

## Autologous Fat Graft: Not Only an Aesthetic Solution

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### Abstract

**Citation:** Scala J, Vojvodic A, Vojvodic P, Vlaskovic-Jovicevic T, Peric-Hajzler Z, Matovic D, Dimitrijevic S, Vojvodic J, Sijan G, Stepic N, Wollina U, Tirant M, Thuong NV, Fioranelli M, Lotti T. Autologous Fat Graft: Not Only an Aesthetic Solution. Open Access Maced J Med Sci. <https://doi.org/10.3889/oamjms.2019.781>

**Keywords:** Autologous; Fat; Fat graft; Aesthetic

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**Received:** 12-Jun-2019; **Revised:** 16-Jul-2019;  
**Accepted:** 17-Jul-2019; **Online first:** 30-Aug-2019

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**Funding:** This research did not receive any financial support

**Competing Interests:** The authors have declared that no competing interests exist

Subcutaneous adipose tissue was defined as the "perfect filler" as is soft and malleable and is usually enough present in the body for correcting volume defects and small remodelling purposes. The first attempts to implant autologous adipose tissue dates back to the end of the twentieth century, and with the refinement of harvesting, processing and replanting techniques today a uniform and predictable amount of survival rate were achieved. Those improvements have led to wider use of autologous fat grafts in many medical specialities not only in aesthetic or reconstructive treatments.

### Introduction

Subcutaneous adipose tissue was defined as the "perfect filler" as is soft and malleable and is usually enough present in the body for correcting volume defects and small remodelling purposes. The first attempts to implant autologous adipose tissue dates back to the end of the twentieth century [1] and after those initial attempts was proposed by many authors to correct many defects with variable results but the real change in application of fat transplantation was possible after the publication of Coleman's studies [2], [3], [4]. Coleman modified and corrected the methods of his predecessors and proposed a protocol for the treatment of adipose tissue that

insured standardised results. According to Coleman's studies, the key to successful fat grafting lies in harvesting, refinement, and transfer technique to provide pure, intact parcels of fat, essential for successful grafting. Also, those refined fat parcels must be infiltrated into the recipient site in very small amounts to be integrated into the host tissues and to survive predictably and uniformly. Having achieved a good survival rate of transplanted fat, many Authors started to use it to treat many different conditions.

### *The biology of transplanted fat survival*

Coleman and other Authors focused on the main problem after adipose tissue auto-transplantation, namely its absorption rate over time

(reported reduction varies from 25 to 70% of the total implanted volume) [4], [5], [6]. The “Cellular survival theory” introduced by Peer argues that the final volume that can be obtained after an adipose tissue transplant depends on the number of vital adipocytes present at the time of transplantation [5], but further studies have shown that mature adipocytes are very fragile cells and have a low level of resistance to trauma and ischemia. In autologous fat graft there are other cellular populations more resistant to hypoxia and traumatic insults caused by the procedures for harvesting, processing and replanting: the preadipocytes or adipose-derived stromal cells (ASCs), this is because all immature progenitor cells have a minimal metabolic activity and thus are able to survive much longer without having all metabolic requirements fulfilled [7], [8].

Recent Authors identify three zones in fat grafting: a thin outer zone with the best chances of survival, an intermediate zone where regeneration takes place and a central zone doomed to necrosis. According to Eto et al., the biggest volume of a fat graft retained depends on the degree of survival in regenerating zone, which contains ASCs with the potential for differentiation and replacement of adipocytes lost in the necrotic zone [9], [10].

In addition to contributing to adipogenesis within transplanted adipose tissue, ASCs have an important role in graft revascularisation via paracrine effects that act in combination with another cellular population the Stromal Vascular Fraction (SVF). Both ASCs and SVF have a role in long-term survival of the transplanted fat tissue because exerting paracrine secretion of several factors such as VEGF, HGF and TGF- $\beta$ , which are released due to many stimuli, including hypoxia and inflammation, and those stimuli strongly affect the differentiation of stem cells and induce angiogenesis causing an overall remodelling of host tissue. Also, thanks to the angiogenic factors released from ASCs and SVF, lipofilling helps to interrupt the vicious circle of vascular lesion caused by ischaemia, hyperpermeability, and fibrosis leading to more ischaemia, helping the growth of a microvascular bed with the correct ratio of adipocytes to capillaries [10], [11], [12].

### **Recent applications of autologous fat grafts**

Many studies demonstrated the capacity, provided by their unique cytokine and growth factor profiles of ASCs to undergo multilineage differentiation, not just into fat but also into bone, cartilage, skeletal muscle, cardiac muscle, blood vessels, nerves and skin [13], [14]. For this reason recent studies have shown the utility of transplanted ASCs contained in lipoaspirate as an highly effective therapeutic approach to treat many different kinds of conditions including degenerative, chronic lesions, late effects of oncologic radiation treatments,

scleroderma and burns in addition to the well-known role in the treatment of lipodystrophy of face and body, recontouring and rejuvenation of the aging face and hands or treatment of depressed or altered scars [15], [16], [17], [18], [19], [20].

There are also many works supporting the efficacy of fat grafting in surgical applications like in temporomandibular joint surgery, for treatment and prevention of ankylosis, fibrosis or heterotopic ossification in total joint prosthesis; in neurosurgery to treat or prevent cerebrospinal fluid leaks in spine and skull base surgeries; in otolaryngology for obliteration of ear, frontal sinus cavities, vocal cord surgery and cleft lip and palate reconstruction and in breast oncology as a vehicle for antiestrogens [21], [23], [24].

Since from early Coleman’s observations, an improvement of pigmentation has also been recorded therefore in the latest proposals for the application of autologous fat grafting is used in vitiligo and grey hair in combination with other treatments. Initial attempts to use ASCs to treat alopecia with good results were also made [25], [26], [27].

In conclusion, fat is the closest to the ideal filler because it is readily available; easily obtainable, with low donor-site morbidity; repeatable; inexpensive; versatile, and biocompatible. Also, its use can help to treat a wide variety of condition aside from reconstructive and cosmetic procedures making it an invaluable tool in regenerative medicine and surgery.

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