Original Article

Indian Journal of Medical & Health Sciences
Volume 7 Number 1, January – June 2020
DOI: https://dx.doi.org/10.21088/ijmhs.2347.9981.7120.2

Role of Stromal Vascular Fraction (SVF) in Scar Management

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Abstract

Scar is a common problem following burn, trauma or infection. There are various methods to improve the scar. But there is no well-established method to prevent or treat the scar. Stem cell therapy is most recent technique that is claimed to hasten the healing. Stromal vascular fraction (SVF) is a source of stem cells. This article highlights the role of SVF in scar treatment.

Keywords: Stromal Vascular Fraction (SVF); Scar Management.

Introduction

Scar is a common problem following any injury, burn or surgical procedure. Besides its undesirable visual appearance, the scar tissue presents poor mechanical strength relative to the surrounding tissue. Various modalities have been described in literature for its management. Among these are– surgical excision with or without grafting (1), pressure therapy (3), intralesional interferon (4), intralesional corticosteroids (5), intralesional bleomycin (6), laser therapy (7), silicone gel sheeting (8), onion extract gel and other therapies directed at collagen synthesis (9). One of the newer modalities available is the Stromal vascular fraction.

Adipose-derived stem cell-based therapy is one of the most recent therapeutic strategies for wound healing that affects all aspect of wound healing i.e. re-epithelization, angiogenesis, and immuno modulation. Stromal vascular fraction (SVF) is a heterogeneous mixture of cells resulting from the mechanical or enzymatic processing of aspirated adipose tissue. SVF contains adipose-derived stem cells in addition to macrophages, various blood cells, fibroblasts, smooth muscle cells and vascular endothelial progenitors. This mixture of progenitor cells in the SVF, particularly the ASC and the EPC polulations, is well documented to have angiogenic and neovasculogenic propertie which are being exploited in several clinical trials to bring about therapeutic angiogenesis. The SVF also harbors mature cells such as fibroblasts, vascular smooth mucle cells, endothelial cells, lymphocytes, monocytes, red blood cells (RBC), and a small fraction of adipocytes. Many clinical trials have demonstrated safety and efficacy of autologous SVF use in regenerative cell therapy for wound healing, skeletal regeneration, cardiovascular and peripheral vascular diseases, and tissue engineering. Common procedures where SVF has been used are postmastectomy breast reconstruction, cosmetic breast augmentation, facial restructuring, scar and deformity correction, and lipoatrophy treatment. In review of literature we have seen very few Indian studies on SVF in scar management. We share our experience on SVF in scar management.

Methodology

This is case series of use of SVF in post burn scar area in two patients. This study was conducted in a tertiary care hospital in 2019. The first patient was 20 year female with post thermal burn scar area on thigh and leg and abdomen (Fig. 1). Second patient was 40 years female with post burn raw area on right upper limb and abdomen (Fig. 4).

Under anaesthesia tumescent was infiltrated in abdominal wall. A stab incision was given at umbilicus and 20 ml of lipospirate was harvested. 4ml of Phosphate buffer solution was added to lipoaspirate Mechanical method was used to separate SVF from adipose cell by vigorously shaking the fluid in a tube for 1–2 minutes. When the tissue is separated, the aqueous infra-natant is saved in tube. The tissue was washed for another

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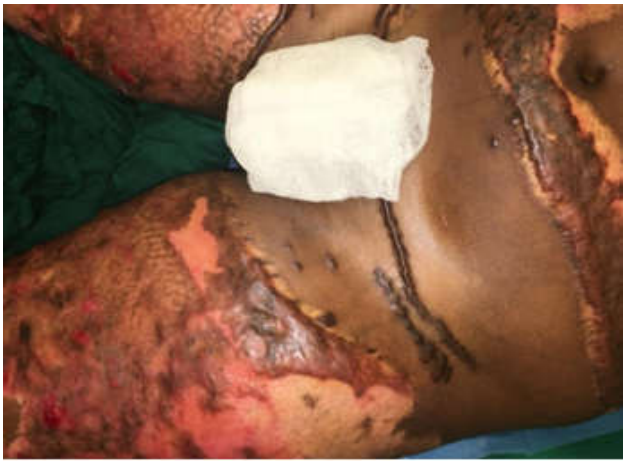

