 (50.0)	5 (50.0)	5 (50.0)	
No	10 (50.0)	5 (50.0)	5 (50.0)	
Postoperative pain/itching, n (%)				>0.999
Decreased	4 (20.0)	2 (20.0)	2 (20.0)	
No change	16 (80.0)	8 (80.0)	8 (80.0)	

^a Median values are presented with minimum–maximum range.

^b Skin types classified according to the Fitzpatrick scale.

^c Previous scar prevention methods included silicone gel application, massage therapy, and topical agents.

Values are presented as mean ± standard deviation (SD) or n (%), unless otherwise specified.

* p value < 0.05 was considered statistically significant.

The VAS scores of the patients in both groups are presented in Table 2. No statistically significant difference was found between the groups in terms of VAS scores, indicating that satisfaction levels were similar in both groups.

When the agreement between the VAS scores given by the patients and the evaluator was assessed (Table 3), a weak but significant agreement was found (Kappa = 0.336; $p = 0.003$).

When all patients were analyzed, no significant correlation was found between satisfaction scores and BMI, or the

time elapsed since surgery (Table 4). However, when only the doctors' average VAS scores were considered, a moderate negative correlation with age was observed ($r = -0.481$; $p = 0.032$). No statistically significant correlation was found between age and other VAS assessments ($p > 0.05$). Although no statistically significant difference was detected between the groups, both treatments demonstrated consistent clinical improvement, suggesting that microneedling itself may represent the primary driver of scar remodeling in this cohort.

Table 2. VAS Scores According to Treatment Group

Variable	Total (n = 20)	Group 1 (n = 10)	Group 2 (n = 10)	p value
VAS DR ^a	2 (0–3)	2 (0–3)	2 (0–3)	>0.999
VAS DR1 ^b	2 (0–3)	2 (0–3)	2 (0–3)	0.582
VAS DR2 ^c	2 (0–3)	2 (0–3)	2 (0–3)	>0.999
VAS Individual	2 (0–3)	2 (0–3)	2 (0–3)	0.628
VAS Patient	2 (0–4)	2 (0–4)	2 (0–4)	>0.999

^a Mean score of two blinded physician evaluators
^b First physician assessment
^c Second physician assessment

Table 3. Agreement Between VAS Patient and VAS Individual Scores

	VAS Individual					Kappa	p
	0	1	2	3	Total		
VAS Patient							
0	2	1	0	0	3	0.336	0.003*
1	0	1	1	0	2		
2	0	1	5	1	7		
3	0	0	2	2	4		
4	0	0	1	3	4		
Toplam	2	3	9	6	20		

* $p < 0.05$ indicates statistically significant agreement.
** Agreement assessed using Cohen's Kappa test.

Table 4. Correlation Between VAS Scores and Clinical Variables

Variable	Age		BMI		Postoperative Time	
	r	p	r	p	r	p
VAS DR	-0.481	0.032*	-0.298	0.203	-0.177	0.454
VAS DR1	-0.403	0.078	-0.149	0.532	-0.184	0.439
VAS DR2	-0.432	0.057	-0.395	0.084	-0.114	0.633
VAS Individual	-0.237	0.315	-0.213	0.367	-0.088	0.713
VAS Patient	-0.414	0.070	-0.214	0.365	-0.290	0.216

Correlation analysis performed using Spearman's rho test.
• $p < 0.05$ was considered statistically significant.

Skin type and treatment outcomes were analyzed in paired groups (Table 5). It was observed that the second doctor's VAS scores were higher in patients with lighter skin types, indicating a better treatment response in fair-skinned individuals ($p = 0.030$). The median values of VAS DR 2 (Visual Analog Scale Doctor 2) were found

to be significantly different between skin type groups ($p = 0.036$). However, no significant difference was found between skin type II and skin type III, or between skin type III and skin type IV groups. Similarly, the individual VAS score was found to be significantly different between skin type II and skin type IV groups ($p = 0.005$).

