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Current uses of adipose grafting with platelet-rich plasma

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Abstract

Aim: The purpose of this study was to analyze fat grafting with platelet-rich plasma (PRP) in the context of volume replacement and scar hypertrophy improvement in a variety of different cases.

Methods: A retrospective review was conducted on 40 patients who underwent a total of 50 fat grafting with PRP procedures by a single surgeon between October 2019 and October 2022. Fat was generally harvested from the abdomen, thighs, or flanks using an enclosed power-assisted system or Toomey syringes with 3.0 or 3.7 mm cannulas. The fat with PRP was grafted into various sites using a 0.9 mm Tulip single port injection cannula for faces/small defects. Of the 50 cases reviewed, the injection sites were as follows: 20 cases of injections into scars (hypertrophic scars, burn/trauma scars, and scars from hidradenitis suppurativa), 15 injections to the face [to replenish volume lost by aging and two cases for human immunodeficiency virus (HIV) facial atrophy], 6 injections to the breasts, 4 injections to keloids, 4 injections to buttocks, and 1 case of injection to the nose.

Results: Overall, for all sites, the average amount of fat harvested was 360 mL, and the average amount of fat with PRP grafted was 96 mL. Of the face grafts, the average amount of fat grafted was 20 mL. The overall complication rate in our cohort was 2%, occurring only in one patient who developed cellulitis after fat grafting to the breast. There were no cases of embolization. The patients showed excellent improvement in volume and significant cosmetic improvement of scars.

Conclusion: Patients who underwent autologous fat grafting with PRP had favorable volume replacement and improvement in scarring deformity following the procedure. Fat grafting with PRP was found to be a safe and reliable technique to address various volume and skin concerns.

Keywords: Adipose grafting, fat grafting, platelet-rich plasma

INTRODUCTION

Autologous fat grafting with enrichment has been gaining popularity in reconstructive and aesthetic plastic surgery to correct soft-tissue volume loss and improve skin defects. Fat grafts themselves contain regenerative mesenchymal stem cells, known as adipose-derived stem cells (ADSC), that can differentiate into various cell lineages and secrete a plethora of cytokines and growth factors including vascular endothelial growth factor (VEGF), insulin-like growth factor (IGF), platelet-derived growth factor (PDGF), and transforming growth factor-beta (TGF-β)[1,2]. Together, these growth factors and cytokines provide a diverse array of regenerative effects to the skin[3]. It has been shown that during the wound healing process, adipose-derived mesenchymal stem cells and their conditioned media stimulate collagen synthesis as well as the migration of *in vitro* monolayer dermal fibroblasts in three-dimensional skin cultures[4-6]. Additionally, adipose transfer is nonimmunogenic, versatile, and easily harvestable with low donor-site morbidity[7,8].

Despite this, fat graft retention is greatly varied in the medical literature, ranging from 10% to 90%, with fat necrosis and subsequent graft resorption being significant problems[8,9]. The exact mechanism of adipocyte death in fat grafting is unknown, but it is hypothesized that ischemia is a major contributor[10].

Because fat graft survival has often been unpredictable, fat is often supplemented with platelet-rich plasma (PRP) or other supplements[11]. Bilkay *et al.* demonstrated that adding PRP to the fat graft reduced the number of fat grafting treatments needed to obtain the desired outcome in calf augmentation compared to the control fat without PRP[12]. Gentile *et al.* also demonstrated the volume maintenance benefits of adding PRP to fat grafting in the context of breast reconstruction[13].

PRP is a preparation of autologous plasma enriched with a platelet count above baseline that can be obtained via a simple blood sample[14,15]. Platelets release many biologically active proteins that promote tissue regeneration, angiogenesis, re-epithelization, and collagen formation. In the context of PRP as an adjuvant to fat grafting, it is believed that the pro-angiogenic and anti-inflammatory components of PRP, along with the potential proliferative effects that PRP can have on ADSCs, serve to improve the overall graft outcome and survivability[16]. Overall, PRP is thought to be a safe, cost-effective method to better fat graft survival, decrease postoperative bruising and inflammation, and increase the ease of graft application[9].

