


European Survey Study Among Plastic/Breast Surgeons on the Use of and Opinion Toward Autologous Fat Transfer: With Emphasis on Breast Surgery

Surgical Innovation
2018, Vol. 25(6) 602–615
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DOI: 10.1177/1553350618799553
journals.sagepub.com/home/sri



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Abstract

Objective. The aim of this study is to examine the experience of European surgeons on autologous fat transfer (AFT) and highlight differences between countries and levels of experience. **Background Data.** The popularity of AFT causes an increase in sophisticated scientific research and clinical implementation. While results from the former are well-documented, important aspects of the latter are far less recognized. **Methods.** An international survey study about surgeon background, besides AFT familiarity, technique, and opinion, was distributed among surgeons from 10 European countries. The differences between countries and levels of experience were analyzed using a logistic regression model. **Results.** The mean respondent age, out of the 358 completed questionnaires, was 46 years. Ninety-seven percent of the respondents were plastic surgeons, who practiced AFT mostly in breast surgery and considered themselves experienced with the technique. The thigh and abdomen were less favored harvest locations by the Belgium and French respondents, respectively, and both the French and Austrian respondents preferred manual aspiration over liposuction in harvesting the fat. Despite minor differences between countries and experience, the intraglandular space was injected in all subgroups. **Conclusions.** The expanding use of AFT in Europe will lead to more experience and heterogeneity regarding the technique. However, despite an obvious adherence to Coleman's method, deviations thereof become more apparent. An important example of such a deviation is the ongoing practice of intraglandular AFT despite being a contraindication in various European guidelines. These unsafe practices should be avoided until scientific clarification regarding oncological safety is obtained and should therefore be the focus of surgeon education in Europe.

Keywords

autologous fat transfer, lipofilling, technique, Europe, opinion, experience

Introduction

Autologous fat transfer (AFT) is becoming an increasingly popular procedure in various areas of plastic surgery. Whether used as a permanent filler in facial rejuvenation^{1,2} or as a volume-enhancing technique in addition to oncoplastic or cosmetic surgery of the breast, much is written regarding the efficacy and safety as well as various techniques and satisfaction.³⁻⁵ Thus, popularity and acceptance is growing. Vice versa, this acceptance leads to more and better research currently being conducted.⁶ Regarding the AFT technique, the systematic review of Strong et al⁷ recently showed higher retention rates in clinical studies with centrifugation—as opposed to sedimentation—and slow reinjection into less mobile areas. However, this same

advantage could not be found in experimental animal and in vitro studies. Satisfaction rates among patients and surgeons are generally assessed with the use of Likert-type scales⁸⁻¹¹ or validated questionnaires such as the Breast-Q.¹²

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Despite the advantages and rising confidence with the procedure, concerns about oncological safety remain, since several experimental studies show potential danger of interaction between adipose-derived stem cells and mammary epithelial cells as well as the potential of CD34+ progenitors in white adipose tissue to promote cancer progression.¹³⁻¹⁵ Regardless of the increase in clinical acceptance of AFT, questions regarding the gold standard in AFT technique and oncological safety remain, partly because of the gap between clinical and basic science studies. One way to narrow the gap between the laboratory and clinical practices is by way of professional survey studies. Two survey studies among professionals are worth mentioning. Kaufman et al¹⁶ in 2007 and Skillman et al¹⁷ in 2013 performed a national survey concerning the use of AFT among 508 US, and 228 UK plastic surgeons, respectively. The former study reported mainly on the use of AFT in facial recontouring, and the latter mainly on the use in breasts, but both studies reported a general approval of the technique by surgeons as well as a high rate of surgeon-perceived patient satisfaction. The AFT technique used by the respondents—as reported in the study by Kaufman et al¹⁶—rarely deviated from the methods discussed in the literature. Since this study dates from 2007 and reports on US respondents only, and given the recent developments in this field,¹⁸⁻²⁰ it is interesting to look at the current situation in Europe. The primary aim of this study is to report on the experience, practice, and opinion of plastic surgeons and breast surgeons in Europe with the AFT procedure in general and with special emphasis on breast surgery. The secondary aim is to highlight the possible differences between surgeons from different countries, thereby aiding the various national (plastic) surgery associations in finding important topics for upcoming meetings as well as surgeon education.

Methods

An international, multicenter, cross-sectional, closed-ended format, study-specific questionnaire was created regarding AFT in general and with emphasis on breast surgery. The national plastic surgery associations of 10 European countries (The Netherlands, Belgium, Germany, Great Britain, France, Spain, Italy, Greece, Austria, and Switzerland) were contacted through email and, after introduction, asked for their participation in distributing this questionnaire among their members (active participation). When no reply was received, the organization was contacted on 2 additional occasions with a minimum of a 2-week interval by telephone during which the method and purpose of the study was explained and the organization was again asked for their participation in the study. Participating organizations distributed the questionnaire among its members with a reminder

email following after 2 to 4 weeks. In the case of passive participation, no mediation by the national association was obtained in the distribution of the email (addresses). Instead, these were actively searched and collected by the first author through screening of the associations—“Member Information” online link, on the respective website. The questionnaire was constructed in SurveyGizmo, an online digital survey tool and translated in the following languages: Dutch, German, Spanish, Italian, and French by either a native-speaking colleague or an Internet-based translational service (www.onehour-translation.com). The survey encompassed 36 multiple-choice questions, concerning 4 aspects of AFT, namely, background, AFT familiarity, AFT technique, and AFT opinion (see Figure 1). A free-text section was provided at the bottom of the appropriate questions to allow respondents to add personal comments. The completion of the questionnaire was strictly voluntary and without compensation. The completed questionnaires were entered into a database (SPSS Inc, Chicago, IL) by one investigator (JG) for further analysis.

