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Original Research Article

An intervention study of autologous fat transfer for scar tissue rejuvenation in the setup

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ABSTRACT

Background: There are lot of work going on AFT procedures. This procedure has been taken recent advances nowadays and very helpful in many conditions to rejuvenate and restoration of damaged tissues. The use of autologous fat for soft tissue augmentation seems attractive because of its relatively ubiquitous availability. Autologous fat transfer is a technique shown to be beneficial as a reconstructive procedure for patients with volume loss of tissue due to disease, trauma, and congenital defects.
Methods: In the present study, 20 patients were taken as sample size. It is an intervention study. Whole procedure has been taken as day case which included local anaesthesia and patient received all the standard monitoring, medications, safety precautions and care that is provided for any patient undergoing any surgery, including antibiotics, pain medicine and other supportive care as needed. The Autologous fat was harvested by surgeon via syringe aspiration technique with a long atraumatic cannula. After processing, the material was injected immediately under designated skin grafts/scars using a small needle. Scar was cleansed with normal saline and dry dressing is applied for a day. Then patient was discharged on the same day.
Results: Results obtained were efficacious with 60 to 80% improvement in all parameters in 15-20 days after the procedure.
Conclusions: AFT procedure was found feasible, efficacious and accepted in patients with scar. It brings scar tissue rejuvenation up to great extent.

Keywords: Autologous fat transfer, Regeneration, Stems cells, Scar tissue

INTRODUCTION

The autologous fat transplantation / transfer (AFT) have been performed since the 1890s and in the last 20 years the interest on this technique is enormously increased.[1,2]

Autologous fat transfer is a technique shown to be beneficial as a reconstructive procedure for patients with volume loss of tissue due to disease, trauma, and congenital defects.[3] Autologous fat transfer has two advantages.

- It is minimally invasive with low associated morbidity because it is autologous and non-carcinogenic and lacks an immune host response.
- Readily available donor source and minimally detectable scarring at the donor site. In case of isolated skin grafting, the quality of dermal reconstruction and its adjacent hypodermis is often neglected.[4] People with scar suffer from pain, discomfort and inability to perform regular activities, especially when there is hard and contracted scar.

AFT can act as "regenerative medicine" as it leads to improved function as well as appearance and associated

with improved motion in areas where movement is limited because of tightening and stiffening of contracted scar. AFT can be used as regenerative medicine as therapeutic approach to patients with old scars due to not only burns but with surgical scar, ulcer scar, radiation therapy and scar which can't be dealt with other treatments.

The discovery of stem cells in fat tissue has given a new direction to the use of fat as a therapeutic treatment for the patient condition, fat has not only a filling effect but also a regenerative effect by improving the quality of the skin that undergoes fat transplantation.[5-7] Due to regenerative stem cell effect of fat, author consider AFT as scar remodelling but with that feasibility, efficacy and acceptance of fat transfer is of same importance.

Aim of this study was to analyze the feasibility of a new surgical approach combining split-thickness skin grafting, with dermal reconstruction and autologous fat-transfer. The objective of this study is to evaluate result of fat transplant in scarred area in context of texture, flexibility and softening of skin appearance, motion/mobility in skin grafted areas. The purpose of this study is also to find out feasibility, efficacy and acceptance of AFT procedure in the setup.

METHODS

The type of study was intervention study of texture, flexibility and softening of skin appearance, motion/mobility in skin grafted areas.

Design of study was comparison between pre and post AFT procedure results on skin grafted area. Intervention study was done using AFT procedure.

Patients will receive AFT in already received skin grafting resulting in scar.

All the patients who will have skin grafting resulting in scar on different injuries and fulfilling the inclusion criteria will be included in the study of early AFT group during 2 months of research period and similar number of patients will be included in delayed AFT group. Duration of the study was 4 months from the date of starting the study including both pre and post intervention study.

Inclusion criteria

- At least one previous wound healed by skin grafting and resulting in scar.
- Study site were anywhere on the body with maximum up to 10cm in size.
- Adequate adipose depot for tissue harvesting.

Exclusion criteria

- Sepsis
- Life/Limb threatening injury/disease
- Pregnancy
- Below 18 years or above 70 years
- History of any blood related disease
- Prior history of non-compliance
- Active drug use/abuse
- Life threatening allergic disorder to one of the agent or medication used in present study
- Scars more than 10cm in size (area).
- Active cancer or new diagnosis of cancer within past 5 years
- Active psychiatric illness
- Use of steroid injections, pressure garments, silicon sheets and similar scar management modalities and cannot be discontinued during study participation.
- Incarceration

Subgroups

- Early AFT subgroup- population which possess scar, medically stable such that study sites are amenable to AFT within 3 months of definitive closure.
- Delayed AFT subgroup- population which possess scar, medically stable such that study sites are amenable to AFT between 3-8 months after definitive closure.

