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THE ROLE OF EXTERNAL VOLUME EXPANTION AND CELL ASSISTED LIPOGRAFTING IN IMPROVING POST BURN SCAR QUALITY, A RANDOMIZED CLINICAL STUDY

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Abstract

Throughout history, scars have represented a problem, where most of the solutions are unsatisfactory. The search for a more successful method with long-term, better results for different skin types remains the main challenge facing plastic surgeons. External volume expansion (EVE) devices mechanically stretch and stimulate tissues by suction in a non-invasive manner. Stretch releases the skin and it has been postulated by different studies that the mechanism of action could be direct mechanical action on individual cells, induction of ischemia, inflammation and soluble mediators which stimulates cell proliferation, adipogenesis and, most importantly, vascular remodeling.. Platelet-rich plasma (PRP) is an autologous blood-derived product enriched in platelets, growth factors and chemo/cytokines delivered in a concentrated volume of plasma. PRP has the potential to deliver a high concentration of growth factors to target tissues by virtue of the contents within the alpha and dense granules. A relatively new option for the treatment of scar tissue is the use of autologous fat grafting, first described by Neuber in 1893 and later refined by Coleman. Autologous fat grafting has a volume-increasing effect and is thought to stimulate the neosynthesis of collagen fibers, which therefore increases dermal thickness, resulting in an improvement in skin quality. The use of autologous fat grafting has increased in common practice, but to date there is a lack of scientific evidence regarding the effects on scar tissue. Fat grafting for soft tissue defects and volume expansion presents an appealing alternative or adjunct to reconstruction with flaps or implants because of its simplicity of technique and low morbidity associated with it. However, the unpredictable survival (30%–80%) and the inverse correlation of survival to injection volume have led to skepticism about its utility.

Key words: External Volume Expansion, Scar, Autologous Fat Grafting, Platelet Rich Plasma

Introduction

The skin is a complex tissue, and its structure is presented by the epidermis, the dermis, the hypodermis, and skin appendages. Processes Skin would healing is a systematic process, traditionally including four overlapping classic phases: hemostasis (coagulation), inflammation (mononuclear cell infiltration), proliferation (epithelialization, fibroplasia, angiogenesis, and formation of granulation tissue), and maturation (collagen deposit or scaring tissue formation) **(1)**. Several factors influence skin healing after burn injuries, e.g., the causes, the degree and size of burn, and the patient's general condition and types of the graft or materials for covering burn wounds. Depending on burn severity, the healing process may result in different consequences. Fibroblasts and keratinocytes are common cells used in products for wound and burn healing. Keratinocytes are the major cell component of the epidermis and responsible for its stratified structure and form numerous tight intercellular junctions. Fibroblasts are the main cell type of the dermis and produce ECM components and secrete various growth factors (TGF-β), cytokines (TNF-α), and matrix metalloproteinases, which ensure the ECM formation and keratinocyte proliferation and differentiation **(2).**

Epidermal stem cells (ESC) are of particular interest for skin tissue regeneration as they have favorable features such as high proliferation rate and easy access and keep their potency and differentiation potential for long periods.

Hypertrophic scar

Generally develops after severe burn injury or skin trauma, is a fibro-proliferative disorder of cutaneous wound healing that manifests as myofibroblasts activity and collagen deposition. The trans-differentiation of fibroblasts to myofibroblasts is a critical procedure in the pathogenesis of scar formation, which is characterized by alpha smooth muscle actin-positive (α-SMA+) fibroblasts that could stimulate collagen synthesis, particularly Col1 and Col3, it causes esthetic destruction and functional impairment, resulting in the physiological and psychological problems. Therefore, it is necessary to explore the novel clinical schedules.

External Volume Expansion

The External volume expander using the Brava device has been on the market for over 10 years as an external soft-tissue expander and has demonstrated modest, permanent augmentation after long-term use.73–77 Short-term use of Brava, however, causes a marked temporary increase in breast size and generates a very large fibrovascular scaffold that would be an ideal recipient for fat grafts, Pregrafting expansion creates a larger and more fertile recipient matrix that will allow more fat graft droplets to be diffusely dispersed, with each maintaining the crucial graft-to-recipient interface contact required for revascularization, Brava works in a similar way. When the device is worn before the procedure, it pre-expands the recipient matrix separating the tissue planes, increasing the parenchymal space, and reducing the interstitial pressure in the scar for a given level of fat injected. Without pre-expansion, the fat plays the dual role of a graft in need of nutrients to survive and of an internal tissue expander **(3)** .