Fig. 1: Preoperative picture of First Case

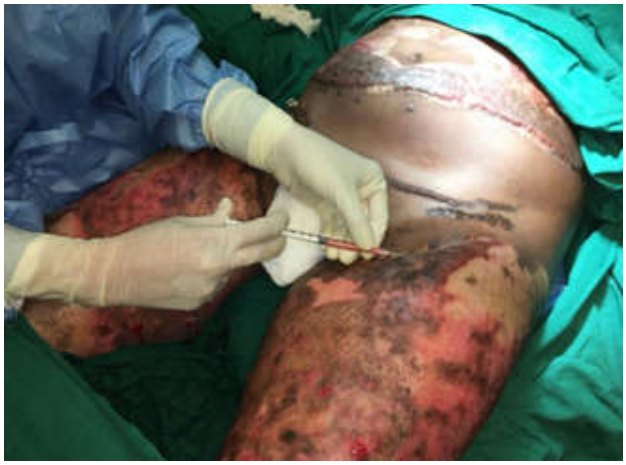

Fig. 2: SVF Injection into Scar Area

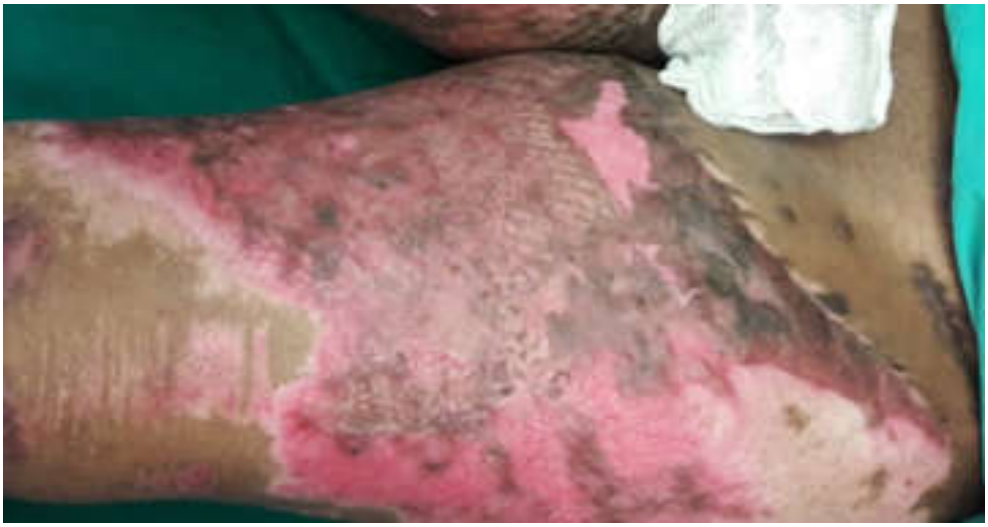

Fig. 3: Postoperative Appearance of Scar

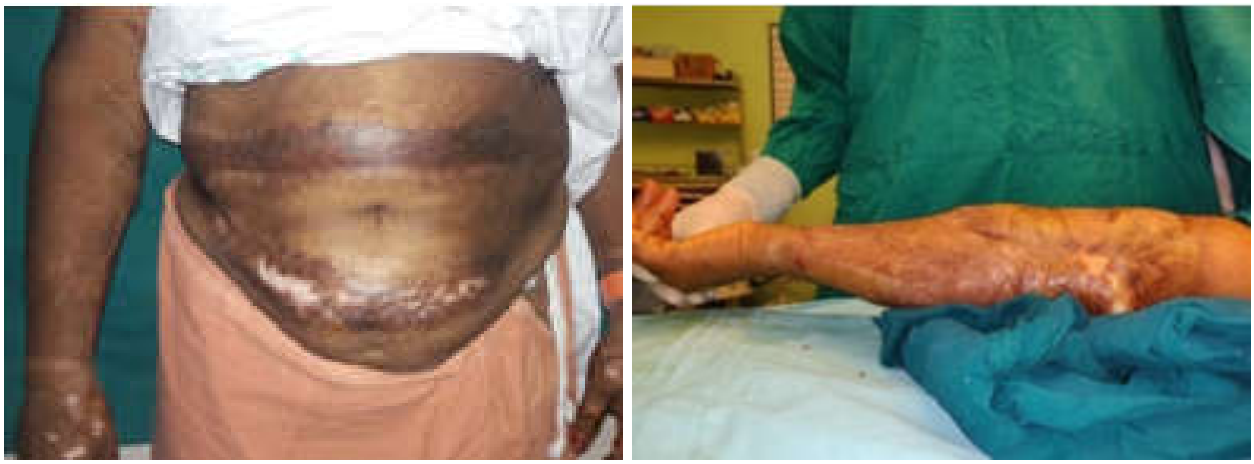

Fig. 4: Preoperative Picture of Second Case Scar at Abdomen and Forearm

2–3 times each time saving the supernatant (fat to be processed separately). The conical tubes with the infra-natant were centrifuged at 1200 rpm for 5 min at room temperature. The SVF pellet will be noted at the lowermost layer in centrifugation tube.

