

# Autologous Fat Grafting: In Search of the Optimal Technique

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## Abstract

**Objective.** Recent advances in adipose cellular biology have repopularized autologous fat grafting as a method widely used in both reconstructive and aesthetic surgery. This review aims to summarize our current knowledge on autologous fat grafting emphasizing harvesting techniques and processing methods as well as current trends and approaches. **Methods.** A thorough search of earlier and recent literature until October 2013 was conducted using the terms *autologous fat grafting*, *autologous fat transfer*, *lipoaspirate*, *lipoinjection*, *fat harvest*, and *lipotransfer* in PubMed and ClinicalTrials.gov databases, and relevant English- and German-language articles were included. **Results.** Findings were categorized in a step-by-step approach of the fat grafting procedure into indications, selection of donor site, techniques for harvesting, processing, and reimplantation of autologous fat. **Conclusions.** Further in-depth knowledge will provide definite answers on fat graft survival; demonstrate safe methods to increase cell viability, grafting outcome predictability; and reliability; enhance safety; and strengthen the scientific and clinical establishment of this increasingly promising method.

## Keywords

breast surgery, evidence-based medicine/surgery, maxillofacial surgery, pediatric surgery, tissue engineering, liposuction, autologous fat grafting

## Introduction

Recent insights into and advances in adipose cellular biology have rekindled the interest in fat grafting. Scientific and clinical research aims to explore the expansion of indications in parallel with investigating the efficacy and safety of the use of adipose tissue and deriving cells. Adipose tissue is used for aesthetic and reconstructive surgery such as fat transfer but also in regenerative medicine and translational research for adipose-derived stem cells (ADSCs). This review is focused solely on autologous fat transfer, also known as autologous fat grafting.

Because data from experimental and animal studies cannot be automatically translated to humans and, to date, even well-conducted clinical studies on fat grafting lack standardized methodology, more questions than answers are raised by controversial and often confusing results. In fact, many techniques in the various steps of the fat-transfer procedure are not at all evidence based, despite fat grafting being a well-established method, important in most fields of surgery. The principal aim of this overview is to summarize our current knowledge about fat grafting, emphasizing techniques, processing methods, and current approaches. Given the substantial differences described in the literature regarding the art and science of fat grafting, practical difficulties in

designing and conducting prospective clinical studies on this topic are recognized. It is hoped that information presented in this review article will be used by surgeons to scientifically approach fat grafting and choose indications and techniques based on objective findings.

## Methods

The authors conducted a comprehensive review on autologous fat grafting involving a thorough search of PubMed and ClinicalTrials.gov until October 2013 using the search terms *autologous fat grafting*, *autologous fat transfer*, *lipoaspirate*, *lipoinjection*, *fat harvest*, and *lipotransfer*. Search was limited to English- and German-language articles indexed as studies, clinical trials, randomized controlled trials, systematic reviews, case series, or case reports.

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Findings were summarized step by step, and the entire basic fat grafting procedure was divided into indications, donor site selection, harvesting, processing, delivery, and graft viability enhancement.

## What Is Fat Grafting and How Is It Different From ADSC Therapy

Autologous fat grafting is the removal of fat from one area of the patient's body and reinsertion into the desired recipient location. Also termed as *fat transfer*, *lipoinjection*, *liposculpture*, or *autologous adipocyte transfer*, it is a method of soft-tissue enhancement for mild to moderate defects.<sup>1</sup>

Harvested fat contains mature adipocytes, extracellular matrix, ADSCs or adipose-derived stromal cells, endothelial cells, pericytes, and vascular smooth muscle cells. After enzymatic processing, the nonbuoyant cellular component contains ADSCs, vascular progenitor cells, pericytes, and endothelial cells and is termed the *stromal vascular fraction*.<sup>2</sup>

ADSCs isolated from the vascular stromal fraction of harvested fat tissue are adherent, cultured, multipotent cells that can be used in regenerative therapy for irradiated, scarred skin or chronic wounds.<sup>2</sup>

The 2 methods exploit the adipose tissue potentials in different ways and may be combined by means of cell-assisted lipotransfer (CAL), but have distinct indications; harvesting, processing, and application techniques; outcomes; risks; and complications.<sup>2</sup> Standard fat grafting procedures that transfer some stem cells naturally present within the tissue should be described as fat grafting procedures, not stem cell therapy.