In the study age range 18 to 70 years of both the genders were eligible. If female used, she must have negative pregnancy test, able and willing to provide informed consent.

Before beginning of study treatment, a complete physical examination was done. Patient is asked about current medication, if he has any recent infection or any other problem. Complete a questionnaire about the appearance of scars and how well they have healed. If scars extend over a joint such as the elbow or a finger knuckles, patient will be tested to see how well patient can move or bend the joint before and after the study treatment.

Screening test before AFT was done like X-ray chest, ECG, CBC and RBS, depending on age, recent surgical or medical history.

Procedure

Whole procedure was taken as day case. It included local anaesthesia and patient received all the standard monitoring, medications, safety precautions and care that is provided for any patient undergoing any surgery, including antibiotics, pain medicine and other supportive care as needed.

Fat grafting

Harvest

Fat grafts were harvested by syringe aspiration using a 20-gauge needle. The needle was moved through the

adipose compartment mechanically, loosening the fat tissue and drawing it into the syringe.

Processing

The fat was transferred to 10ml tubes for centrifugation. Fat grafts were centrifuged at 1000-3000rpm for 3 minutes. Top supernatant and bottom blood cells and debris were removed. Fat was transferred to 10cc syringes with blunt tip cannula.

Implantation

Small aliquots of fat were transferred with multiple passes at different depths. Fat aspirate was injected over scar area with multiple passes with 20-gauge needle. Implantation was done in maximum up to 10cm area despite of larger scar.

Scar was cleansed with normal saline and dressing was applied for a day. Then patient was discharged on the same day with advice of taking medicines which were prescribed and keeping the area dry.

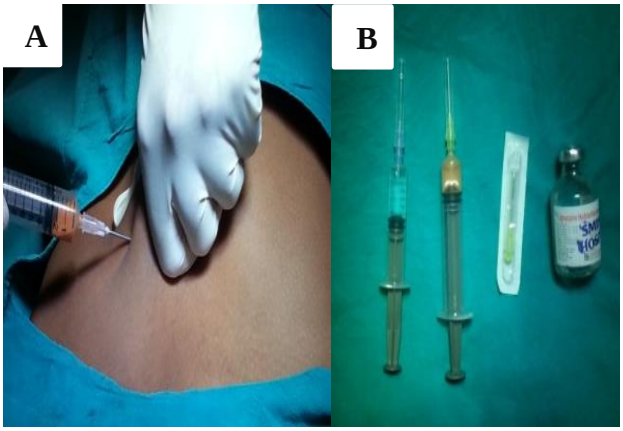

Figure 1: (A) Process of fat harvesting; (B) Local anaesthesia lignocaine in 5cc syringe, fat aspiration in 10cc syringe, 20-gauge needle, lignocaine.

Follow up assessment

Patients were followed up on next day, 1 week, 2 week, 4 weeks and 8 weeks after the AFT procedure.

Data collection and analysis

Results of fat-grafting procedures typically were assessed by observation, examination with palpation and questionnaire interview. In present study author took STG patients from last ten months divided into two subgroups; early AFT and late AFT groups. 10 patients were included in early AFT group as their STG was done within 3 months when author intervened, and 10 patients were included in late AFT group as their STG was done between 3 months to 8 months. Author interviewed these all 20 patients and called them up for follow up on frequent basis as mentioned above. And on follow up author collected data as;

Data collection

Data was collected by using variables methods like:

1. Interview- Scar assessment: with questionnaire.
2. Clinical examination- Active range of motion assessment and pain analysis.
3. Appearance- using photographs.

Statistical analysis

Plan analysis-outcome measures were based on visual analogue score (VAS) and to compare and analyze collected data following statistical tools were used by help of SPSS software, author applied non- parametric, Wilcoxon signed Rank test by SPSS 16.

Confidentiality of patients was taken care of and the patient's details were kept confidential. Informed Consent form was obtained from patients before the procedure.

RESULTS

The objective of this study was to evaluate result of fat transplant in scarred area in context of texture, flexibility and softening of skin appearance, motion/mobility in skin grafted areas. Following figure depicts the improvement obtained before AFT and after AFT.

Figure 2: (A) Before AFT; (B) after AFT.

Before AFT and After AFT

Before AFT texture is rough and hard scar and dark pigmented area with adherent scar over underlying tissue.

After AFT texture is improved to smooth and soft scar and light pigmented area and resolved adherence.

