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Review

Procedure, applications, and outcomes of autologous fat grafting

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HIGHLIGHTS

- Fat grafts are used to correct post-surgery defects, release of scars contractures, radiodermatitis, and cosmetic surgery.
- Different fat harvesting, processing, and injecting procedures have been proposed by various authors.
- Fat grafts exhibit regenerative potential owing to the presence of adipose stem cells.
- Autologous fat grafting is a low-risk procedure with minimal discomfort for patients.

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ABSTRACT

Objective: To systematically review the procedure, applications, and outcomes of autologous fat grafting, a promising technique with various clinical applications.
Patients and methods: Literature review of publications concerning autologous fat grafting.
Results: Since its introduction, lipofilling has become increasingly popular; however, its results are variable and unpredictable. Several modifications have been made to the procedures of fat harvesting, processing, and injecting. Surgical excision and low negative-pressure aspiration with large-bore cannulas minimize adipocyte damage during fat harvesting. The "wet" method of fat harvesting involves fluid injection at the donor site and facilitates lipoaspiration while minimizing pain and ecchymosis. For fat processing, centrifugation at a low speed is preferable to high-speed centrifugation, gravity separation or filtration. Fat injection at the recipient site should be performed using small-gauge cannulas in a fanning out pattern over multiple sessions, rather than a single session. Fat grafts exhibit not only dermal filler properties but also regenerative potential owing to the presence of stem cells in fat tissue. Thus, the clinical applications of autologous fat grafting include correction of secondary contour defects after breast reconstruction, release of painful scar contractures, and treatment of burn scars and radiodermatitis. Lipofilling is also used in aesthetic surgery, such as facial and hand rejuvenation, augmentation rhinoplasty, and breast and gluteal augmentation. The complications of lipofilling are minimal and include bruising, swelling, pain, infection, necrosis, and calcification.
Conclusions: Lipofilling is a low-risk procedure that can be used to correct soft-tissue defects in the face, trunk, and extremities, with minimal discomfort for patients.

Contents

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1. Introduction

Historically, the use of fat grafts to correct congenital deformities and complex traumatic wounds with soft-tissue loss after radical oncological surgery was proposed in 1893 by Neuber, by Hollander in 1912, by Neuhof in 1921, and by Josef in 1931 [1]. The liposuction technique, introduced by Fisher in 1974, followed by the tumescent technique, introduced by Klein in 1985, accelerated the development of the lipofilling technique. The tumescent technique allowed patients to undergo liposuction under local anaesthesia administered using small cannulas [2]. In 1987, Coleman introduced a new technique to decrease traumatic handling of fat during liposuction. His technique consisted of three steps: manual lipoaspiration under low pressure, centrifugation for 3 min at 3400 rpm, and reinjection in 3D. This technique remains the gold standard for liposuction and lipofilling, but has undergone some technical modifications [2,3]. Since the 1980s, autologous fat transplantation has been one of the most popular procedures performed by plastic surgeons [4]. In 2009, fat grafting represented 5.9% of all non-surgical aesthetic procedures [5]. However, because the results of lipofilling are variable, optimization of the procedure is required. The long-term results of fat grafting are often disappointing because of unpredictable partial absorption of up to 70% of the volume of the fat graft. A number of studies have reported resorption rates of 30%–70% within a year [6]. Thus, autologous fat grafting has unpredictable success rates, and there is no agreement among physicians as to the ideal method for the harvesting and handling of fat grafts [5–7]. The Coleman technique should be considered as the standard and preferred method for harvesting and processing. However, one of the problems observed is a decrease in the number of fat cells because of damage caused during the aspiration and centrifugation steps [8]. Another limitation is the requirement to infiltrate cells in direct contact with well-vascularized tissues [8]. Furthermore, the Coleman technique can be operator dependent and time-consuming if performed by less-experienced surgeons. Numerous modifications of the Coleman have been attempted in order to improve the survival of the injected fat, including atraumatic fat-harvesting, fat washing to eliminate inflammatory mediators, centrifugation, and incubation of fat grafts with different bioactive agents. Fat is a filler with ideal properties: it naturally integrates into tissues, is autologous, and is 100% biocompatible. However, this is not the only function of lipofilling; fat is an active and dynamic tissue composed of several different cell types, including adipocytes, fibroblasts, smooth muscle cells, endothelial cells, and adipogenic progenitor cells called “preadipocytes” [9–11]. Adipose-derived stem cells (ASCs) have a differentiation potential similar to that of other mesenchymal stem cells as well as a higher yield upon isolation and a greater proliferative rate in culture when compared to bone marrow–derived stem cells [12–14]. Because of these properties and because these cells can be easily harvested in great amounts with minimal donor-site morbidity, ASCs have proved to be particularly promising for regenerative therapies [12,15].

2. Fat harvesting

It is widely accepted that less-traumatic methods of fat harvesting result in increased adipocyte viability and graft survival [16,17]. Several techniques have been proposed for fat harvesting, and there is an ongoing debate in the literature as to which method produces more viable and functional adipocytes. The main techniques are vacuum aspiration, syringe aspiration, and surgical excision. Recent experimental as well as some clinical studies support direct fat excision over aspiration. Fagrell et al. [16,18] introduced a technique called “fat cylinder graft,” in which fat is drilled out in cores by a punching device, whereas Qin et al. [16,19] recommended the core graft for block grafting because it maintains the structure and viability of harvested fat tissue by avoiding damage to the adipocytes. Pu et al. [16,20] found significantly impaired adipocyte function in conventional liposuction aspirates compared with fresh fatty tissue samples and syringe-aspirated fat. Low negative-pressure lipoaspiration may yield fat faster than syringe aspiration and can be used when a large volume of fat is required, as in breast surgery. The high vacuum pressures of conventional liposuction may cause structural disruption in up to 90% of adipocytes [16,17]. Cannula size may also affect the viability of harvested fat [21]. The use of the excisional method and fat harvesting with large-bore cannulas reduce the occurrence of cellular