Statistical Analyses

The total number of estimated members of the participating countries (The Netherlands 425, Belgium 181, Germany 400, Great Britain 365, France 770, Spain 643, Italy 473, Austria 199, Switzerland 154, Greece 271)²¹ was 3881. With this, a sample size of 350 is adequate to achieve a confidence level of 95% with a margin error or confidence interval T5% for the entire population.²² Continuous data are presented as mean, standard deviation, and range. Categorical data are presented as counts or proportions. Differences between baseline characteristics of the respondents from different countries were assessed using *t* tests for continuous variables (age) and the Kruskal-Wallis test for ordinal variables (number of years of experience and number of procedures performed per year). Differences between both technical choices and attitude toward fat grafting were assessed in relation to country, years of experience (resident, 0-10, 10-20, and >20 years of experience), and number of procedures performed per year (0-10, 10-20, and >30 procedures performed per year). We used logistic regression in case of a binary response variable, ordinal regression in case of an ordinal response variable, and multinomial logistic regression in case of multiple response categories.

Results

Details of the the countries participating, the method by which survey invitations were send (passive vs active), and the response rate are accessible through the online supplemental data (Appendix A1, available in the online

1) In which country do you currently practice?	<input type="checkbox"/> Finland
	<input type="checkbox"/> Greece
<input type="checkbox"/> The Netherlands	<input type="checkbox"/> Hungary
<input type="checkbox"/> Belgium	<input type="checkbox"/> Israel
<input type="checkbox"/> Germany	<input type="checkbox"/> Poland
<input type="checkbox"/> Great-Britain	<input type="checkbox"/> Portugal
<input type="checkbox"/> France	<input type="checkbox"/> Romania
<input type="checkbox"/> Spain	<input type="checkbox"/> Sweden
<input type="checkbox"/> Italy	<input type="checkbox"/> Turkey
<input type="checkbox"/> Austria	<input type="checkbox"/> Norway
<input type="checkbox"/> Switzerland	<input type="checkbox"/> Other - Write In (Required)
<input type="checkbox"/> Croatia	
2) What is your age?	
3) What is your specialty?	<input type="checkbox"/> Breast Surgeon
	<input type="checkbox"/> Other - Write In (Required)
<input type="checkbox"/> Plastic Surgeon	
4) What is your current position?	
<input type="checkbox"/> Resident	<input type="checkbox"/> Registered medical specialist
	<input type="checkbox"/> Other - Write In (Required)
5) What is your current year of residency?	
	<input type="checkbox"/> 3rd
	<input type="checkbox"/> 4th
<input type="checkbox"/> 1st	<input type="checkbox"/> 5th
<input type="checkbox"/> 2nd	<input type="checkbox"/> 6th
6) What is your work experience (years since registered medical specialist)?	
	<input type="checkbox"/> 5-10 yrs
	<input type="checkbox"/> 10-15 yrs
	<input type="checkbox"/> 15-20 yrs
<input type="checkbox"/> < 5 yrs	<input type="checkbox"/> > 20 yrs
7) Do you-, or have you ever practiced AFG in general or in surgical procedures to the breast?	
	<input type="checkbox"/> I (have) also practice(d) AFG in surgical procedures to the breast
	<input type="checkbox"/> I have never practiced AFG for any indication
<input type="checkbox"/> I (have) practice(d) AFG in general (i.e. for other indications then breast surgery)	
8) How many fat transfer procedures do you perform per year?	
	<input type="checkbox"/> 10-30
	<input type="checkbox"/> 30-50
<input type="checkbox"/> < 10	<input type="checkbox"/> >50
9) Do you perform fat transfer procedures yourself or with a colleague?	
<input type="checkbox"/> With a colleague	<input type="checkbox"/> With a senior colleague
	<input type="checkbox"/> With a resident
	<input type="checkbox"/> Myself

10) How experienced do you consider yourself with fat transfer procedures?	<input type="checkbox"/> Moderately experienced
	<input type="checkbox"/> Moderately unexperienced
	<input type="checkbox"/> Unexperienced
<input type="checkbox"/> Experienced	
11) What is/are the preferred harvest location/donor site(s) for injectable fat? (Mark all that apply)	
	<input type="checkbox"/> Thigh
	<input type="checkbox"/> Flank
	<input type="checkbox"/> Abdomen
<input type="checkbox"/> Gluteal	<input type="checkbox"/> Knee
	<input type="checkbox"/> Other - Write In (Required)
12) What local anesthesia is used for the donor site?	
	<input type="checkbox"/> Wetting solution (50 ml of 1% lidocaine plus 1 ml of epinephrine 1:1000 plus 1 liter of normal saline)
<input type="checkbox"/> 0.5% lidocaine with epinephrine	<input type="checkbox"/> Epinephrine alone
<input type="checkbox"/> 1% lidocaine with epinephrine	<input type="checkbox"/> Other
13) How much local anesthesia (cc) is used for the donor site?	
	_____ Flank
	_____ Abdomen
_____ Gluteal	_____ Knee
_____ Thigh	_____ Other
14) What harvest technique is used?	
	<input type="checkbox"/> Microcannula according to Coleman technique
<input type="checkbox"/> Liposuction cannula with constant suction	<input type="checkbox"/> Syringe plus large-bore needle
	<input type="checkbox"/> Other:
15) If a liposuction cannula is used, what size is used most commonly?	
	<input type="checkbox"/> 3 mm
	<input type="checkbox"/> 4 mm
<input type="checkbox"/> 1 mm	<input type="checkbox"/> Unknown
<input type="checkbox"/> 2 mm	<input type="checkbox"/> Other - Write In (Required)
16) If a syringe and cannula are used, what size is used most commonly?	
	<input type="checkbox"/> 16 gauge
	<input type="checkbox"/> 18 gauge
<input type="checkbox"/> 14 gauge	<input type="checkbox"/> Unknown
	<input type="checkbox"/> Other - Write In (Required)
17) What kind of fat preparation do you use?	
	<input type="checkbox"/> Centrifugation
	<input type="checkbox"/> Adding Insuline
<input type="checkbox"/> None	<input type="checkbox"/> Decantation
<input type="checkbox"/> Washing	<input type="checkbox"/> Other
18) Do you ever freeze excess fat for later application?	
<input type="checkbox"/> Yes	
<input type="checkbox"/> No	