The SVF was injected into the dermohypodermic junction in all cases in multiple radiating passages in different directions (Fig. 2 & 5).

The treated area is covered with sterile dressing for 1 week and the patient is told to avoid pressure

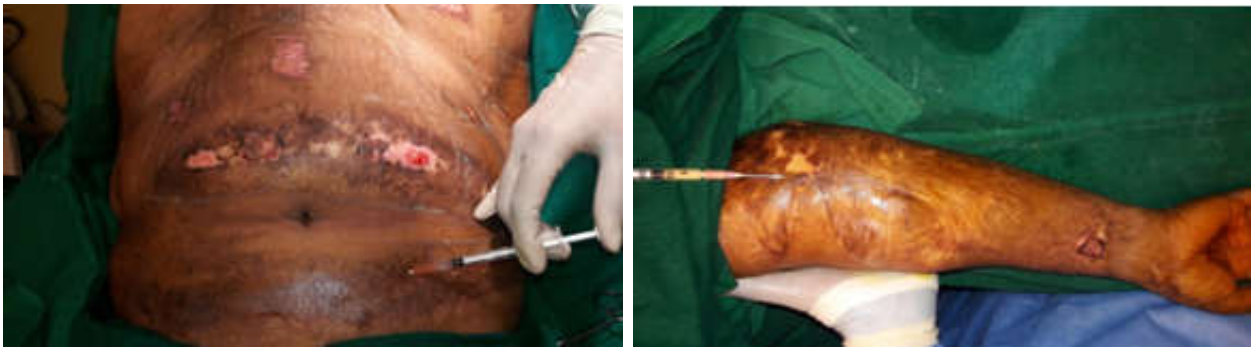

Fig. 5: SVF Injection into Scar Area

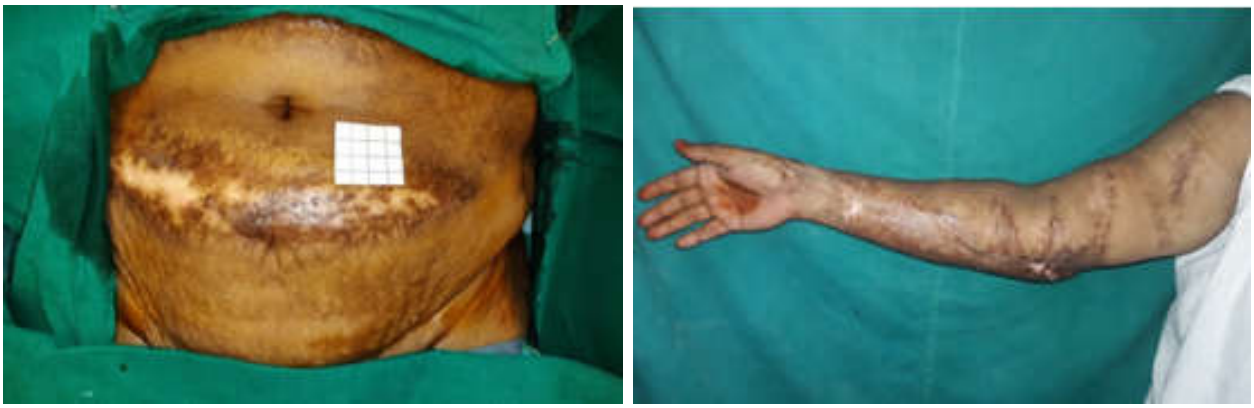

Fig. 6: Weeks Postoperative Appearance of Scar

and friction to limit the displacement of SVF infiltration. The abdominal incision was closed by polypropylene suture, and compression dressing was applied to be kept in place for 5 days to prevent hematoma formation.

Scar was evaluated at 2 weeks and at 6th week (Fig. 3 & 6). Clinical assessment of scars with the POSAS (Patient and Observer Scar Assessment Scale) was performed. Each patient scored the characteristics of scar color, pliability, thickness, relief, itching, and pain whereas the physician scored scar vascularization, pigmentation, pliability, thickness, and relief. The score is composed of a numerical scale (1–10) in which 10 corresponds to the worst possible scar characteristic while 1 corresponds to normal skin. The POSAS evaluation of the physician is not known to the patient.