In the literature, adipose grafting with PRP has been briefly analyzed in the context of wound healing[17-19], scar treatment[20,21], facial lipofilling[22-24], gluteal augmentation[25], calf augmentation[12], and breast reconstruction[26,27]. Initial results reveal variable superiority over other fat grafting techniques, but overall positive short-term outcomes indicate potential efficacy that warrants additional exploration[16]. This study aimed to analyze fat grafting with PRP in the context of volume replacement and scar hypertrophy improvement in a variety of different cases.

METHODS

A single institution, Institutional Review Board (IRB)-approved (IRB-300006012) retrospective chart review was conducted on 40 patients who underwent a total of 50 fat grafting/PRP procedures by one provider from October 2019 to October 2022. Data collection included patient demographics as well as both major and minor postoperative complications. Patients were followed at all subsequent appointments following the procedure to assess results and monitor complications.

The majority of cases were grafted with a fat/PRP ratio of 0.8 fat/0.2 PRP (20% PRP) or 0.9 fat/0.1 PRP (10% PRP), depending on body location and pathology. The PRP was prepared using a centrifuge in the operating room. All fat was processed using a washing and filtration technique. Tumescent was infiltrated into the donor sites, and the fat was harvested using a standard liposuction technique. Fat was harvested from the abdomen, thighs, and/or flanks using an enclosed power-assisted system or Toomey syringes with 3.7 or 3.0 mm cannulas. A 0.9 mm Tulip single port injection cannula with 1ml syringes was used for injections into the face, neck, and smaller areas of scarring. For breast and buttocks, a 3.7 cannula or Tuohy needle was used. An 18-gauge needle for injection into hypertrophic scars was utilized. Multiple 10 mL syringes were used for larger areas such as breasts, buttocks, hypertrophic scarring, burns, and keloids. Sixty mL Toomey syringes were used with the 3.7 or 4.6 cannula for buttocks. The majority of harvested fat was washed with saline, strained, placed in syringes, and emulsified. For cases where minimal fat was harvested, the fat was processed by being rolled onto Telfa after being washed with saline. The correct ratio of PRP was then added to the prepared fat prior to injection.

For the cases involving hypertrophic scarring, 5-fluorouracil (5-FU) and triamcinolone were also injected in addition to the PRP. For each session, the patient was put under general anesthesia and abdominal fat was harvested through liposuction. Aspirated fat was washed, emulsified, and mixed at a ratio of 0.8 fat to 0.2 PRP. This was injected into areas of hypertrophic scarring using an 18-gauge needle. Following the fat grafting, 5-FU (45 mg/0.9 mL with triamcinolone 1 mg/0.1 mL) and triamcinolone (40 mg/mL) were injected into the same sites of hypertrophy.

RESULTS

The cohort consisted of 12 males and 28 females with an average age of 52 years (range 18-79). The analyzed cases included 13 burn scars, 6 hypertrophic scars, 1 case of scarring from hidradenitis suppurativa, 13 cases for facial aesthetics, 2 procedures for human immunodeficiency virus (HIV) facial atrophy, 6 cases for breast aesthetics, 4 keloid excisions, 4 cosmetic buttock fat grafts, and 1 nose fat graft. The average amount of fat and PRP grafted in each case is depicted in Table 1.

All cases analyzed involved fat grafting with the addition of PRP. Results showed obvious improvement in the appearance of prior scars, excellent volume replacement, and overall favorable cosmetic results for patients. A review of all 50 cases showed a 2.0% complication rate, with only one complication of cellulitis occurring in a fat graft breast patient. There were no cases of embolization.

