Comparison of Results After Facial Fat Grafting with Filtered and Washed Fat Versus Centrifuged Fat

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ABSTRACT

Objectives: To compare the centrifuged fat versus filtered and washed fat for facial fat grafting in terms of patient satisfaction and subjective/objective appearance.

Study Design: Comparative prospective study.

Setting/Duration of Study: Department of Plastic Surgery, CMH, Rawalpindi Pakistan, from Aug 2017 to Jan 2020.

Methodology: A total of 64 patients (32 in each group) requiring facial fat grafting who fulfilled the sample selection criteria were included in the study. Patients who had received facial cosmetic surgery previously had systemic comorbid or were suffering from active infections were excluded. Group-A patients received centrifuged fat grafts, while Group-B patients received filtered and washed fat grafts. All patients were followed for patient satisfaction and subjective/objective appearance.

Results: In Group-A, 23 (71.9%), 3 (9.4%), and 6 (18.7%) patients were happy, just satisfied and unhappy with the overall results of the procedure, respectively, while these numbers were 25 (78.1%), 3 (9.4%), and 4 (12.5%) in Group-B (p=0.785). Patients' evaluation of their general appearance post-procedure (scored out of 10) showed a mean score of 6.53 ± 2.46 in Group-A and 6.72 ± 2.19 in Group-B (p=0.749). Scoring for a general appearance by an expert panel showed a mean score of 6.72 ± 2.16 in Group-A and a mean score of 7.13 ± 1.81 in Group-B (p=0.418).

Conclusion: There is no difference between centrifugation and filtration/washing of fat grafts for facial grafting regarding patient satisfaction and subjective/objective appearance.

Keywords: Centrifuged, Filtered, Facial fat grafting, Washed.

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INTRODUCTION

Dermal ageing is a continuous process which starts at birth. A great deal of time and effort has been spent studying and perhaps reversing this process.[1] Various factor are involved in its aetiology and are classified as either intrinsic (decreased stratum basale proliferation, epidermal thinning, decreased dermo-epidermal contact, decreased fibroblast formation, loss of subcutaneous fat, as well as degeneration of elastin, fibrillin, and collagen proteins) or extrinsic (air pollution, smoking, poor nutrition, and sun exposure).[2] These factors also result in synergistic structural changes to osseous tissue, adipose tissue, and supporting ligaments in association with the skin, compounding the issue.[3]

Dermal fillers are increasingly employed as a counteracting agent to skin ageing, registering a 6.5% increase in total procedures by 2015 for some fillers and a concurrent decrease in cosmetic facial surgeries.[4] Various soft tissue fillers have been proposed for use with purported qualities, including countering sagging, and skin atrophy, while having properties of predictability, malleability, and biocompatibility.[4] Of the fillers available, autologous fat transfer is the most cost-effective and, at the very least, comparable in efficacy, with multiple studies demonstrating good results with minimal side effects.[4,5]

Fat transplantation has a long history, starting in 1889 with Van der Meulen, who carried out a procedure involving autologous fat transplantation to treat a diaphragmatic hernia.[6] Lexer, in 1910, was famously credited with the first cosmetic surgery using fat to correct changes brought about by ageing. He used a fat-based filler to spread dermal wrinkles in the malar infraorbital region.[6] However, real progress was made by Coleman, in 1986, in terms of graft survivability, when proposed protocols and techniques for fat grafting and placed a great onus on the processes involved in the harvesting, refinement, and transfer of the graft to increase the chances of long-term success.[6]

In this regard, various processing techniques have been proposed, including centrifugation, gravity separation, washing, and filtration, with the ultimate aim of

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identifying the optimal method to enhance graft survivability. In some surveys, it was seen that, due to the lack of established protocols for fat graft processing, of the total plastic surgeons surveyed, 45% used gravity separation, 34% used centrifugation, 34% used filtration, 11% used gauze rolling, 3% used no processing, and 7% used unspecified methods, with varying results.[7,8]

Centrifugation and a combination of filtering and washing are common techniques. This study was conducted to compare centrifugation versus filtering and washing for facial fat grafting in terms of patient satisfaction and subjective/objective evaluation by the patients themselves and a panel of experts.

METHODOLOGY

A prospective comparative study was conducted from August 2017 to January 2020 in the Department of Plastic Surgery, Combined Military Hospital, Rawalpindi, after approval from the Ethical Review Committee of Combined Military Hospital, Rawalpindi (Number:45). Written informed consent was taken from every patient included in the study.