Pathophysiology of wound healing and post inflammatory scar

In postnatal tissue, wound healing occurs in three discrete phases that ultimately result in the formation of a scar: inflammation, proliferation, and remodeling. Modulation of the three phases can allow the wound to heal without scar or result in excessive fibrosis. Although a flat, less fibrotic scar is desired, when the acute inflammatory phase persists or wound healing is delayed, pathological scars form (panel).

Stem Cells

Stem cell based wound healing therapies represents as a new promising modality for the treatment of fibrosis, scarring and treatment for wound contraction. Post injury, stem cells are heavily involved in all overlapped phases of wound healing. Endogenous stem cells migrate to the site of injury during the initial inflammatory phase, where they elicit immunomodulation effects, followed by accelerated wound closure, angiogenesis and reepithelialization **(4).** Mesenchymal stem cells (MSCs) and adipose derived stem cells (ADSCs) have been widely investigated in scar treatment, wound contraction and in the pathophysiology of scar formation. MSCs are defined as self-renewing multi-potent stem cells that can be differentiated into various lineages of mesenchymal origin. ADSCs have received considerable attention in skin regeneration as it has potential to regenerate hypodermis, dermis and epidermis **(7).** Fat grafting together with ADSCs enhanced wound angiogenesis, decreased inflammation, improved burn scar size and quality in both murine models and human studies **(8).**

Platelet Rich Plasma

History of Platelet-Rich Plasma Platelet-rich plasma (PRP) is also known as platelet rich growth factors (GFs), platelet-rich fibrin (PRF) matrix, PRF, and platelet concentrate. The concept and description of PRP started in the field of hematology**.** PRP is prepared through a process known as differential centrifugation, in which acceleration force is adjusted to sediment certain cellular constituents based on different specific gravity. Regarding the preparation of PRP, there are 2 techniques:

1. Open technique: the product is exposed to the environment of the working area and comes in contact with different materials that should be used for their production, such as pipettes or product-collection tubes. In the blood processing to obtain PRP with the open technique, it should be guaranteed that the product is not contaminated during microbiological handling.
2. Closed technique: it involves the use of commercial devices with CE marking (including centrifuge equipment and application) in which the product is not exposed to the environment (recommended). Several CE medical devices are available for the production of autologous PRP**(9).**

Conclusion

We concluded that statistically significant difference was noted regarding pliability and total score in pre- and post-treatment Vancouver scare scale (VSS) in group (A). According to post-treatment histopathological evaluation there was statistically significant difference between the two studied groups (A) and (B) as regard sebaceous glands. However, these findings require confirmation by

larger, more-powered study with larger sample size. Also, Large-scale randomized controlled trials and long-term follow-up studies are still needed to confirm the effectiveness and evaluate the quality of healing.

References

1. Takeo M, Lee W, Ito M. Wound healing and skin regeneration. Cold Spring Harbor perspectives in medicine. 2015 Jan 1;5(1):a023267..
2. Bhardwaj N, Chouhan D, B Mandal B. Tissue engineered skin and wound healing: current strategies and future directions. Current pharmaceutical design. 2017 Jul 1;23(24):3455-82.
3. Khouri RK, Eisenmann-Klein M, Cardoso E, Cooley BC, Kacher D, Gombos E, Baker TJ. Brava and autologous fat transfer is a safe and effective breast augmentation alternative: results of a 6-year, 81-patient, prospective multicenter study. Plastic and reconstructive surgery. 2012 May 1;129(5):1173-87.
4. Kanji S, Das H. Advances of stem cell therapeutics in cutaneous wound healing and regeneration. Mediators of inflammation. 2017;2017(1):5217967.
5. Robinson C, Shore RC, Brookes SJ, Strafford S, Wood SR, Kirkham J. The chemistry of enamel caries. Crit Rev Oral Biol Med. 2000;11(4):481–95.
6. Cenci MS, Pereira-Cenci T, Cury JA, Ten Cate JM. Relationship between gap size and dentine secondary caries formation assessed in a microcosm biofilm model. Caries Res. 2009;43(2):97–102.
7. Shpichka A, Butnaru D, Bezrukov EA, Sukhanov RB, Atala A, Burdukovskii V, Zhang Y, Timashev P. Skin tissue regeneration for burn injury. Stem cell research & therapy. 2019 Dec;10:1-6.
8. Shukla N, Choong E, Reid I, Karnezis T, Shayan R, Shukla L. The therapeutics of fat grafting and adipose derived stem cells in burn injuries—a comprehensive review of the evidence and challenges. European Journal of Plastic Surgery. 2024 Apr 1;47(1):39.
9. Textor J. Platelet-rich plasma (PRP) as a therapeutic agent: platelet biology, growth factors and a review of the literature. Platelet-Rich Plasma: Regenerative Medicine: Sports Medicine, Orthopedic, and Recovery of Musculoskeletal Injuries. 2013 Oct 30:61-94.