(continued)

19) What local anesthesia is used at the injection site?	<input type="checkbox"/> Wetting solution (50 ml of 1% lidocaine plus 1 ml of epinephrine 1:1000 plus 1 liter of normal saline) <input type="checkbox"/> Epinephrine alone <input type="checkbox"/> None <input type="checkbox"/> Other	<input type="checkbox"/> 0.5% lidocaine with epinephrine <input type="checkbox"/> 1% lidocaine with epinephrine
20) What do you use to inject the fat?	<input type="checkbox"/> Needle <input type="checkbox"/> Ratchet gun <input type="checkbox"/> Other	<input type="checkbox"/> Cannula
21) What is your estimated volume injected per pass?	<input type="checkbox"/> 2 - 4 cc <input type="checkbox"/> > 4 cc <input type="checkbox"/> Unknown	<input type="checkbox"/> < 1 cc <input type="checkbox"/> 1 - 2 cc
22) How much do you aim to over-correct?	<input type="checkbox"/> 10-20% <input type="checkbox"/> 20-30% <input type="checkbox"/> 30-40% <input type="checkbox"/> 40-50% <input type="checkbox"/> > 50%	<input type="checkbox"/> None <input type="checkbox"/> < 10%
23) In what anatomical locations do you place fat grafts in addition to flap reconstructions? (Mark all that apply)	<input type="checkbox"/> Intraglandular <input type="checkbox"/> Subglandular <input type="checkbox"/> Pectoral <input type="checkbox"/> Subpectoral <input type="checkbox"/> Other - Write In (Required)	<input type="checkbox"/> Subcutaneous
24) In what anatomical locations do you place fat grafts in addition to implant reconstruction/ -augmentation? (Mark all that apply)	<input type="checkbox"/> Intraglandular <input type="checkbox"/> Subglandular <input type="checkbox"/> Pectoral <input type="checkbox"/> Subpectoral <input type="checkbox"/> Other - Write In (Required)	<input type="checkbox"/> Subcutaneous
25) In what anatomical locations do you place fat grafts in addition to local defect corrections? (Mark all that apply)	<input type="checkbox"/> Intraglandular <input type="checkbox"/> Subglandular <input type="checkbox"/> Pectoral <input type="checkbox"/> Subpectoral <input type="checkbox"/> Other - Write In (Required)	<input type="checkbox"/> Subcutaneous
26) What is your estimated total injection volume in addition to flap reconstruction?	<input type="checkbox"/> 50-100 cc <input type="checkbox"/> 100-150 cc <input type="checkbox"/> 150-200 cc <input type="checkbox"/> > 200 cc	<input type="checkbox"/> < 50 cc
27) What is your estimated total injection volume in correction of local defects?	<input type="checkbox"/> 100-150 cc <input type="checkbox"/> 150-200 cc <input type="checkbox"/> > 200 cc	<input type="checkbox"/> < 50 cc <input type="checkbox"/> 50-100 cc
28) What is your estimated total injection volume in addition to implant reconstruction/ -augmentation?	<input type="checkbox"/> 50-100 cc <input type="checkbox"/> 100-150 cc <input type="checkbox"/> 150-200 cc <input type="checkbox"/> > 200 cc	<input type="checkbox"/> < 50 cc
29) Which graft take "enhancing" methods do you use? (Mark all that apply)	<input type="checkbox"/> BRAVA (preoperatively) <input type="checkbox"/> BRAVA (postoperatively) <input type="checkbox"/> Rigotomies <input type="checkbox"/> Other - Write In (Required)	<input type="checkbox"/> None
30) What is your general opinion on the use of AFG?	<input type="checkbox"/> I somewhat agree with it <input type="checkbox"/> I am undecided <input type="checkbox"/> I somewhat disagree with it <input type="checkbox"/> I disagree with it <input type="checkbox"/> I strongly disagree with it	<input type="checkbox"/> I strongly agree with it <input type="checkbox"/> I agree with it
31) What is your perception of volume retention after 6 months?	<input type="checkbox"/> 50-60% <input type="checkbox"/> 60-70% <input type="checkbox"/> 70-80% <input type="checkbox"/> >80%	<input type="checkbox"/> < 30% <input type="checkbox"/> 40-50%
32) Do you think the maintenance of volume at 6 months is a result of fat survival, replacement with scar tissue, or a combination?	<input type="checkbox"/> Fat Survival <input type="checkbox"/> Replacement with scar tissue <input type="checkbox"/> A combination <input type="checkbox"/> Other	
33) In your estimation, what is the overall patient satisfaction with the procedure?	<input type="checkbox"/> Excellent <input type="checkbox"/> Good <input type="checkbox"/> Poor	
34) Which one of the following concerns about the use of AFG in breast surgery compares the closest to your own? (Please submit from most to least)	<input type="checkbox"/> Radiological: "The use of AFG in breast surgery impairs future radiological follow-up and breast cancer screening because of the frequent formation of fat necrosis and micro-/ macrocalcifications" <input type="checkbox"/> Oncological: "The transplantation of adipose-derived-stem-cells and CD34+ progenitors in white adipose tissue poses a risk to promote cancer progression" <input type="checkbox"/> Practical: "The use of AFG in breast surgery is associated with unacceptable complications such as hematomas, infections and the need for draining oily cysts/ fat necrosis"	
35) If you have any additional comments about the use of AFG in breast surgery in general or about this survey, please fill them in below		

Figure 1. Survey questions.