Table 5. VAS Scores According to Fitzpatrick Skin Type

Variable	Skin Type II	Skin Type III	Skin Type IV	p value
VAS DR	1.8 (0–3)	2.0 (1–3)	2.8 (0–3)	0.077
VAS DR1	1.5 (0–2)	2.0 (1–3)	2.5 (0–3)	0.112
VAS DR2	2.0 (0–3)	2.0 (1–3)	3.0 (0–3)	0.036*
VAS Individual	2.0 (0–2)	2.0 (1–3)	3.0 (0–3)	0.024*
VAS Patient	2.0 (0–4)	2.5 (0–4)	3.5 (0–4)	0.086

Values are presented as median (min–max).
Comparison performed using Kruskal–Wallis test.
* $p < 0.05$ indicates statistically significant difference.

Discussion

Scar tissue is a result of the physiological wound healing cascade for plastic surgeons. However, it poses functional, aesthetic, and emotional challenges for patients. In numerous studies evaluating postoperative aesthetic outcomes, scar appearance has been demonstrated to negatively influence patient-reported satisfaction and psychosocial well-being after aesthetic and reconstructive procedures (8). Scar tissue often serves as a personal standard for patients to judge the success of the procedure.

The treatment of incisional scars is closely related to the stages of wound healing. In elective surgical patients, scar management begins with the informed consent process. Initially, individual factors such as age, ethnicity, and a history of pathological scarring are unchangeable factors. The only modifiable factor is the surgical technique. The most critical underlying principle is the tension-free approximation of tissues. Postoperative scar tissue may appear raised, erythematous, itchy, and painful, and in some cases, it may be considered unacceptably unsightly (9).

This study included patients who underwent breast reduction surgery. In this patient group, tissues are approximated under some degree of tension, making postoperative widening-type scars more likely.

There is no universally defined method for treating postoperative scars, but various approaches exist that can

help reduce scar appearance (10). It is a well-known fact that scars never completely disappear; at best, they can be minimized. The primary goal of scar treatment is to optimize its color (11, 12).

It has been proposed that treatment methods used for scar management and prevention act through one of three mechanisms:

1. Correction of abnormal collagen metabolism
2. Modification of the immune/inflammatory response
3. Manual simulation of the mechanical properties of wound healing

Some systemic pharmacological agents that act through these mechanisms include colchicine, D-penicillamine, antihistamines, and intralesional steroids (13).

Conservative treatment methods include massage, silicone gel or sheeting, pressure garments, herbal products, antimetabolic agents, laser therapy, soft tissue fillers, radiotherapy, interferon, and cryotherapy. Additionally, COX-2 inhibitors, nonsteroidal anti-inflammatory drugs, collagen synthesis inhibitors, angiotensin-converting enzyme inhibitors, minocycline, and gene therapies, which target the TGF- β superfamily, are among the currently defined treatment approaches (14).

Despite these advancements, silicone therapy is still considered the standard non-invasive approach (15).

The microneedling method has been used since 1995 to reduce skin imperfections by inducing collagen production. Microneedling(dermaroller) has been shown to be an effective and well-tolerated treatment option for atrophic acne scars (16). Today, skin needling techniques are effectively used in the treatment of scars and wrinkles (17, 18).

Microneedles penetrate the epidermis, creating rapidly healing microchannels, as this technique involves only tissue injury, unlike ablative procedures. In ablative laser applications, however, the epidermis and superficial dermis are vaporized and destroyed (19). This destruction can lead to various complications, particularly in individuals with darker skin tones (Fitzpatrick skin types IV-VI), including dyspigmentation, post-inflammatory hyperpigmentation and hypopigmentation, infection, and scarring (20, 21).

During microneedling, melanocytes are not directly targeted (17), and there is no increase or decrease in their numbers (18). Since microneedling does not target melanocytes or cause significant skin damage, it has been suggested that it can be safely used on Asian and darker-skinned individuals, as well as on skin previously treated with laser or dermabrasion (17). In the present study, none of the dark-skinned (Fitzpatrick IV) individuals developed hyperpigmentation, hypopigmentation, or abnormal scarring.