The patient in Figure 1 is a 68-year-old man who sustained a large chemical burn spanning his right scapular region, right shoulder, and right axilla after falling backward onto flooring covered with a chemical tile stripper. The burn measured 33 cm × 34 cm. He underwent debridement in the burn unit at the time of the incident and then presented to the clinic four months later for revision of his hypertrophic and keloid scarring. This patient has received 3 treatments over an 8-month period of adipose grafting with PRP, along with injections of Kenalog and 5-FU, to the affected areas. For each operation, the patient's abdomen and flanks were infiltrated with tumescent and adipose tissue was harvested using a 3.7 mm liposuction cannula.

Table 1. Injection volume (fat and PRP) based on recipient site and/or specific pathology

Recipient site/pathology (*n* = 50)	Amount (mL) of fat and PRP grafted mean (range)
Nose (*n* = 1)	2.4 (2.4)
Hidradenitis suppurativa (*n* = 1)	23.0 (23.0)
HIV facial atrophy (*n* = 2)	32.0 (25.0-39.0)
Keloid (*n* = 4)	22.5 (7.0-60.0)
Buttocks (*n* = 4)	266.7 (250.0-300.0)
Breasts (*n* = 6)	81 (25.0-230.0)
Face cosmetic (*n* = 13)	20.3 (6.0-33.0)
Burn/hypertrophic scars (*n* = 19)	28.9 (5.0-60.0)

PRP: Platelet-rich plasma; HIV: human immunodeficiency virus.

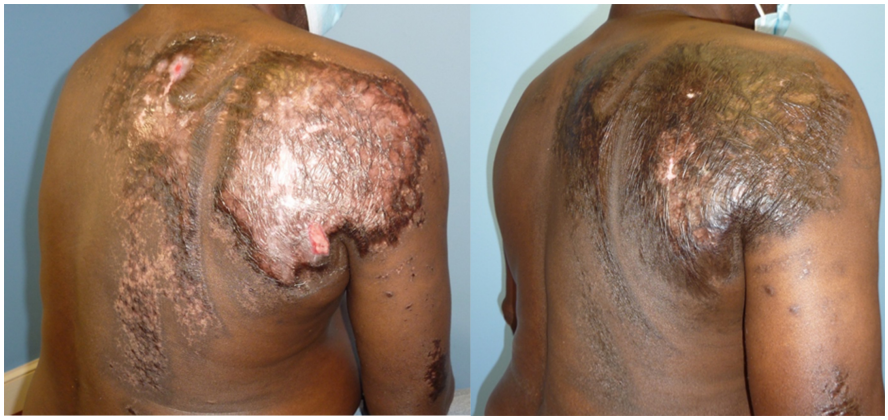

Figure 1. Before any intervention (left) and 8 months post-op (right) after fat grafting with PRP, Kenalog, and 5-FU to a hypertrophic burn scar on the back. PRP: Platelet-rich plasma; 5-FU: 5-fluorouracil.

The fat was processed intraoperatively by normal washing, rolled out on Telfa, emulsified, put into 10 mL syringes, and mixed with the patient's PRP. For his first treatment, 80 mL of fat and PRP was injected (9 mL fat/1 mL of PRP), as well as 1 mL of 5-FU (45 mg/0.9 mL)/triamcinolone (1 mg/0.1 mL) and 2mL of (10 mg/mL) Kenalog. For his second operation, 50 mL of fat and PRP was injected at the same ratio as the first treatment and 3 mL of 5-FU (45 mg/0.9 mL)/triamcinolone (1 mg/0.1 mL). For his third treatment, 18 mL total of fat and PRP was injected (2.5 mL fat/0.5 mL PRP), along with 2 mL 5-FU (45 mg/0.9 mL)/triamcinolone (1 mg/0.1 mL) and an additional 1 mL (40 mg/mL) of Kenalog. Figure 1 highlights the impressive results for this patient. On the left, the image shows the scarring on the patient's first visit. On the right, the image displays the area following three surgical injection treatments and 4 fractional CO_2 laser treatments. The procedures significantly improved the overall appearance and texture of the scar area. The area of the lesion has flattened and shows obvious cosmetic improvement. The patient was satisfied with his results and even reported an increased range of motion of his right shoulder due to decreased skin tightness and thickness.