Result

The quality improvement was shown both from an aesthetic and functional point of view; in particular, relief from pain, itching and increase in scar elasticity. For first patient POSAS score for pain was 6 that became 5 and for itching it was 6 and 2 weeks after treatment became 5 and decreased further to 3 after 6 weeks. POSAS score for relief as assessed by physician, was 6 before fat grafting and became 5 after 6 weeks of the procedure.

For second patient POSAS score for pain was 3 that remained 3 and for itching it was 7 and 2 weeks after treatment became 5 and decreased further to 2 after 6 weeks. POSAS score for relief as assessed by physician, was 6 before fat grafting and became 5 after 6 weeks of the procedure.

Discussion

Cell based therapy is rapidly emerging as a part of wound management, but is seldom used alone. These cells can be harvested from bone marrow or adipose tissue. Stromal vascular fraction (SVF) isa heterogeneous mixture of cells resulting from the mechanical or enzymatic processing of aspirated adipose tissue. SVF contains macrophages, various blood cells, fibroblasts, smooth muscle cells, vascular endothelial progenitors and adipose-derived stem cells. In the mid–1960s, Rodbell first isolated SVF from rats. Later 1970s Wagner isolated EC from SVF. Significant advance was made in 1980s when Jarell, William, et al isolated SVF from human adipose tissue. Since then SVF has been investigated for various clinical applications.

There are various growth factors that are present in SVF. These are involved in all three phases of wound healing and may affect the outcomes of scarring. In the first phase of wound healing (inflammatory phase), SVF decreases the levels of mast cells and myofibroblasts through immunosuppressive and anti-inflammatory effects, leading to reduced active scar formation. In the proliferative phase of wound healing, the differentiation of adipose-derived stem cells and numerous growth factors contained in SVF helps in wound healing. In the maturation phase, excessive collagen synthesis is suppressed and remodeling of collagen is induced by chemokines such as transforming growth factor (TGF) beta 3 and matrix metalloproteinases. The presence of growth factors (i.e., Platelet-Derived Growth Factor (PDGF), Insulin-like Growth Factor (IGF), Keratinocyte Growth Factor (KGF), Basic Fibroblast Growth Factor (BFGF), and Vascular Endothelial Growth Factor (VEGF) accelerates wound healing and is generally favorable for scar formation. Modulation of collagen synthesis may also explain the favorable changes observed in pliability caused by SVF through a process involving the down-regulation of MMP1 and migration of human dermal fibroblasts.

SVF can be Prepared by Two Methods

1. *Enzymatic:* This methods used to manually process adipose tissue using collagenase. Lipoaspirate is washed 2–3 times using an aqueous salt solution such as PBS, Lactated Ringer's solution, or Hank's Balanced Salt Solution (HBSS). The washed lipoaspirate is then incubated with a collagenase solution of variable concentration and composition, depending on the method and tissue dissociation enzyme product used. Enzymatic digestion is typically carried out in a heated shaker to provide constant agitation at 37°C for 30 min to 2h. The digested adipose tissue is then centrifuged, which separates the processed lipoaspirate into three main layers, the oil/adipose tissue layer, the aqueous layer, and the pellet. The SVF is contained within the pellet, so the other layers are discarded,
2. *Mechanical Method:* Mechanical methods seek alternative non-enzymatic means of removing SVF cells from the adipose tissue and tend to be focused around washing and shaking/vibrating lipoaspirate followed by centrifugation in order to concentrate the SVF cells.

There are automated and semi-automated systems which are able to carry out each step of the process with little or no interference from a technician. Benefits offered by many of these systems are increased sterility through the use of a closed system.

There is no standardized protocol for SVF refinement. In this study we have used mechanical method for harvesting SVF. We have done SVF harvest while patient undergoing other surgical procedures therefore separate anaesthesia was avoided. Limitation of this study is that it has only two cases. Scar maturation and remodeling is a long process but short follow up in this study is another drawback. Though the follow up period was short, some improvement was noted in scar quality.

Conclusion

In this study we found that SVF has role in remodeling of scar. The resultant scar was also of better quality. But since it is a two case study, definite conclusion cannot be made. Large randomized control trials are required to confirm the efficacy of SVF in scar management.

Conflicts of interest: None.

Declarations

Authors' Contributions: All authors made contributions to the article.

Availability of Data and Materials: Not applicable.

Financial Support and Sponsorship: None.

Consent for Publication: Not applicable.

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