REVIEW ARTICLE

Long Term Volume Survival after Autologous Fat Transplantation to the Breast: A Review

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Abstract

Importance
Autologous fat transplantation for breast augmentation has become a standard technique and is widely applied. The major weak point is that long time results, especially studies about long term volumetric survival of the fat grafts have not been available yet.

Observations
We compared the available literature about volume survival after fat transplantation. This review includes various studies and recent findings six years after fat transfer to the breast, showing stable results and even volume gain of transplanted fat grafts in patients that gained weight after fat transfer.

Conclusions
Fat transplantation to the breast for cosmetic breast augmentation offers stable long term results regarding volume survival of the transplanted fat grafts. The available long term studies do not show any severe late complications of fat transfer documenting the safety of the procedure.

Keywords: fat transplantation, lipofilling, volume survival, 3 D volumetry, MRI volumetry, breast augmentation

Introduction

Both, silicone implants and autologous fat transplantations, are established and proven techniques for breast augmentation. Keeping in mind that capsular fibrosis is a common problem in silicon implant breast augmentation with high grade capsular fibrosis rates of 10 % after 8 years [1-3], many patients are interested in lipofilling for breast aumentation as an alternative. Leaving aside the drawbacks of fat transplantation, like limited augmentation volume in a single operation due to basic principles of fat transfer and oil cysts or calcification as a consequence that the transplant will not survive completely, one major weak point is that long time results were missing and results may vary a lot between surgeons depending on their experience and the technique they use.

Not long ago, the first surgeons who applied fat transplantation for breast augmentation, used to describe their results by simply estimating the final results of volume survival by comparing pre- and postoperative pictures. Nevertheless the first published work about MRI volumetry after fat transplantation is more than 25 years ago [4].

Various techniques have been used to measure breast volume [5]. The anthropometric method, thermoplastic casts or the Archimedean principle of water displacement are older options. They have been replaced by more exact and reproducible tools like MRI volumetry or 3 D body surface scans. For qualitative (volume survival) and quantitative (detection of oil cysts, necrosis or pathologies) progress control MRI volumetry offers all needed information. This means evaluation of fat survival and diagnostically precious imaging to exclude possible complications of autologous fat transplantation [6]. Alternatively 3 D surface imaging is an option when only volume survival should be analyzed [5].

Aims and scope

With this short review we aim to give an overview about the available data, especially about volumetric analysis of long term volume survival of fat grafts after fat transplantation to the breast.

Avaiable studies on volume survival after fat grafting

In 2010 we started to perform the first studies using MRI volumetry for quantitative analysis after fat transplantation for breast augmentation [7]. Six months after lipofilling for aesthetic reasons using the WAL based BEAULI technique a volume survival of 76 ± 11 % was found via MRI volumetry [8]. In a study conducted by Delay et al. lipofilling of the breast the Coleman technique was applied. Based on clinical examination and 3D volumetry a resorbtion rate of 30-40% (= volume survival of 60-70%) three months after surgery was found. In these patients post oncological reconstructions, aesthetic breast augmentations and correction of congenital deformities were performed [9]. Spear et al. used MRI volumetry and found a survival rate of 36-39% after one year [10]. Khouri et al. described an autologous fat tissue transplantation technique with Brava pre-expansion in 476 patients. A mean volume of 346 ml of fat tissue was transplanted. After at least 6 months postoperatively, the mean volume survival of the transplanted tissue was 266 ml (78%) [11]. After an average follow up time of 3,5 years, the study described a low rate of complications. MRI revealed localized fat necrosis in 19% and palpable breast nodules in 15% of the patients, all these findings were benign in radiological imaging studies. There was one reported case

of pneumothorax as an immediate complication of fat transfer to the breast [11].

In our recent study 14 patients underwent MRI scan before and 5-9 years (mean 6 years) after aesthetic breast augmentation by fat transfer [12]. The difference in volume was calculated with the open source software OsiriX®. Two groups were analyzed separately to calculate the influence of body weight changes in final volume gain. In the first group patients with a stable BMI (increase of less than 1 kg/m$^{2)}$ were included. The second group includes patients with a BMI gain exceeding more than 1 kg/m^2. The mean increase in BMI was 1,6 kg/m^2 (minimum 0 – maximum 3,9). None of the patients showed a weight decrease. Depending on the desired increase in breast volume the patients underwent between one to four operations. An average of 176 cc fat was transplanted per breast and surgery. In the first group a mean volume survival of 74% (IQR 58% - 92%) was observed. In the second group an increase of 135% (IQR 105% - 318%) of the transplanted volume was observed. The high correlation of increased volume survival to weight gain shows that the transplanted adipose tissue is vital tissue with preserved storage function, which is able to store more fat after transplantation. In summary this shows the context of a disproportionately increasing breast volume by gaining weight. In a patient with a weight gain of 11 kg, an increase of volume of over 340% based on the transplanted fat graft could be observed. Another patient, with a low volume survival of 50%, had a baseline BMI of 19.4 kg/m^2 and increased her food intake before each procedure in order to have fat deposits for liposuction. After time had passed this patient had returned to her original baseline weight, meaning she lost several kilogramms, so that it can be assumed that the transplanted adipose tissue in this patient had a lower volumetric survival [12]. A lower volume survival rate following weight loss after surgery has already been observed in other studies [9]. A volume gain (=more than 100% volume survival of the fat grafts) after transfer to the breast in patients without significant weight gain could be partially explained by cycle-related fluctuations. These fluctuations of - 5.5% to + 8.1% change in volume of the breast are described in an MR volumetric study [13]. Another possible explanation for the increase in volume could be that the adipocytes are damaged during the lipotransfer and are at first reduced in volume, which, after a regeneration phase recovers to the original volume.