Please note that—in question #1—the participating countries exceeds the number of countries originally contacted. This is due to the fact the multiple respondents currently practiced in their home country after completing their residency abroad, a period in which they became members of their visiting countries' national plastic surgery association.

Table 1. Baseline Characteristics.

Question/Variable	Outcome: Mean (%)								Missing (%)
Age	46 ± 10.8								—
Specialty									—
• Plastic surgeon	347 (96.9)								
• Breast surgeon	6 (1.7)								
• Other	5 (1.4)								
Training									
• Resident (per year of training)	57 (15.9)	1st 5 (1.4)	2nd 5 (1.4)	3rd 7 (2.0)	4th 11 (3.1)	5th 8 (2.2)	6th 15 (4.2)	Other 6 (1.6)	—
• Registered medical specialist (experience)	288 (80.4)	<5 years 43 (12.0)	5-10 years 62 (17.3)	10-15 years 47 (13.1)	15-20 years 44 (12.3)	>20 years 92 (25.7)			1 (0.3)
• Other	12 (3.4)								
AFG familiarity									1 (0.3)
• Familiar with AFG in general but not for breast procedures	120 (33.5)								
• Familiar with AFG in general and for breast procedures	203 (56.7)								
• Not familiar with AFG (never practiced)	34 (9.5)								
Number of AFG procedures per year	<10 95 (26.5)	10-30 138 (38.5)	30-50 48 (13.4)	>50 42 (11.7)					35 (9.9)
Perform AFG alone or with colleague	Alone 237 (66.2)	With colleague 23 (6.4)	With senior colleague 30 (8.4)	With resident 32 (8.9)					36 (10.1)
Experience (self-assessment)	Experienced 149 (41.6)	Moderately experienced 145 (40.5)	Moderately unexperienced 19 (5.3)	Unexperienced 9 (2.5)					36 (10.1)

version of the article). A total of 358 completed questionnaires were retrieved for analysis over a 10-month period (June 2016 to April 2017). Table 1 illustrates the baseline “respondent” demographics. The mean age was 46 years (SD = 10.8 years), with the majority being plastic surgeon (96.9%), followed by breast surgeons (1.7%) and other (1.4%, mostly German gynecologists). Eighty percent were consultants, with a majority having more than 20 years of practicing experience. Ninety percent disclosed having practiced AFT for general purposes (33.5%) or in addition to breast surgery (56.7%). The majority performed AFT alone (66.2%) in <10 (26.5%) or between 10 and 30 (38.5%) procedures per year, and the vast majority considered himself or herself to be either experienced (41.6%) or moderately experienced (40.5%).

Technique

The harvest locations most often used were the abdomen (78.8%), the thigh (56.7%), and the flank (55.6%), with

most respondents using wetting solution (50 mL of 1% lidocaine plus 1 mL of epinephrine [1:1000] plus 1 L of normal saline) as their primary choice for harvest site infiltration (Table 2). Harvesting of fat was mostly performed by way of a liposuction device (41.9%), preferably through 3-mm cannulas (41.1%). When manual aspiration was used for harvesting (14.0%), most respondents did not know the actual diameter size of the cannula/needle. For preparation most respondents performed centrifugation (38.8%) besides washing of the fat (21.2%). Seventy-five percent of the respondents used a cannula to reinject the fat, aiming at 1 to 2 cc (30.7%) or >4 cc (21.5%) of volume per pass. Overcorrection was used by most respondents (80.5%) ranging from 20% to 30% (28%) to more than 50% (3.1%). In breast surgery, more than half (52%) of the respondents grafted the subcutaneous plane in addition to both flap and implant reconstructions as well as the correction of local defects. For flap reconstructions, other planes most commonly grafted were the subglandular (31.8%) and the pectoral (29.9%) spaces with more than half of the respondents

Table 2. AFT Technique and Opinion.

AFT Technique	Outcome: Mean (%)							Missing (%)
Question/Variable	Gluteal	Thigh	Flank	Abdomen	Knee	Other		
Harvest location ^a	25 (7.0)	203 (56.7)	199 (55.6)	282 (78.8)	92 (25.7)	15 (4.2)	—	—
Anesthesia at harvest location	0.5% Lido. + Epi	1% Lido. + Epi		Wetting solution	Epinephrine	Other		37 (10.3)
Harvesting technique	24 (6.7)	37 (10.3)		186 (52.0)	26 (7.3)	48 (13.4)		37 (10.3)
Harvest Cannula diameter	Cannula + constant suction	Coleman technique (with micro-cannula)		Syringe + large-bore needle	Other			
• Liposuction device	150 (41.9)	98 (27.4)		50 (14.0)	23 (6.4)			
• Syringe	1 mm	2 mm	3 mm	4 mm	Unknown	Other		37 (10.3)
Fat preparation	24 (6.7)	72 (20.1)	147 (41.1)	39 (10.9)	25 (7.0)	14 (3.9)		43 (12.0)
Freeze fat (yes/nn)	14 Gauge	16 Gauge	18 Gauge		Unknown	Other		53 (14.8)
Anesthesia at injection site	43 (12.0)	64 (17.9)	40 (11.2)	Adding insulin	147 (41.1)	21 (5.9)		37 (10.3)
Method of injection	None	Washing	Centrifugation	2 (0.6)	Decantation	Other		45 (12.6)
Estimated volume of injection per pass	12 (3.4)	76 (21.2)	139 (38.8)		47 (13.1)	29 (8.1)		38 (10.6)
Overcorrection (aim)	10 (2.8)	Yes		311 (86.9)	No			38 (10.6)
Grafted anatomical planes per indication ^a	0.5% Lido. + Epi	1% Lido. + Epi	Wetting solution	Epinephrine	None	Other		40 (11.2)
• Flap reconstructions	19 (5.3)	68 (19.0)	34 (9.5)	3 (0.8)	162 (45.3)	27 (7.5)		45 (12.6)
• Implant recon struction/augmentation	268 (74.9)	45 (12.6)	Needle	1 (0.3)	Ratchet gun	Other		37 (10.3)
• Local defect corrections	< 1 cc	1-2 cc	2-4 cc	> 4 cc	Unknown	6 (1.7)		38 (10.6)
	68 (19.0)	110 (30.7)	43 (12.0)	77 (21.5)	22 (6.1)	Unknown		38 (10.6)
	None	10-20%	20-30%	30-40%	>50%	22 (6.1)		40 (11.2)
	30 (8.4)	96 (26.8)	99 (27.7)	40 (11.2)	11 (3.1)	>50%		40 (11.2)
	Subcutaneous	Intraglandular	Subglandular	Pectoral	Subpectoral	Other		40 (11.2)
	186 (52.0)	83 (23.2)	114 (31.8)	107 (29.9)	43 (12.0)	12 (3.4)		40 (11.2)
	186 (52.0)	66 (18.4)	75 (20.9)	78 (21.8)	25 (7.0)	7 (2.0)		40 (11.2)
	186 (52.0)	107 (29.9)	104 (29.1)	78 (21.8)	32 (8.9)	8 (2.2)		40 (11.2)