Texture/ consistency of scar

In the present study, out of 20 patients 19 patients had hard texture of skin and 1 patient had firm consistency. Improvement in texture towards softness comes in 13 patients and texture of 7 patients did not improve. 65% improvement is seen in present study.

If author inject AFT in 100 patients improvement will be in minimum 40.78% patients and maximum up to 84.61% patients. Range of Improvement minimum to maximum is 95%. According to Wilcoxon signed rank test of texture P value 0.002 which is significantly shows that AFT is effective to improve texture of skin. The previous research has showed that improvement in texture of skin with matrix formation is quite good with good take rate of patient of AFT in split thickness graft of burns patients.[10,11]

Mobility of scar over underlying tissue

In the present study, out of 20 patients 17 patients had discomfort due to scar because of adherent scar with underlying tissue. 3 patients were with mobile scars. Out of 17 patients adherence of scar of 2 patients did not improve. Adherence of scar was resolved in 15 patients.

An 88.28% improvement is seen in the present study. If author inject AFT in 100 patients improvement will be in minimum 63.56% patients and maximum up to 98.54% patients. Range of improvement minimum to maximum is 95%. According to Wilcoxon signed rank test of texture P value <0.001 which is significantly shows that AFT is effective to improve mobility of scar, reduce discomfort due to scar and resolve adherence of scar. In previous research, AFT were able to immediately resolve adherence of the scar directly against the muscle without need or use of complete scar succession. Manual palpation post-operative days 1 through 5 and weeks 2 through 4 did not reveal any subcutaneous fremitus or hypermobility of scar.[12]

Pain over scar and joint involved

In the present study, out of 20 patients 10 patients had pain over scar and joint involved due to scar. Out of 10 patients pain was reduced in 7 patients. There was no improvement in pain in 3 patients. Seventy percentage improvement is seen in the present study.

If author inject AFT in 100 patients improvement will be in minimum 34.75% patients and maximum up to 93.33% patients. Range of Improvement minimum to maximum is 95%. According to Wilcoxon signed rank test of texture P value 0.008 which is significantly shows that AFT is effective to reduce pain over scar area. In previous research, AFT were effective to reduce pain associated with split thickness graft. The results are noticeably good when the joints were involved. Especially in burns patients when there is hard keloid scar, pain in joint movement occurs due to stretching of STG over wound.[13]

Mobility of joint involved

In the present study, improvement in joint mobility is noticeable in the range of 3-5 degrees. Out of 20 patients 16 patients had restricted movements. Out of 16 patients improvement in range of movement occurred in 11 patients. 68.75% improvement is seen in present study.

If author inject AFT in 100 patients improvement will be in minimum 41.34% patients and maximum up to 88.98% patients. Range of Improvement minimum to maximum is 95%. There is very little improvement in range of motion as in present study there is only 10ml of fat is transferred and to 10cm area. Because of single step injection and little amount implantation there is less improvement in degree of range of motion. For wide range of movement, to mobilize joint to a greater extent there is a need of great amount of aspiration which can be obtained by liposuction. But as present study is simplified with only injection harvesting only small amount of fat can be harvested and implanted.

Colour of scar

In the present study, out of 20 patients 12 patients showed improvement in colour and appearance of scar towards natural skin. There was no improvement in pain in 8 patients. 60% improvement is seen in present study. If author inject AFT in 100 patients improvement will be in minimum 36.05% patients and maximum up to 80.88% patients. Range of improvement minimum to maximum is 95%. According to Wilcoxon signed rank test of texture P value 0.001 which is significantly shows that AFT is effective to show improvement in appearance of scar. In previous studies, the colour and appearance of scar has improved with the patients of acne scars, burns scars, ulcer debridement and STG, etc. Especially there is up to 70% improvement in appearance of scar of ulcer after STG in lower limbs.[14]

Thickness of scar

Previous research has showed that fat grafting has a tissue regenerative effect when applied to the skin, resulting in thickening of the dermis, the presence of newly formed collagen, and an increase in local vascularity. Results are quite good up to 60 to 80% in the studies. Thickness in facial fat graft is improved very well with AFT. Thickness has increased in burn patients scar as well as breast reconstruction. This effect could be due to several hypotheses described in the literature.[15]

- The grafted fat tissue induces neoangiogenesis and collagen synthesis via the effect of adipokines secreted by the injected mature Adipocytes as well as other growth factors. This results in an increased density of the extracellular matrix.