Additionally, the benefits of fat grafting with PRP for cosmetic purposes alone can be seen in Figure 2. This patient had previously undergone a facelift in 2014 and presented to the clinic with complaints of infraorbital volume loss and the appearance of dark circles. She previously had filler injections elsewhere, one of which was Aquamid. She then underwent a facelift in September 2021 with fat grafting and PRP injections (26.3 mL) to the face. The sites grafted included the infraorbital rims and zygomas, temples, lips, right side of nasal bones, over the left upper lateral cartilage, the marionette lines, and the nasolabial folds.

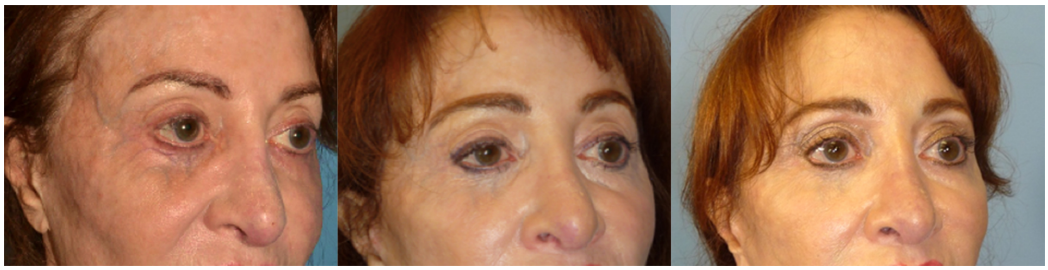

Figure 2. Before (left), 4 months post-op (middle), and 10 months (right) after facelift with fat grafting with PRP to face (26.3 mL). PRP: Platelet-rich plasma.

Adipose tissue was harvested from the sides of the abdomen, washed, emulsified, and then mixed with the patient's PRP intraoperatively. 26.3 mL of fat mixed with PRP was injected into bilateral facial regions described above, along with 1ml into the nasal concavities. Figure 2 shows the excellent improvement in periorbital fullness, decrease in scleral show, and improvement in nasal contour.

The only complication experienced by our cohort consisted of one case of cellulitis in a patient who underwent fat grafting of the breast. The patient was a 79-year-old female with a history of bilateral breast cancer, whose initial procedure included a bilateral capsulectomy with implant exchange, fat grafting with PRP to bilateral breasts, and liposuction of the upper-outer quadrant of each breast at the axilla. Per protocol, the patient was to be discharged the same day as the procedure; however, she was found to be hypoxic in the recovery area and was admitted overnight for observation. She returned home the following morning with an appropriate oxygen saturation and no additional complications upon discharge. Four days after discharge, she presented to an outside hospital with increasing erythema of both breasts and was subsequently transferred to our institution due to concern about a necrotizing infection. Upon transfer, the infection site was incised and drained in the operating room and IV antibiotics (meropenem, vancomycin, and clindamycin) were administered. The final diagnosis was bilateral cellulitis with seroma, which responded well to treatment, and she was discharged on doxycycline and Eliquis eight days after her initial presentation. The infection cleared completely, and the patient recovered well, later undergoing another round of fat grafting with PRP to the right breast that healed beautifully with no postoperative adverse outcomes. Figure 3 depicts the patient's results prior to surgery and following infection resolution. Additional fat grafting to the breast cases experienced no complications. The patient in Figure 4 demonstrates bilateral breast deformities with the absence of the right breast following a burn injury. She had initial fat grafting followed by placement of breast expanders 3 months following the fat/PRP injections. The initial fat/PRP (10/0.5) (4.7% PRP) grafting was performed using 10 mL syringes, injecting 230 mL into the right breast and 50 mL into the left breast. The expanders were then exchanged to implants 2 months later.