Platelet-rich plasma (PRP) is a plasma component derived from autologous blood that contains a significantly higher concentration of platelets per unit volume compared to normal plasma. In addition to its high platelet content, PRP also includes all components of clotting factors at normal physiological levels. It has been proven that the numerous cytokines and growth factors contained in platelets can influence inflammation, postoperative blood loss, infection, osteogenesis, muscle and nerve tissue regeneration, and wound healing. In recent years, its popularity has increased in plastic surgery, orthopedic surgery, ophthalmic surgery, and anti-aging applications (22). Despite the increasing use of platelet-rich plasma (PRP) in scar modulation, recent evidence reveals a heterogeneous and at times inconsistent efficacy profile. Several systematic reviews and meta-analyses have evaluated PRP, alone or in combination with

microneedling or laser therapy (23), reporting improved clinical outcomes and patient satisfaction compared to controls, but also noting substantial methodological variability and low to moderate quality of evidence across studies (24).

The effect of microneedling depends on its ability to stimulate wound healing and new collagen production in the upper dermis. Needling triggers a cascade of growth factors that directly stimulate the maturation phase of wound healing and enhance skin repair mechanisms (25). Additionally, microneedling provides an effective channel for the absorption of topical agents through the skin surface, with PRP being a prime example.

In the present study, PRP, whose effectiveness has been demonstrated in multiple fields, was combined with the microneedling system to leverage its remodeling effects and its ability to enhance skin penetration. The study aimed to evaluate whether this combined therapy offers superiority over microneedling alone.

While better outcomes were expected in the combined treatment group, contrary to the existing literature, the addition of PRP to microneedling (dermapen) therapy did not result in a significant difference in the treatment of incisional scars.

In this study, PRP was prepared based on Marx's double centrifugation method (26). Redaelli et al. reported that intradermal PRP injection improved acne scars while using PRP for skin rejuvenation (27). They were the first to suggest that further studies should be conducted to examine PRP's positive effects on acne scars.

Lee et al. demonstrated that in patients receiving simultaneous PRP injection with carbon dioxide laser treatment, the damaged skin improved, and the clinical appearance of acne scars was reduced due to a synergistic effect (28). The only study that combined dermaroller with topical PRP was conducted by Fabbrocini et al. (29). They divided the face into two halves to compare the effectiveness of microneedling alone versus its combination with topical PRP. The results showed a significant reduction in scar severity on both sides of the face, but the improvement was more pronounced on the side treated with both microneedling and PRP. A recent meta-analysis published in 2022 reported that PRP achieved predominantly moderate improvement rates (47%) in acne scar treatment and did not demonstrate a

statistically significant difference compared to baseline in validated scar scales, suggesting that the clinical efficacy of PRP alone remains controversial (30).

In our study, unlike previous research using dermarollers, a dermapen device was used.

There is no established consensus on the number of sessions and time intervals for dermapen and PRP applications. In our study, for better patient compliance, each patient underwent two sessions, scheduled three weeks apart.

From our perspective, optimizing treatment outcomes may involve increasing the number of sessions and prolonging the interval between them, potentially promoting greater dermal collagen formation.

Limitations

This study has several limitations that should be acknowledged. First, the relatively small sample size ($n=20$) may limit the statistical power to detect subtle differences between treatment groups. Second, the follow-up period was limited to six months, which may not fully capture long-term scar remodeling processes that can continue for up to 18 months after surgery. Third, scar assessment relied primarily on Visual Analog Scale (VAS) evaluations, which include a subjective component despite the use of multiple blinded evaluators. In addition, objective scar scoring systems such as the Vancouver Scar Scale were not employed. Finally, this was a single-center study and no histological evaluation of collagen remodeling was performed. Future randomized controlled studies with larger patient populations, longer follow-up periods, and objective scar assessment methods are needed to further clarify the role of microneedling and PRP in the management of postoperative scars.

Conclusion

In conclusion, both microneedling alone and microneedling combined with platelet-rich plasma (PRP) were associated with clinical improvement in postoperative breast reduction scars. However, the addition of PRP did not result in a statistically significant difference compared with microneedling alone. Importantly, neither treatment modality was associated with serious adverse effects, and both were well tolerated by patients. These findings suggest that microneedling

represents a safe treatment option for postoperative scars, while the adjunctive use of PRP appears to be feasible without increasing complication risk. Further randomized studies with larger patient populations and longer follow-up periods are required to better define the potential additional benefits of PRP in postoperative scar management.

Declarations

Ethical Approval Statement: This study was designed as a prospective and single-blind study and was approved by Izmir Katip Celebi University, Atatürk research and Training Hospital Ethics Committee following the principles of the Helsinki Declaration (01.04.2015/79).

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