(continued)

Table 2. (continued)

AFT Technique	Outcome: Mean (%)					Missing (%)		
Question/Variable	Strongly agree	Agree	Somewhat agree	Undecided	Somewhat disagree	Disagree	Strongly disagree	Other
• Flap reconstructions	21 (10.6)		72 (36.2)	48 (24.1)	42 (21.1)	16 (8.0)		
• Implant reconstruction/augmentation	39 (19.6)		73 (36.7)	44 (22.1)	31 (15.6)	12 (6.0)		
• Local defect corrections	39 (19.6)		95 (47.7)	47 (23.6)	17 (8.5)	1 (0.5)		
AFG enhancement ^a	None		BRAVA preop	BRAVA postop	Rigotomies			
	121 (33.8)		27 (7.5)	22 (6.1)	77 (21.5)			8 (2.2)
AFT Opinion								
Question/Variable	Outcome: Mean (%)					Missing (%)		
General opinion (agreement with AFG)	Strongly agree	Agree	Somewhat agree	Undecided	Somewhat disagree	Disagree	Strongly disagree	Other
Estimated volume retention > 6 months	171 (47.8)	136 (38.0)	28 (7.8)	6 (1.7)	8 (2.2)	1 (0.3)	2 (0.6)	
	<30%	40-50%	50-60%		60-70%	70-80%	>80%	
Estimated cause of volume retention	47 (13.1)	84 (23.5)	78 (21.8)		101 (28.2)	33 (9.2)	10 (2.8)	
	Fat survival		Replacement with scar tissue		Combination (fat survival + scar tissue replacement)	Other		
Estimated patient satisfaction with AFG	179 (50.0)		9 (2.5)	Good	150 (41.9)	14 (3.9)		
	Excellent					Poor		
	184 (51.4)		142 (39.7)			27 (7.5)		5 (1.4)

Abbreviations: Lido., lidocaine; Epi, epinephrine; wetting solution (50 mL of 1% lidocaine + 1 mL of epinephrine [1:1000] plus 1 liter of saline); BRAVA, Breast Enhancement and Shaping System; preop, preoperatively; postop, postoperatively.

^aMultiple answers possible.

aiming at a total grafted volume of 50 to 100 cc (36.2%) or 100 to 150 cc (24.1%). For implant reconstruction/augmentation and for local defect correction (LDC), the preferred planes of reinjection were pectoral (21.8%) versus subglandular (20.9%) and intraglandular (29.9%) versus subglandular (29.1%) spaces, respectively. Methods for AFT take enhancement varied from none (33.8%) to rigotomies (21.5%) and preoperative and postoperative external expansion devices like the Breast Enhancement and Shaping System (BRAVA) in a few select cases (7.5% and 6.1%, respectively).

Attitude

The vast majority of respondents strongly agreed (47.8%) or agreed (38.0%) with the use of AFT for appropriate indications (Table 2), with an almost equal distribution of respondents estimating the volume retention after 6 months to be in the range of 40% to 50% (23.5%), 50% to 60% (21.8%), or 60% to 70% (28.2%). There was a clear division in the opinion about causative factors when it comes to volume retention, with approximately half of the respondents attributing the results to fat survival (50%) or a combination of fat survival and scar tissue replacement (41.9%). Patient satisfaction as estimated by the surgeon was either excellent (51.4%) or good (39.7%) in the majority of respondents.

Differences Between Countries, Surgeon Experience, and AFT Procedure Performed per Year

Due to the small numbers of respondents for most participating countries (Denmark, Great Britain, Spain, Italy, Switzerland, Greece) a comparison could only be made between the Netherlands, Belgium, France, and Austria, with the remaining countries pooled together as "other." Furthermore, since no consensus and therefore gold standard currently exists regarding the AFT technique, no deviation thereof with regard to the various countries analyzed can be calculated. Therefore, the largest group of respondents (the Netherlands) was considered as an arbitrary baseline (see Table 3a).