When looking at the elective buttock augmentation cases, we see that these procedures were very well tolerated with all patients being discharged following completion of the procedure as expected. Upon analyzing these patients' subsequent follow-ups, all patients achieved their desired increase in volume and seemed very pleased with the result with no complaints post-op. This tolerance was comparable to that experienced by our patient undergoing fat grafting with PRP for HIV facial atrophy [Figure 5]. He was grafted with 25 mL fat/PRP (0.8/0.2) (20% PRP). The donor site was the abdomen. The areas injected included the infraorbital rim, cheeks, temples, and nasolabial folds. He was discharged as expected and had no adverse outcomes at postoperative follow-ups. Following the patient's second fat grafting with PRP procedure, 6 months after the first graft, the patient was very pleased with the outcome and believed that his face looked much more plump than it did previously.

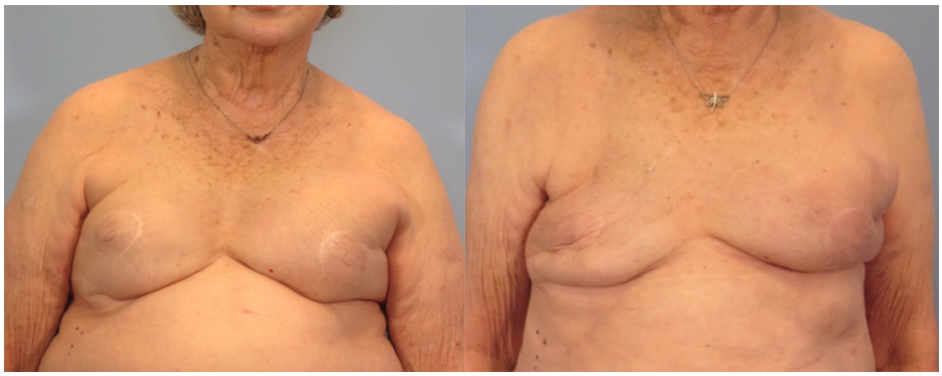

Figure 3. Before any intervention (left) and 4 months post-op (right) following cellulitis resolution prior to undergoing another round of fat grafting with PRP to the right breast. PRP: Platelet-rich plasma.

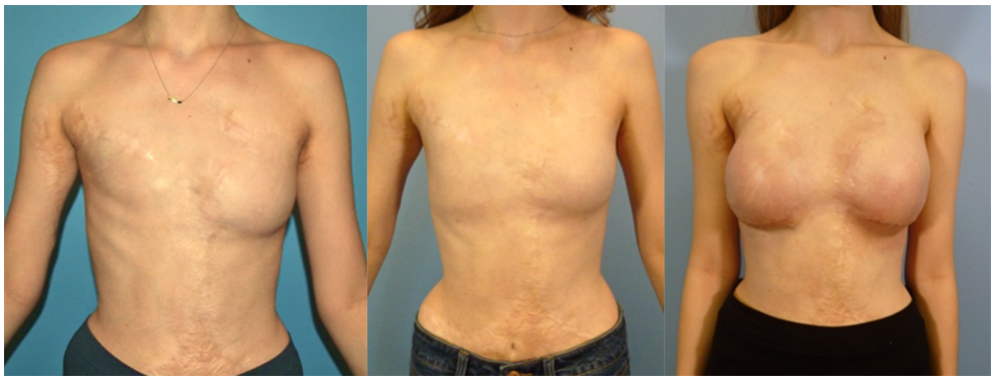

Figure 4. Burn injury pretreatment (left), 3 months following initial fat grafting with PRP (middle), 1 month following expander exchange to implants. PRP: Platelet-rich plasma.