The sample size was calculated by using the WHO sample size calculator with Power of test (1-β)= 99%, level of significance (α)=5%, population SD (σ)=7, population variance (σ2)=49, test value of the population mean=45, and anticipated population mean=38.8.9 The sample size was calculated as 32 ± 32 = 64 patients. The sampling technique was non-probability consecutive sampling.

Inclusion Criteria: Patients of both genders, aged between 40 and 55 years who required facial fat grafting were included in the study.

Exclusion Criteria: Patients suffering from severe photo-aging, concurrent systemic co-morbidities or pre-procedure systemic/local infections, those suffering from coagulation disorders, or who had received some form of cosmetic facial surgery/previous facial dermal fillers were excluded from the study.

All the participants were randomly divided into two equal groups (Group A & B) consisting of 32 patients each by lottery method. Group-A patients received a facial fat graft which underwent centrifugation, while Group-B patients received filtered and washed fat grafts.

All the patients underwent the procedure in the operation theatre under general anaesthesia. A donor site was chosen in the lower abdomen, and the tumescent solution containing Lidocaine 0.05% and epinephrine 1:1,000,000 in lactated ringer solution were injected into the selected area. A small stab in-cision was made in the donor site with a No. 11 blade tip, and adipose tissue was aspirated using a 2.5 mm diameter blunt-tipped cannula connected to a fat collection reservoir via suction. One of two fat proces-sing techniques followed this: in Group-A, harvested fat from the collection reservoir was transferred to 10 ml syringes. These syringes underwent centrifugation at 1000 rpm for 3 minutes. The upper free lipid layer and the lower fluid mixture and cells and cellular debris were discarded, leaving the middle layer of purified adipose tissue for further processing injection. For Group-B patients, the fat was filtered using a sterilized common strainer and then washed with 0.9% normal Saline. This process washed away the cellular debris and free oil. After this, the bottom of the strainer was tapped with dry gauze to absorb the residual fluid from the fat. Finally, a sterilized spoon transferred the purified fat from the strainer to 10cc Luer-Lock syringes.

The refined adipose tissue from both groups was then transferred into a $1cm^3$ syringe, and the fat was injected through a 1.5mm blunt tip cannula with a lateral opening. The process was performed carefully while withdrawing the cannula under mild pressure, depositing the graft subcutaneously, and using a fanning technique to ensure even distribution. Postoperatively, all patients received sterile strip coverings, cool compresses, and systemic antibiotics. Patients were discouraged from touching the grafted areas for two days.

Patients were followed up with photographs before the procedure and six-months post-procedure. The lighting, position, expression, and the distance from the camera of the face were kept the same, and the camera settings remained unchanged throughout the study. Patients were given a questionnaire for self-assessment at six months. It was based on a scoring system used and validated by Botti *et al*,[9] for their study and encompassed factors which included notable asymmetries (none=0, some=1, gross=2), deformities (no=0, yes=1), skin thickening (none=0, some=1, gross=2), skin discoloration (none=0, some=1, gross= 2), change in skin texture (none=0, some=1, gross=2), or pain (no=0, yes=1). The scores from these factors were added to calculate the general level of patient satisfaction (scored from 0 to 10). For objective assessment, a panel of three plastic surgeons (blinded to the study) was assembled and were asked to rate the

results for a general level of improvement (scored from 0 to 10), as well as improvement for specific areas (i.e. temple, eyelid, malar region, tear trough, cheek, nasolabial fold, lips, mandible, marionette fold, and chin; also scored from 0 to 10) after review of the photographs taken before and six months after the procedure. The scoring by the panel was conducted based on the same factors as the patients with two changes: scoring for deformity was changed (none=0, some=1, gross=2), and the pain was not included as the panel could not assess it.

Statistical Package for Social Sciences (SPSS) version 23.0 was used for the data analysis. Mean and SD were calculated for quantitative variables like age and points scored on the various aspects of the questionnaire. Qualitative variables like gender, patient satisfaction, and subjective appearance were recorded in frequency and percentage. The chi-square test was applied for qualitative variables. An independent sample T-test was applied for quantitative variables. The *p*-value of ≤0.05 was considered significant.

RESULTS

A total of 64 patients were included in this study and were divided into two groups of 32 patients each. The patients included 56 females (87.5%) and 8 males (12.5%). The mean age of patients was 46.36 ± 4.51 years (range 40-55 years). In Group-A, the mean age was 46.78 ± 4.89 years, while in Group-B, the mean age was 45.94 ± 4.12 years (*p*=0.459).