The mean age of the Dutch respondents was significantly lower than that of other countries. The years of experience and number of AFT procedures performed yearly were higher in Belgium, France, Austria, and the other countries combined. Considering harvest locations, the thigh was significantly less used in Belgium and in the other countries combined, and the French respondents were less inclined to use the abdomen compared with the Dutch. The French and Austrian respondents seemed to prefer manual aspiration over a liposuction device and larger over smaller cannula sizes (>3 vs <2

mm) compared with the Dutch respondents. Furthermore, centrifugation was performed significantly more by the French and both centrifugation as well as washing significantly less by the Austrian surgeons, respectively. In addition to both flap and implant (breast) reconstruction as well as in correcting local (mammary) defects, the French respondents performed significantly less AFT in the subcutaneous plane, compared with the Dutch. In addition, so did both the French and the Austrian respondents when it came to intraglandular AFT for LDC. On the contrary, in addition to flap (breast) reconstructions, the French performed significantly more subpectoral fat injections. Finally, when asked about the amount of injected fat, both the French and the Belgian surgeons injected significantly more in addition to flap reconstruction than the Dutch surgeons.

Table 3b and 3c stratify the number of respondents based on their experience and number of AFT procedures performed yearly. What stands out is both the harvesting location as well as technique and cannula size, besides the estimated injected volume. For example, we see that the flank as a harvesting location is more utilized by surgeons who perform more AFT procedures yearly, but is used less by surgeons with more overall clinical experience. On the contrary, the use of a liposuction device is less often used by both less experienced surgeons as well as surgeons who perform more AFT procedures per year. When looking at the different injection planes used, compared with the number of AFT procedures performed yearly, there seems to be a direct relationship between the two for all injection planes. In other words, the higher the numbers of AFT procedures performed yearly, the more injection planes are utilized by the surgeon. This holds true for intraglandular injections as well.

Discussion

With the growing popularity of AFT among plastic surgeons, the number of AFT techniques and subsequently the patented AFT devices currently commercially available increases. The obvious attraction of the technique for both patients and surgeons comes forth from the desire to recycle fat tissue for a beneficial—often defect occupying—goal in reconstructive or augmentational surgery, hence the high surgeon and patient satisfaction rates that are generally reported in clinical studies and systematic reviews.^{23,24} However, critics of AFT have strong arguments in pointing out the disadvantages, such as uncertainty regarding oncological and radiological safety in breast reconstruction/augmentation, besides unpredictable long-term results. In the United Kingdom, Germany, and France, clinical guidelines are now available to standardize the technique, aiding both clinical practice and reproducibility among scientific studies. In this light an

Table 3. Outcome per Country, Years of Overall Experience, and AFT Procedures Performed Yearly^a.

3a. Outcome per Country

	Netherlands (Baseline) ^b	Belgium	France	Austria	Other
No. of respondents (%)	141 (39.4)	42 (11.7)	65 (18.2)	30 (8.4)	80 (22.3)
Mean age ± SD	42 ± 10	46 ± 11 ↑*	51 ± 10 ↑***	45 ± 10 ↑ns	50 ± 10 ↑***
Experience (%)					
• Resident	32.8	5.0	0.0	10.3	9.5
• Specialist (0-10 years)	43.3	40	23.4	41.4	18.9
• Specialist (10-20 years)	21.9	27.5	28.1	31.0	31.1
• Specialist (>20 years)	10.9	27.5 ↑***	48.4 ↑***	17.2 ↑*	40.5 ↑***
AFT procedures/year (%)					
• <10	47.9	15.0	18.5	20.0	21.1
• 10-30	38.5	47.5	35.4	48.0	51.3
• >30	13.7	37.5 ↑***	46.2 ↑***	32.0 ↑*	27.6 ↑***
Harvest location (%)					
• Thigh	55.3	50.0 ↓*	72.3	56.7	50.0 ↓*
• Abdomen	75.2	78.6	81.5 ↓* ²	70.0	86.3
Local (donor site) anesthesia (%)					
• Wetting solution	69.8	50.0	34.4 ↓***	64.0	61.8
Harvesting technique (%)					
• Liposuction device	65.5	57.5	39.1 ↓***	28.0 ↓***	52.6 ↓*
Liposuction cannula (%)					
• <2 mm	43.8	30.8	24.2	13.0	39.1
• >3 mm	56.2	69.2	75.8 ↑**	87.0 ↑**	60.9
Preparation (%)					
• Washing	27.6	31.3	22.8	20.0 ↓*	21.3
• Centrifugation	44.0	43.8	68.4 ↑**	16.0 ↓**	41.3
Estimated volume per pass (%)					
• <1 cc	26.5	20.5	5.1	12.5	36.5
• 1-2 cc	46.1	38.5	15.3	54.2	35.1
• >2 cc	27.5	41.0	79.7 ↑***	33.3	28.4
Overcorrection (%)					
• None	10.3	0.05	4.7	20.0	11.0
• <20	42.2	42.5	32.8	32.0	45.2
• 20-30	26.7	35.0	37.5	32.0	30.1
• >30	20.7	17.5	25.0 ↑*	16.0	13.7
AFT + Flap reconstruction; injection planes (%)					
• Subcutaneous	54.6	52.4	46.2 ↓**	53.3	51.2 ↓*
• Intraglandular	25.5	35.7	26.2	0.0	18.8 ↓*
• Subpectoral	7.1	19.0	27.7 ↑*	3.3	7.5
AFT + Implant reconstruction/augmentation; injection planes (%)					
• Subcutaneous	55.3	52.4 ↓*	47.7 ↓***	50.0	50.0 ↓**
AFT + Local defect corrections; injection planes (%)					
• Subcutaneous	53.9	52.4	46.2 ↓**	56.7	51.3 ↓*
• Intraglandular	38.3	38.1	24.6 ↓**	16.7 ↓*	20.0 ↓***
AFT + Flap reconstruction; estimated total injection volume					
• <100	62.4	30.4	9.4	47.1	52.4
• 100-150	25.9	26.1	15.6	35.3	21.4
• >150	11.8	43.5 ↑*	75.0 ↑***	17.6	26.2

(continued)