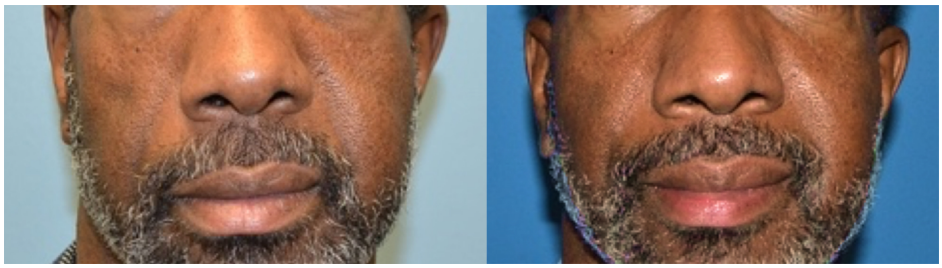

Figure 5. Patient with HIV facial atrophy prior to treatment (left), 8 months after his fat/PRP grafting session (right). HIV: Human immunodeficiency virus; PRP: platelet-rich plasma.

All of the scar patients experienced an improved appearance and texture of their scar as well as an increase in skin flexibility regardless of the anatomic location of the scar. The patient with hidradenitis suppurativa experienced relief from groin scarring, which had resulted from continual abscess drainage, following fat grafting with PRP. She also reported a significant decrease in inguinal pain and a decrease in the number of postoperative open inguinal lesions.

DISCUSSION

While autologous fat grafting with PRP has steadily been gaining popularity due to its availability, regenerative effects, and potential to improve graft survival, the current literature remains somewhat divided regarding the technique's efficacy and long-term results. This study examined a variety of cases that employed adipose grafting with PRP to gain further insight into the safety of this procedure as well as its potential benefits.

Unlike other specialties, plastic surgery has a distinct disadvantage when it comes to measuring objective outcomes. The combination of both art and science that makes plastic surgery unique also poses a challenge in terms of quantifying results[28]. While we were able to quantitatively analyze complication rates in this study, the somewhat subjective cosmetic outcomes are difficult to numerically objectify. We used pre-operative and postoperative photographs, physician notes, and physician-documented patient satisfaction to determine successful cosmetic outcomes. These cases each individually revealed promising results, as visual improvement was noted in the context of volume replacement and/or scarring deformities following the procedure. Along with obvious visual advancements, both the physician and the patients documented satisfaction with the results of the procedure. While this reported documentation is qualitative in nature, it allows us to explore the subjective aspects of both the patient and physician experience, which are crucial to address in the effort to improve care.

When analyzing the cases and outcomes entirely objectively, we see that the complication rate was minimal, with only one major complication presenting from the 50 fat grafting with PRP procedures. While the exact complication rate of autologous fat grafting without PRP varies in the literature, our overall 2.0% complication rate was in line with the reported 2.27% complication rate associated with facial fat grafting and the 2.1% complication rate related to fat grafting of the breast[29,30]. Various complications have been reported in the context of adipose grafting, including infection, calcification, fat necrosis, and fat embolism[31]. The only complication experienced by our cohort consisted of one case of cellulitis in a patient who underwent fat grafting of the breast. To our knowledge, this is the first study analyzing fat grafting with PRP in the context of multiple, vastly different indications each in diverse anatomic location. Our retrospective review found PRP to be overall safe and effective in the context of facelifts, hypertrophic scars treatments, keloid excisions, buttock augmentation, HIV facial atrophy treatments, breast implant removals, and structural fat grafting for the nose.

Focusing specifically on scar improvement, autologous fat grafting has emerged as a technique able to essentially reverse fibrotic changes in the skin by restoring skin texture and pliability[32]. Multiple studies, including some with level-I evidence, have analyzed the beneficial effects of fat grafting alone and fat grafting with PRP in the context of radiation-induced skin alterations, scar tissue from trauma, and scar-related conditions[20,21,33-35]. In this study, we looked at the potential benefit of fat grafting with PRP in burn scars, hypertrophic scars, and scarring from hidradenitis suppurativa. All of the scar patients experienced an improved appearance and texture of their scar as well as an increase in skin flexibility regardless of the anatomic location of the scar.