In Group-A, 23 (71.9%), 3 (9.4%), and 6 (18.7%) patients were happy, satisfied, and unhappy with the overall results of their procedure at six months, while in Group-B, these figures were 25 (78.1%), 3 (9.4%), and 4 (12.5%). The comparison of the general patient satisfaction between the two groups was statistically insignificant (*p*=0.785). After the procedure, patients' evaluation of their general appearance showed a mean score of 6.53 ± 2.46 points in Group-A, while Group-B scored their procedure with a mean value of 6.72 ± 2.19 points. The *p*-value for comparison for both groups was statistically insignificant (*p*=0.749, see Table-I).

Figure illustrated the notable irregularities noted in both groups, and there was no statistical difference between the two groups in this regard (*p*=0.646). The remaining parameters assessed by the patients themselves are shown in Table-I, the differences in none of which attained statistical significance.

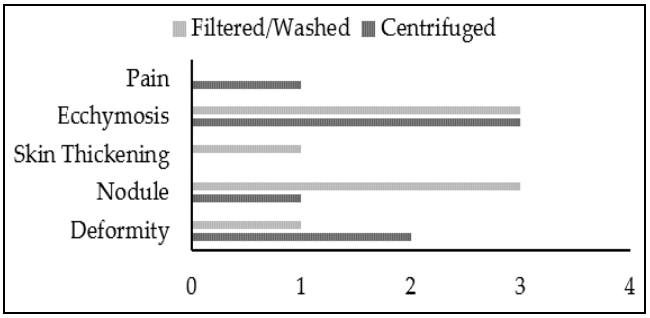

Figure: Notable irregularities.

Table-I: Summary of results: patients' evaluation.

	Group A (n=32)	Group B (n=32)	*p*-value
Gender (M:F)	3 (9.4%): 29 (90.6%)	5 (15.6%) 27 (84.4%)	0.450
Age (Years)	46.95 ± 4.89	45.94 ± 4.12	0.459
General Satisfaction Score (Out of 10)	6.53 ± 2.46	6.72 ± 2.19	0.749
Patient Satisfaction			
Good	23 (71.9%)	25 (78.1%)	0.785
Satisfactory	3 (9.4%)	3 (9.4%)	
Bad	6 (18.7%)	4 (12.5%)	
Facial Asymmetry			
None	29 (90.6%)	27 (84.4%)	0.545
Some	3 (9.4%)	4 (12.5%)	
Gross	0 (0%)	1 (3.1%)	
Skin Texture Improvement			
High	26 (81.3%)	26 (81.2%)	0.801
Low	5 (15.6%)	4 (12.5%)	
None	1 (3.1%)	2 (6.3%)	

Scoring for a general appearance by a panel of experts showed a mean score of 6.72 ± 2.16 in Group A and a mean score of 7.13 ± 1.81 in Group-B; this difference was not statistically significant (*p*=0.418). The scoring of each region of the face by the expert panel is shown in Table-II. Again, none of the differences in both groups reached significance.

Table-II: Summary of results: expert panel's evaluation.

	Group A (n=32)	Group B (n=32)	*p*-value
General Satisfaction Score	6.72 ± 2.16	7.13 ± 1.81	0.418
Temporal Region	7.09 ± 2.33	6.71 ± 2.36	0.525
Eyelids Region	7.19 ± 2.25	7.16 ± 1.95	0.953
Malar Region	6.72 ± 1.92	7.03 ± 2.24	0.551
Tear Trough Region	6.86 ± 2.18	7.25 ± 2.06	0.483
Cheek Region	6.41 ± 2.55	6.69 ± 2.56	0.661
Nasolabial Fold Region	7.28 ± 1.67	7.31 ± 1.49	0.937
Lips Region	7.13 ± 1.79	7.16 ± 1.53	0.940
Mandible Region	7.41 ± 1.64	7.09 ± 1.92	0.487
Marionette Fold Region	7.22 ± 1.54	7.09 ± 1.39	0.735
Chin Region	7.56 ± 1.21	7.50 ± 1.41	0.850

DISCUSSION

Conflict exists in the literature on whether anyone's technique is superior in the outcome. For example, studies like Wick *et al*,[10] vigorously recommend centrifugation over other techniques. In contrast, others such as Rohrich *et al*,[11] and Xue *et al*,[12] advocate against it, and still others like Sarfati *et al*,[13] propose no difference between the various processing techniques.