Although fat grafting was first introduced by Neuber in 1893,<sup>3</sup> the method was popularized after 1980 when the evolution of liposuction allowed the retrieval of generous amounts of fat that could be transferred as grafts.<sup>4</sup> Fat grafting is a reconstructive and cosmetic procedure for patients with volume loss or contour deformities caused by disease, trauma, congenital defects, tumor extirpation, or the natural aging process.<sup>5,6</sup> Actually 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. Therefore, it is the standard against which all other fillers are compared.<sup>6</sup>

Despite ongoing concerns about survival and longevity of fat grafts after implantation and unpredictability of long-term outcome, fat has been successfully used as a filler in facial hemiatrophy and lipodystrophy,<sup>6,7</sup> in recontouring and rejuvenation of the aging face<sup>8-13</sup> and the hands,<sup>14</sup> in the treatment of depressed scars,<sup>15,16</sup> in breast augmentation and reconstruction,<sup>17-21</sup> and in volume and contour deformities of the trunk<sup>19</sup> and lower limbs.<sup>22</sup> It has also been successfully used in cleft lip and palate surgery,<sup>23,24</sup> in

orbital reconstruction after tumor extirpation,<sup>25</sup> in the treatment of painful extremity neuromas,<sup>26</sup> and in nailbed contour deformities.<sup>27</sup> It has been useful in temporomandibular joint surgery for treatment of ankylosis and prevention of fibrosis and heterotopic ossification around total joint prosthesis.<sup>28</sup>

Fat grafts have long been used in neurosurgery for spine and skull base surgeries to treat or prevent cerebrospinal fluid leaks<sup>29</sup> as well as in otolaryngology for obliteration of ear<sup>30</sup> and frontal sinus cavities<sup>31</sup> and for vocal cord augmentation.<sup>32</sup> Recently fat grafting has been used in the successful treatment of chronic anal fissures and fistulas<sup>33</sup> as well as in endoscopic management of vesicorenal reflux in children.<sup>34</sup>

## Preferable Donor Site for Fat Retrieval

The most common fat harvest sites include the abdominal wall, thighs, hips, flank, inner knee, upper extremity, and dorsocervical fat pad. The presacral region has been reported to be associated with minimal donor-site morbidity.<sup>11</sup> Greater cell size and adipogenic activity has been demonstrated in fat tissue from the femoral and gluteal area compared with abdominal fat, whereas smaller adipocytes with almost no adipogenic activity were found in facial fat.<sup>35</sup>

The recipient site may also determine the choice of the donor site. Trepsat<sup>12(p246)</sup> suggested the inner part of the knee as the most suitable fat donor site for the lower palpebral area because the fat was "less fibrous, more supple and provided smaller individual tissue particles." In our experience, for buttocks enhancement, the back, flank, and gluteal donor sites are preferred so as to achieve a better contour of the surrounding area by liposuction as well. In a study conducted by Rohrich et al,<sup>36</sup> no differences in adipocyte viability were demonstrated among abdominal, thigh, flank, or knee fat donor sites, with fat that was immediately removed and untreated.

In a more recent study, however, Padoin et al<sup>37</sup> investigated the influence of donor sites on cell concentrations of the lipoaspirate and found that the lower abdomen and the inner thigh have a higher processed lipoaspirated cell concentration. Fat grafts obtained from these sites might theoretically be of better quality because they naturally contain more stem cells; however, the method used in this study for measurement of stem cells was the C-kit expression, which is known to also measure lymphocytes. Therefore, conclusive evidence to support superiority of a specific fat harvest site in terms of improved adipose cell count and viability does not exist.<sup>38-40</sup> In our clinical praxis, abdominal, gluteal, and flank harvest sites are the most frequently used because of their ease of access and tissue availability.

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