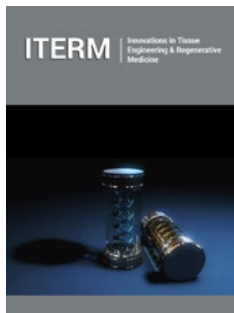


# Scar Modulations using Autologous Fat Injections

Ashok Gupta\*

Division of Plastic and Reconstructive Surgery, Bombay Hospital Institute of Medical Sciences, Mumbai, India



\***Corresponding author:** Ashok Gupta, Division of Plastic and Reconstructive Surgery, Bombay Hospital Institute of Medical Sciences, Mumbai, India

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## Abstract

Post-burn and post-traumatic scar contractures causing functional and cosmetic defects are major sources of morbidity the reconstructive surgery faces today. Split or full thickness skin grafts, flaps and tissue expansion and some other techniques fall short in overcoming soft-tissue deficit/limitations. Lesser invasive procedures having equally good or even superior outcomes in terms of scar maturation such as use of adipocyte derived stem cell (ADSC) injections have been explored as a newer modality of treatment. Since the bio-engineering revolution, autologous fat graft (AFG) therapy has become a rapidly evolving field. Currently, this form of therapy has broad applications in modern medicine and regenerative plastic surgery ranging from the treatment/improvement of wound healing to scar modulations/maturation.

Numerous studies have provided evidence that stromal cells derived from the adipose tissue (adipose tissue-derived stromal cells [ADSCs]) contain a population of adult multi-potent mesenchymal stem cells and endothelial progenitor cells that can differentiate into several lineages, including endothelial cells, smooth muscle cells, and cardio-myocytes and act through paracrine mechanisms for potential myocardial repair.

**Keywords:** Post-burn scar contractures; Bio-engineering revolution; Autologous fat graft therapy; Adipocyte derived stem cell (ADSC) injections

## Key Messages

- Autologous fat grafts as part of regenerative plastic surgery yields good results towards post burn scar Maturation, but the outcome is not always predictable.
- Blunt tipped cannulas are used to create a tunnel at insertion and fat graft to be injected during withdrawal.
- Clinical and Histological evidence shows increased collagen deposition, neo-vascularization and dermal hyperplasia.
- Effects are thought to be possibly influenced by a population of stem cells, residing in the stromal vascular fraction of lipo-aspirate tissue, capable of differentiating into multiple tissue types
- The impact on the therapeutic results, intraoperative extent of correction and the need of numerous transplantations as methods counteracting the postoperative resorption remains unclear.

## Introduction

Millions of people with post burn scars suffer from pain, discomfort and functional disabilities, which are a major source of morbidity that a plastic surgeon faces today. Adipose tissue is a sort of connective tissue existing in three different morphology and function types i.e., white, brown and medullar. Under the influence of various stimuli could turn into one another. The white adipose tissue is of greatest surgical importance. Morphologically white tissue consists of stroma-vascular fraction and lipid inclusions containing mature adipose cells called adipocytes [1-8]. The similarities between stem cells extracted from the bone marrow and the adipose tissue suggest the potential for the adipose tissue to act as an alternative, and perhaps preferable, cell source for repairing damaged tissues, such as the ischemic or infarcted heart. It contains a population of adult multi-potent mesenchymal stem cells and endothelial progenitor cells that can differentiate into several lineages, including endothelial cells, smooth muscle cells and cardio-myocytes.

## Materials and Methods

### Study

Autologous fat transfer for scar modulations/maturation post-burn scar +contractures: A new window in plastic and reconstructive surgery.

### Sample size: 70

A study was conducted on 70 patients having disfiguring and deforming post burn scar treated by injection of extracted autologous adipose tissue.

- A. 20 patients were used as control
- B. 40 were treated by conventional split/full thickness skin graft and
- C. 10 were treated with advanced techniques such as Pre-fabricated flaps/ local rotation/distant/ free flaps.

### Methods

About 50 to 150 cc of autologous fat graft was harvested from the gluteal/lower abdomen/inner thigh region using manual syringe aspiration technique. The fat graft was allowed to sediment (no centrifuge) and the supernatant oily layer and sub-natant fluid were discarded using fine needle aspiration technique.

The residual autologous fat graft injections were given in sub-dermal, sub-facial and intradermal planes. The volume injected was about 10cc in each plane. Mode of injection were either droplet, honey combing or streak methods [9-17].

### Transfer and Purification

The aspirate divides into 3 layers.