There was a preponderance of females in our study: 87.5% and the female to male ratio was 7:1. The mean age of the patients was 46.36 ± 4.51 years. In an analogous study, Wu *et al*, reported a population composed of 76.7% females, with a female to male ratio of 3.3:1, and had a much younger population of 22.2 ± 8.0 years.[8]

In our study, patients whose grafts underwent centrifugation had a subjective satisfaction rate of 81.3% at six months post-procedure, while in those whose grafts were filtered and washed, this figure was 87.5% (p=785). In a similar study conducted by Botti *et al*, the results were compared with 90% satisfaction in the centrifuged group, and 88% in the filtered/washed group (p=0.317).[9]

In this study, patients' evaluation of their general appearance after the procedure (out of 10) showed a mean score of 6.53 ± 2.46 points in graft centrifugation. In comparison, patients who received a filtered/ washed graft scored their procedure with a mean value of 6.72 ± 2.19 points. Botti *et al*, reported a score of 7.5 ± 1.9 in the centrifuged group and 7.6 ± 1.9 points in the filtered/washed group (p=0.867).[9] we believe that the lower scores in our study are due to cultural norms, as the difference between both groups in either study is not significant. The same could be said of scoring for a general appearance by a panel of experts, which showed a mean score of 6.72 ± 2.16 in the centrifuged group. There was a mean score of 7.13 ± 1.81 in the filtered and washed group in our study, while it was 7.7 ± 0.6 and 8.0 ± 1.0, respectively, in the study conducted by Botti *et al*,[9] Both our study and Botti *et al*, agreed that there was no difference between the two preparation techniques. Asilian *et al*,[14] also concluded that there was no difference between the two methods when it came to patient satisfaction; 87.5% and 94% for centrifuged grafts and filtered/washed grafts (p= 0.468), respectively, a conclusion that was shared by the systematic review conducted by Wang *et al*.[15]

Conversely, Fulton *et al*, actively proposed centrifugation as a safe and effective means for preparing the fat graft and reported very good results with the process but did not compare it to any other processing technique.[16] El Sayed *et al*, stated that traumatic injury to blood vessels during graft harvesting results in extravasation of blood cells into the graft, which may induce an inflammatory reaction at the recipient site; such blood components may not be removed by filtration, and the centrifugation process was thus proposed as the go-to fat graft processing technique.[17]

Wu *et al*, used 3D reconstruction and volumetric data to assess the results of their study. They concluded that filtration and washing were statistically superior to centrifugation, which conflicted with ours (p<0.001).[8] A mechanism proposed for the increased survival rates and improved results with washing was that the procedure removed pro-inflammatory compounds present in the graft, resulting in reduced inflammation and fibrosis once it was implanted at the recipient site.[18] the author believes that centrifugation, especially at high RPMs, places stress on the cytoskeletons of the individual adipocytes, resulting in dysfunction and reduced survivability after grafting. These cells die early, resulting in the local release of pro-inflammatory compounds, cancelling out the benefits of centrifugation. These effects possibly account for the difference between the results of our study and those referenced above.

In 2010, Xie *et al*, conducted a study to measure the viability of fat cells in harvested grafts after centrifugation. This was an in-vitro study, and the grafts were subjected to different centrifugation speeds, i.e., between 1000 and 4000 rpm. They were compared to a control group which did not receive any centrifugation. This study demonstrated that higher centrifugation speeds resulted in higher damage to fat cells, decreased glucose uptake, and decreased graft viability.[19] Conde *et al*, compared fat grafts prepared by centrifugation and sedimentation histologically and found that the adipose layer obtained post-centrifugation for grafting showed distortion in most of the cells, with minimal presence of stem cells when compared to grafts that were sedimented.[20]

Autologous fat grafting is a safe and effective procedure. It has a long history of application. However, there is much debate about the technicalities involved, such as the ideal donor site, processing, and application techniques. Different centres have developed their standard operating procedures, citing varying bodies of evidence to support their practice.

However, the research community is still conflicted as to the best practice. Our study was mainly composed of female patients and followed results in the mid-term only. Further research is required on the topic with a larger, more diverse sample, along with a better, objective method of evaluating the outcomes (such as 3D graft volume measurement that is not based on ionizing radiation) to determine long term graft retention, graft volumes, and complications associated with the different techniques for fat graft processing.

CONCLUSION

There is no difference between processing the fat graft via centrifugation or the combination of filtering/washing in terms of the outcome as measured by patient satisfaction and peer review. Therefore, both techniques can be equally employed with on-par results.

Conflict of Interest: None.

Author's Contribution

TS:, RA:, AA: Data collection, SH: Supervision, RSA:, WUDB: Manuscript.

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