Depending on the life cycle of the adipocytes exact this process could be observed happening sometime after fat transfer [12].

A frequently asked question is whether an increased healing rate of the transplanted adipose tissue can be achieved by adding stem cells. The existing opinions on this are controversial. Two studies by Peltoniemi et al.[14,15], that applied water-jet assisted liposuction with and without the addition of stem cells, showed no significant difference in the healing rates (79% and 83% healing rate without the addition of stem cells and 74% and 83% healing rate with the addition of stem cells). In a further study, an estimated healing rate of 60% with and 40% without the addition of stem cells was estimated from the difference between the circumference above the areoles and the inframammary circumference [16]. A review of CAL (cell-assisted lipotransfer) showed that the healing rate is significantly higher compared to non-CAL, but this is especially true for small transplant volumes <100 ml [17].

Study	Indication	Volume survival of transplanted fat graft	Number of patients	Lipofilling technique		FU (in months)
Delay et al. 2009. (9)	breast augmentation, congenital, reconstruction	60-79%	n.a.	Coleman (centrifugation)	3D	3
Herold et. al 2010 (7)	breast augmentation	72+/-11%	10	WAL (Beauli)	MRI	6
Ueberreiter et al. 2010 (8)	breast augmentation	76 +/-11%	36	WAL (Beauli)	MRI	6
Alexander Del Vechio et al. 2012 (18)	breast augmentation	64 +/-13%	25	no centrifugation incl. Brava	MRI and 3D	6
Khouri et al. 2012 (20)	breast augmentation	82 +/-18% 55% without brava	81	KVAC incl. Brava	MRI	12
Fiaschetti et al. 2013 (21)	breast augmentation, congenital	72%	15	Coleman (centrifugation) and PRP	MRI	12
Peltoniemi et al. 2013 (14)	breast augmentation	79+/-13%	8	WAL (Beauli)	MRI	6
Gentile et al. 2013 (22)	breast reconstruction	69% (with PRP)	50	Coleman (centrifugation) and PRP	3 D	12
Gentile et al. 2013 (22)	breast reconstruction	39 % (without PRP)	50	Coleman (centrifugation)	3 D	12
Spear et al. 2014 (10)	breast augmentation	36,0 % r , 39 % l 3D, 39,8 r , 38,1 l MRI	10	low pressure machine liposuction and centrifugation	MRI and 3D	12
Khouri et al. 2014 (11)	breast augmentation, congenital	77%	476	KVAC incl. Brava	MRI and 3D	42 (3,5 years)
Dos Anjos et al 2015 (23)	breast augmentation, congenital, reconstruction	75 % high SVF. 50 % low SVF	74	SVF enriched	3D	18
Ho Quoc et al. 2015 (24)	breast reconstruction with latissimus dorsi flap, 2. step lipofilling	81%	32 breasts	centrifugation	CT	3
Peltoniemi et al. 2016 (15)	breast augmentation	83%	4	WAL + Celution, 2 TX (intra patient control)	MRI	4 to 15
Glovinski et al. 2016 (19)	no information given	30-90%	4	no information given	MRI	12
Chiu et al. 2019 (25)	breast augmentation	68%	101	SVF	3D	12
Chiu et al. 2019 (25)	breast augmentation	68%	105	normal	3D	12
Ueberreiter et al. 2020 (12)	breast augmentation	74%	14	WAL (Beauli)	MRI	72 (6 years)

Not all studies explicitely contain information, if the volume of the injected fat graft (which contains roughly 30% water if no centrifgation is applied) [8,9], or if solely the fat part of the fat graft is counted as transplanted volume. As the water will definitely be resorbed during the first days after fat transplantation, studies that did compare the volume of the total fat graft (including water) will inevitably have lower volume survival rates, as 30% of the volume of non-centrifuged fat grafts will be lost due to resorption of the water. Results of the studies might also differ due to the volumetry protocol applied and due to the fact, that there is a tendency to overcalculate to postoperative volume as explained in the work by Glovinsky et al. [18]. But even if the real volume survival should be a little less, it is quite sure, that volume remains and stable long term results are possible.

Conclusion and recommendations

Ten years after the first volumetric studies on fat graft survival after fat transplantation to the breast, finally first long term results (> five years) are available. The results of fat transplantation to the breast seem to be stable. It has been described in several studies, that there is a volume loss in the first three to twelve months after lipofilling, but after that initial phase, implied a correct technique is used, there will be a stable volume of the transplant. In cases with weight gain (what is rather common in aging) there might be even a volume enlargement. Based on the above mentioned studies, autologous fat transplantation to the breast offers stable long term results, once the primary resorbtion phase has been overcome.

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