A Comparative study between fat cell grafting alone and fat graft augmented with stromal vascular fraction (cell assisted lipotransfer) in the management of postburn hypertrophic scarring

Thesis

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Abbrev.	Description
ADSCs	Adipose derived stem cells
ASCs	Adipose stem cells
C.A.L	Cell assisted lipotransfer
CD	Cluster of differentiation
ECM	Extracellular matrix
g	Gravitational force of centrifuge
H&E	Hematoxylin and eosin
HLA-DR	Human leukocyte antigen-antigen D related
IQR	Inter quartile range
ISCT	International society for cellular therapy
LAF	Liposuction aspirate fluid
M.S.Cs	Mesenchymal stem cells
MAPS	Matching Assessment of Scars and Photographs
MMP-1	Matrix metalloproteinases
PDL	Pulsed dye laser
PLA	Processed lipoaspirate
POSAS	Patient and Observer Scar Assessment Scale
R.P.M	Revolution per minute
S.V.F	Stromal vascular fraction
SD	Standard deviation
TGF	Transforming growth factor

TGF β	Transforming growth factor beta
TIMPs	Tissue inhibitors of Matrix metalloproteinases
TNF	Tumor necrosis factor
TNF-α	Tumor necrosis factor alpha
VEGF	Vascular endothelial growth factor
VSS	Vancouver scar scale

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INTRODUCTION

Post burn scarring still represents a challenge to plastic surgeons as it does not have only aesthetic and functional impacts but also affects the patient's social and psychological life.

Deep burns often result in fibrotic scars characterized by abnormal color, texture, thickness and pliability **(Sultan et al., 2011).**

Stages of wound healing include: inflammation, proliferation, and matrix remodeling/scar formation. An early inflammatory cascade ensues immediately after injury, during which much of the later outcome of scar development is dictated. The final stage of wound healing includes migration and proliferation of fibroblasts, collagen production and deposition, and angiogenesis. The remodeling process of collagen synthesis and lysis can lasts up to two years after initial injury. There is a complex interplay between cells, which elaborate growth factors, cytokines, and components of the extracellular matrix and modulate collagen metabolism **(Reish and Eriksson, 2008).**

Hypertrophic scars occur in scars resulting from surgery, trauma, and burns, Clinically hypertrophic scar can be defined as a fibroproliferative disorder of the skin that

does not grow beyond the boundaries of the original wound **(Ogawa, 2010).** They characterized by a proliferation of dermal tissue with excessive deposition of fibroblast-derived extracellular matrix. This condition is common, occurs in up to 64% of surgical incisions and can cause a wide range of functional and psychological impacts **(Khoo et al., 2011).**

Classifying a scar is important in choosing which treatment modality best fits. Factors contributing to scar formation include pigmentation/vascularity, thickness, pliability, surface texture, and surface area. Accurate and reliable tools developed to measure each of these features subjectively and some even objectively. Many scar assessment scales are available, the most widely used is Vancouver burn scar scale introduced by Sullivan et al. at 1990 and patient observer scar assessment scale introduced by Draaijers et al. (2004) **(Idriss and Maibach, 2009).**

A number of topical and minimally invasive techniques have been used in an attempt to improve the quality and appearance of burn scars. These treatment options include topical silicone gels, pressure dressings, corticosteroids and, most recently, autologous fat grafting **(Sultan et al., 2011).**

Fat grafting has been introduced to the world of burn reconstruction to improve the contour, elasticity, and quality

of skin. The ease of the procedure and minimal associated morbidity make its consideration for use in secondary burn reconstruction, as it serves to minimize scar tissue formation through softening of scars, enhancement of the angiogenesis and collagen remodeling**.** Its use in the field of plastic and reconstructive surgery has evolved from the use of fat as a space filler to its use as a regenerative agent **(Ranganathan et al., 2013).**

Maily et al. (2013) stated that aspirated adipose tissue consists of 2 components, namely, lipid inclusion containing adipocytes and stromal cells containing a cellular compartment.

Adipose tissue is a reserve of mesenchymal stem cells that can divide indefinitely, producing various cellular lines. It could be the physiologic means of replacing cells lost in atrophied scar tissues and ameliorating the mechanical and biological properties of the skin **(Brongo and Nicoletti, 2012).**

Studies have demonstrated that lipoaspirates containing adipose-derived stem cells are effective in enhancing angiogenesis and ultimately augmenting the healing capacity of devitalized tissue **(Rigotti et al., 2007).**

In recognition of the potential ability of mesenchymal and adipose-derived stem cells to aid in tissue

revascularization, scientists began to explore the utility of these cells in the treatment of radiation- induced tissue damage, dermatitis, ischemia, erythema, desquamation, edema, and radionecrosis **(Agay et al., 2010).**

Adipose-derived stem cells are typically a minor fraction of the lipoaspirate; however, it has high capacity for proliferation and differentiation that may compensate for graft volume loss **(Wang et al., 2013).**

The clinical potential of supplementing fat grafts with adipose-derived stem cells has been reported as a novel method of autologous tissue transfer, termed cell-assisted lipotransfer. It is a concurrent transplantation of aspirated fat and adipose-derived stem cells (i.e., transplantation of adipose-derived stem cell– rich aspirated fat**) (Yoshimura et al., 2008).**

Yoshimura et al. (2008) reported the use of fat graft enhanced with stromal vascular fraction (cell assisted lipotransfer) in cosmetic breast augmentation and facial lipoatrophy, they suggested that cell assisted lipotransfer is safe and may be superior to conventional lipoinjection.

Adipose- derived stem cells are multipotent cells they can be harvested through liposuction without altering their viability, the stromal vascular fraction of adipose tissue consists of multiple cell types including adipose-derived stem