- A. The top layer is free oil from ruptured fat cells and is decanted or blotted gently.
- B. The bottom layer contains amounts of tumescent fluid and blood and is drained.
- C. The middle layer consists of fat cells for grafting. More vigorous washing or straining may damage the fragile cells and decrease the viability of the graft.

Most important principle in the surgical management is the atraumatic transfer of fat. Trauma to fat in the process of harvesting or placing, affects the survival of the graft. Any blood that remains in the harvested fat facilitates rapid degradation of the fat [18-28].

### Placement

- A. Gently apply the graft to a well-vascularized bed to maximize graft take and every part of the graft should be within 1.5 mm of living, vascularized tissue.
- B. Create small tracks for the grafts helps keep the grafted fat adherent to the recipient site. Keep tracks independent to prevent the fat from leaking out.

- C. Guide the needle or cannula superficially under the scar and inject fat in a controlled method gently upon withdrawal.
- D. Even distribution of the injection is crucial.
- E. Serial injection may be performed at 3-6 months intervals.

### Result

- A. Patient was asked to complete a quick and simple questionnaire about the appearance of scar
- B. An Observer (Resident doctor from other Plastic Surgery Department) was also asked to complete a quick and simple questionnaire about the appearance of the scar

### Vascularity

Presence of vessels in scar tissue assessed by the amount of redness, tested by the amount of blood return after blanching.

### Pigmentation

Brownish coloration of the scar by pigment (melanin); apply Plexiglas to the skin with moderate pressure to eliminate the effect of vascularity.

### Thickness

Average distance between the sub-cuticle-dermal border and the epidermal surface of the scar.

### Pliability

Suppleness of the scar tested by wrinkling the scar between the thumb and index finger.

Scar was assessed by using the Patient and Observer Scar Assessment Scale before the autologous fat graft was injected and at 3 months, 6 months and 1 year interval from the injection. There was significant improvement in terms of function, texture and depth in the group of patients treated with the autologous grafts + fat-derived stem cell method.

### Discussion

Post-burn scars are a source of significant functional morbidity, and these scars may present with a significant contour deficit or depression. Fat Injection is an effective corrective procedure for bigger defects. The fat cells inject are essential grafts which pick up blood supply from the surrounding tissue. Depending on the amount of fat required to fill the deficit, usually repeated surgery may be required before a satisfactory result can be achieved. Fat tissue is soft and feels natural.

Fat tissue consists of fat cells, which have thin cell membranes enmeshed in a fibrous network. Without the supporting fibres, the cells tend to collapse. An additional supporting network of connective tissue structure creates the lobules of fat, which can be observed grossly. Harvesting fat while maintaining as much supporting structure as possible preserves structural integrity of the tissue and helps the tissue retain bulk in the transplanted site. Almost any site can be used for harvesting; however, the abdomen

is easily accessible. The most important principle in the surgical management is the atraumatic transfer of fat. Trauma to fat in the process of harvesting or placing fat affects the survival of the graft.

It can be introduced to correct various deficiencies, it is not immunogenic, and it is readily available and inexpensive. The results are aesthetically pleasing and also appear to mimic the texture of skin better. Neovascularization, increased collagen deposition, and dermal hyperplasia are seen histologically. These effects are thought to be due to a population of stem cells, residing in the stromal vascular fraction of lipo-aspirate tissue that is capable of differentiating into multiple tissue types. Some animal studies have tested pharmacological agents such as insulin-like growth factor, basic fibroblast growth factor, and a selective B1 blocker to enhance the survival of lip graft in rats. Other studies have suggested that increased collagen synthesis, decreased degradation or a combination of both may be a possible mechanism.

## Conclusion

Adipose tissue-derived stem cell injections are an effective method in the treatment of various extensive post-burn scar deformities that makes it possible to re-create the lost sub-dermal tissue for improvement in function of involved joint movements. Controversies and unsolved questions still remain regarding the autologous fat grafting efficiency, resorption rates and the unpredictability of the post-operative outcomes.

The impact on the therapeutic results, intraoperative extent of correction and the need of numerous transplantations as methods counteracting the postoperative resorption remains unclear. Significant improvements were observed in dermal elasticity, patient and observer perception of scar thickness, patient perception of scar stiffness and irregularity and observer perception of relief and pliability. No significant differences were seen in vascularity and pigmentation. Dermal and sub-dermal scar tissue with cicatrization is most likely to benefit from sub-dermal fat grafting with fibroblast maturation.

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