Table 3. (continued)**3b. Outcome per Year of Experience**

	Residents (Baseline)	<10	10-20	>20
No. of respondents (%)	57 (15.9)	104 (29.1)	91 (25.4)	92 (25.7)
Harvest location (%)				
• Flank	47.3	59.6 ↓* ^c	65.9 ↓* ^c	48.9 ↓** ^c
Harvesting technique (%)				
• Liposuction device	47.1	47.5 ↑*	52.2 ↑*	62.9 ↑**
<i>Liposuction cannula (%)</i>				
• <2 mm	18.2	30.3	31.7	44.4 ↑*
• >3 mm	81.8	69.7	68.3	55.6
Estimated volume per pass (%)				
• <1 cc	23.1	13	25.0	31.3
• 1-2 cc	38.5	50.0	33.0	26.5
• >2 cc	38.5	37.0	42.0	42.2

3c. Outcome per AFT Procedures Performed Yearly

	<10 Proc./ Year (Baseline)	10-30 Proc./ Year	>30 Proc./ Year
No. of respondents (%)	95 (26.5)	138 (38.5)	90 (25.1)
Harvest location (%)			
• Flank	50.5	61.6 ↑*	73.3 ↑**
Harvesting technique (%)			
• Liposuction device	67.4	50.0 ↓*	43.2 ↓*
AFT + Flap reconstruction; injection planes (%)			
• Subcutaneous	53.7	57.2	62.2 ↑*
• Subglandular	23.2	34.8	48.9 ↑**
• Pectoral	20.0	30.4	51.1 ↑***
AFT + Implant reconstruction/augmentation; injection planes (%)			
• Intraglandular	15.8	18.1	28.9 ↑*
Subglandular	15.8	23.2	31.1 ↑*
Pectoral	16.8	21.7	35.6 ↑*
AFT + Local defect corrections; injection planes (%)			
• Subcutaneous	52.6	55.8	65.6 ↑**
• Subglandular	26.3	29.7	42.2 ↑*
• Pectoral	11.6	22.5	40.0 ↑***

Abbreviation: AFT, autologous fat transfer.

^aThe arrow (↓, ↑) indicates the value in which the country (3a), the experience (3b), or the AFT procedures performed yearly (3c) differs from the baseline (↓ = lower/less; ↑ = higher/more).

^bArrows in the columns depict significant deviations from the baseline (column "Netherlands" in 3a, column "Residents" in 3b, and column "<10 proc./year" in 3c).

^cPercentages are based on the data, significance levels are based on model estimates. Discrepancies between differences between percentages and the direction of the arrows are due to correction for other variables in the model.

Significance: ns = $P > .05$. * $P \leq .05$. ** $P \leq .01$. *** $P \leq .001$.

overview of real-time clinical practice of AFT in Europe identifying differences between countries might aid further scientific studies in the search for the gold standard in AFT.

Despite an adequate overall response rate we found a low response rate per country, which may have been

attributable to the headline of the survey invitation. This revealed the technical aspect of some of the questions, which might have discouraged surgeons who never practice AFT to respond. More than a quarter of the respondents had >20 years of practicing experience and higher rates of these more experienced surgeons were found in

all of the other countries compared with the Netherlands. This was probably attributable to the higher number of residents among the Dutch respondents. Our survey showed that breast surgery is still the most prominent indication for AFT in Europe. Also, the majority of surgeons performed AFT alone, in accordance with the findings of Skillman et al,¹⁷ showing that while AFT can be time consuming, it is not a two-man's job necessarily. While AFT is a popular procedure, it is still not practiced often, with 26.5% of the respondents performing less than 10 AFT procedures per year and only 11.7% performing more than 50. These findings are in line with Kaufman et al,¹⁶ and although a longer learning curve might be the result of the relative few procedures performed, most surgeons considered themselves experienced.

The technique used remains one of the most heterogeneous aspects of AFT, and while factors like harvesting technique and preparation seem to be rather uniform with the Coleman technique,^{25,26} deviations thereof are becoming apparent. The abdomen is still the most prominent harvesting location overall. Second to this is the flank with even higher rates in the subgroup of respondents who perform more AFT procedures. In 2017 Europe, the vast majority (41.9%) of surgeons is using a liposuction device, which might be attributable to the time-saving properties of this technique. The French and the Austrian respondents used a liposuction device significantly less often than the Dutch population, which we hypothesized as possibly due to the higher level of experience (and Coleman technique adherence) of respondents from these countries. While randomized controlled trials comparing both methods are clearly needed, the recent systematic review by Shim et al²⁷ indicated a slight preference for manual aspiration, based on several small-cohort, retrospective and prospective studies.²⁸⁻³¹ The preferred cannula size when using a liposuction device was 3 mm in 41%, with an equal percentage of respondents indicating not knowing the cannula size when using manual aspiration. This seems to be an area where improvement can be achieved, since several studies have indicated that the size of both the aspiration and injection cannula (>3 mm to <6 mm) matter significantly in terms of adipocyte viability.^{32,33} Finally, in terms of injection technique and planes, half of the respondents aimed at injecting <1 to 2 cc of fat, while overcorrecting 10% to 30%, in line with the Coleman method, with only the French injecting more. With regard to breast surgery, when AFT is used in addition to flap reconstruction, implant reconstruction or augmentation, and LDC, the subcutaneous plane was grafted most, followed by the subglandular and pectoral planes. What is interesting to see is that the intraglandular plane was grafted for all indications ranging from 18.4% in

addition to implant reconstruction, to 30% in LDC. Even more interesting is the fact that intraglandular injection rates also seemed to be higher in more experienced surgeons based on the number of AFT procedures performed. Both the British and German clinical guidelines^{34,35} currently strongly advise against the utilization of intraglandular AFT because of the possible carcinogenic differentiation of (remaining dormant) breast (cancer) cells.³⁶⁻³⁸ While the number of respondents from the United Kingdom and Germany were too low to make any comparisons between countries, the Dutch plastic surgery association (NVPC) advises its members to adhere to the British guidelines and otherwise to keep up-to-date on the most recent scientific literature when performing AFT. The authors presume the same holds true for other countries, but nonetheless, there seems to be a gap between what is recommended and what is actually performed and herein might lay certain benefits from proper surgeon education when it comes to oncological safety of AFT.