PRP is a treatment method used in a wide spectrum of skin conditions for anti-inflammatory, healing, and cosmetic purposes[36]. When combined with the use of triamcinolone, improved scar height, pigmentation, and pliability have been noted in comparison to those treated with triamcinolone alone[37]. Fat grafting has been proposed for the treatment of hypertrophic scarring, with histological analysis of hypertrophic scars treated with autologous fat showing improved structural features[32,38]. Although evidence on the effectiveness of fat grafting to treat hypertrophic scarring is low, a systematic review suggests that

autologous fat injections provide beneficial effects with limited side effects[39].

While we are unable to directly compare the outcomes of this study to those of fat grafting without PRP, this study suggests that the addition of PRP is low-risk and provides a subjectively positive cosmetic result from the perspective of both the patient and surgeon. In addition, this technique has been shown to be safe and efficacious in a wide range of procedures spanning the entire body. The potential benefits of adding PRP to adipose grafts may be related to the released platelet components that help support the adipose graft. These components have been shown to help reduce inflammation, promote blood vessel growth, and contribute to the proliferation of ADSCs, thereby potentially improving graft survival and contributing to this study's overall positive outcomes. It is also worth noting that while there are different techniques for PRP preparation, most are relatively low-cost and require very little additional equipment, making the technique a good adjuvant to the already cost-effective fat grafting procedure[9]. That said, different countries have different policies related to blood products and these should be taken into account based on provider location.

This study was limited by the somewhat subjective nature of cosmetic outcomes as well as the known limitations that accompany any retrospective review. The lack of objective measures is a limitation and an area for improvement in future studies. Employment of one of the currently available cosmetic grading scales to better quantify subjective results would potentially be beneficial[40].

In conclusion, this study demonstrates that autologous fat grafting with PRP is a safe technique that is effective for various indications with a low complication rate. All patients analyzed in this study exhibited success in the context of volumization and/or scar improvement. Larger-scale prospective, randomized studies analyzing adipose grafting with PRP in comparison to fat grafting alone and/or to other fat grafting techniques are warranted to truly understand the proposed additive benefits of PRP.

DECLARATIONS

Acknowledgments

Collawn SS presented "Platelet Rich Plasma assisted Adipose Grafting for Scars and Aesthetics" at the International Federation for Adipose Therapeutics and Science (IFATS) meeting in Fort Lauderdale, FL, November 2022 and "Combination Therapy with Adipose Fat Grafting for Hypertrophic Burn Scars" at the International Federation for Adipose Therapeutics and Science (IFATS) meeting in Washington, DC, October 2023.

Authors' contributions

Writing - original draft (lead), visualization (equal), writing - review and editing (equal), chart review and data collection (equal): Braswell AC
Writing - original draft, visualization (equal), writing - review and editing (equal), chart review and data collection (equal): Buchanan K
Writing - review, editing, and additions (equal), visualization (equal), chart review and data collection (equal): Wagner G
Writing - review, editing, and additions (equal): Fujihashi A
Writing - review, editing, and additions (equal), conceptualization: Rudnicki P
Methodology (lead), conceptualization (lead), supervision (lead), writing - review and editing (equal), surgeon performing the fat grafting: Collawn SS

Availability of data and materials
Data supporting our findings can be obtained upon request to the corresponding author.

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None.

Conflicts of interest
All authors declared that there are no conflicts of interest.

Ethical approval and consent to participate
This study was approved by the University of Alabama at Birmingham Institutional Review Board for Human Use (IRB-300006012). Informed consent was obtained from all individual participants included in the study.

Consent for publication
Consent for publication has been obtained.

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