The overall approval of the respondents with AFT in general as well as the surgeon-perceived patient satisfaction was considered high and seems in line with recent studies. The perception of what causes the eventual volume retention was either fat survival or a combination thereof with scar tissue formation, and further histological animal studies, preferably with long-term follow-up, are needed to substantiate the answer to this question. Finally, concerns with AFT in breast surgery are mainly regarding oncological safety, radiological safety, or practical issues. Figure 2 highlights the order in which these concerns troubled the respondents, illustrating that further studies should focus on the oncological and radiological safety of the technique.

Limitations

The information gathered by survey studies is dependent on honest answers. While the authors trust the intentions of the respondents, the accuracy of the answers given can—on a subconscious level—be colored by embarrassment, lack of memory, alacrity, or even boredom.³⁹ Furthermore, the survey was distributed among a select group of physicians, namely, plastic surgeons and breast surgeons who happened to be members of a plastic surgery association. Therefore, large numbers of—possible AFT practicing—surgeons (like members of the United Kingdom; Royal Colleges of Surgeons) were potentially missed and discrepancy between responders and nonresponders can create a selection bias. Finally, while the questions leave little room for interpretation, certain options like “somewhat agree” can mean different things to different individuals. Nonetheless, for the first time we were able to

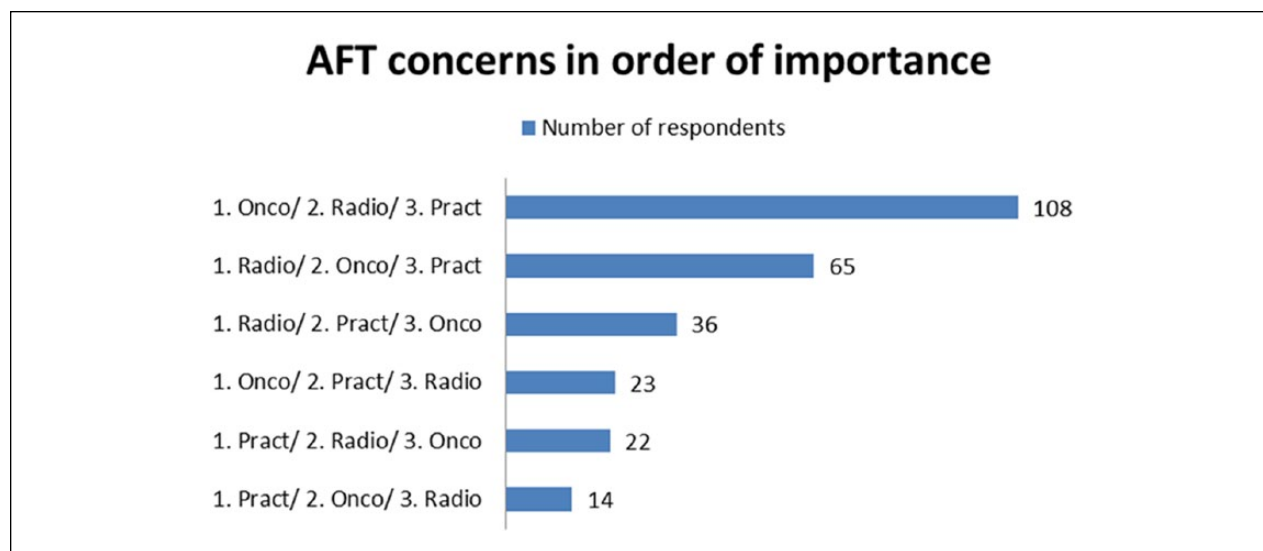


Figure 2. Respondents' concerns with the practice of autologous fat transfer (AFT) in order of most clinically important.

Oncology: "The transplantation of adipose-derived stem cells and CD34+ progenitors in white adipose tissue poses a risk to promote cancer progression."

Radiology: "The use of AFG in breast surgery impairs future radiological follow-up and breast cancer screening because of the frequent formation of fat necrosis and micro-/macro-calcifications."

Practice: "The use of AFG in breast surgery is associated with unacceptable complications such as hematomas, infections, and the need for draining oily cysts/fat necrosis."

highlight differences in AFT technique between countries and levels of experience and point out the ongoing practice of intraglandular fat grafting in conjunction with breast surgery.

Conclusion

This study provides the first overview of clinical practice regarding AFT in Europe and highlights important differences between countries that can aid in the focus of future studies as well as point out discrepancies in the physician adherence to clinical guidelines. The overall experience with AFT among respondents was moderate to high, with most applying its use in addition to breast surgery. Coleman's method is still the most widely used AFT technique but deviations thereof lay in the areas of harvesting technique and cannula sizes. The injection planes of AFT, in addition to breast surgery, are in order of most used: the subcutaneous, subglandular, and pectoral planes. However, despite prominent discouragement of the British and German clinical guidelines, intraglandular AFT still occurs in clinical practice today and this should be the focus of further surgeon education in Europe. Finally, it is the authors' hope that this "pilot study" into the realm of real-time reporting on the clinical practice of AFT may incite more *prospective* studies on the subject that may even one day lead to a European "Fat Grafting" database.

Acknowledgments

The authors would like to thank Shan Shan Qui, MD, PhD, Denise Zuniga, MD, and Camille Guillaume, MD, for their tremendous work in translating the questionnaires.

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Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.


Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

Supplemental Material

Supplemental material for this article is available online.

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