- The production of matricriptines results from destruction of collagen fibers contained in the injected tissue. These are powerful inducers of collagen fibers.
- The synthesis of extracellular matrix and collagen fibers could be influenced by the preadipocytes, precursors of Adipocytes that multiply easily.
- Stem cells transform to fibroblasts that secrete neoformation collagen.[3,16-18]

In the present study, out of 20 patients in 7 patients thickness were increased and in 13 patients there were no improvement. Only 35% improvement is seen. As for bringing improvement in thickness there is a need of large amount of fat aspirate and repeated implantation over period of time. In this preliminary and simplified study single implantation and small amount of aspirate justifies the results.

If author inject AFT in 100 patients improvement will be in minimum 19.12% patients and maximum up to 63.59% patients. Range of Improvement minimum to maximum is 95%. According to Wilcoxon signed rank test of texture P value 0.004 which is significantly shows that AFT is effective to show increase in thickness of a scar.

Complications

Fat grafting may be associated with complications. Common side effects include swelling, redness, and loss of volume to some extent, tingling, and moderate bruising. Less common complications include hematoma, cellulitis responsive to antibiotics, fibrosis, oil cysts, and calcification.[19]

Results are potentially good. After the procedure there were no signs of ulceration or discharge. There was subjective softness over the scar area where AFT was done in almost around 10*10 areas in all of them. In 16 patients joint was involved and range of movement at that joint level were little improved as these are preliminary results. Pain was reduced in 70% patients. There were signs of inflammation after procedure in two patients which were treated by antibiotics. No complications come along after procedure and in follow ups in any patients.

Table 1: Visual analogue score chart for well-being of patient.

		Mean	SD	Median(IQR)	P-value
Physical well-being 0-10	Before AFT	6.10	2.05	7(5-8)	P<0.001
	After AFT	8.15	1.87	9(7.25-9)	
Physical quality of scar 0-10	Before AFT	4.05	1.43	4(4-5)	P<0.001
	After AFT	6.50	1.31	7(7-7)	
Social/family well-being 0-10	Before AFT	5.45	0.944	5(5-6)	P<0.001
	After AFT	7.75	0.966	8(7.25-8)	
Relation with doctor 0-10	Before AFT	8.30	1.34	9(8-9)	P<0.001
	After AFT	9.40	0.99	10(9-10)	
Emotional well-being 0-10	Before AFT	6.45	1.36	7(6-7)	P<0.001
	After AFT	8.05	1.50	8.5(8-9)	
Functional well-being 0-10	Before AFT	4.85	1.63	5(3.25-6)	P<0.001
	After AFT	7.05	1.64	7(6-8.75)	

The purpose of this study was also to find out feasibility, efficacy and acceptance of AFT procedure in the setup. This procedure is feasible in the setup as author could do procedure in all the patients. Efficacy of this procedure is discussed above and acceptance of this procedure in patients can be evaluated by VAS score of well-being which shows condition of patient before and after AFT procedure.

DISCUSSION

Survival of AFT depends on the health of the transplant as well as the suitability of the recipient area to which it is transferred. AFT's durability improves when it is delicately handled and moved to a vascular recipient site. For successful fat transfer the presence of well vascularized tissue is mandatory. Distribution of small particles of fat in the respective region of interest is required to enable the cells to connect to the local blood supply. The previous research showed a regenerative effect with fat transplant that included an increased thickness of the dermis, collagen neo-formation and the presence of increased vascularity in local skin subjected to treatment, resulting in better skin quality. The transplanted fat not only adjust facial and body proportions but also improves surrounding tissues into which the fat is placed. AFT can replace the use of dermal grafts, local flaps, free tissue transfer, alloplastic implants and injectable fillers. Adipocytes represent a heterogeneous population of cells with differences based on the method of extraction and the site of harvest. Age and sex also can greatly influence the behaviour of the Adipocytes.[8,9]

Treatment goals and strategies vary, depending on the patient's injury, stage of treatment, age, and co

morbidities. Goals range from minimizing loss of range of motion (ROM) in the critically ill patient to establishing a work-hardening program in recovered patients.

Three broad aspects are involved in this effort-rehabilitation, reconstruction, and reintegration. An ideal substance would be readily available, inexpensive, long-lasting, natural-feeling, and would not cause adverse immunologic reactions. Autologous tissue meets these requirements. Fat tissue is soft and feels natural. It can be introduced to correct various deficiencies, it is not immunogenic, and it is readily available and inexpensive.

This procedure can be performed on an outpatient basis with local anaesthesia. The preoperative consultation is crucial. By far, the most important part of the preoperative workup is an extensive discussion identifying areas to be treated. In addition, details of the procedure, postoperative care, expectations, and possible adverse outcomes should be discussed.

Since description on Autologous Fat Transfer by Van der Meulen and then by Neuber, lipofilling has evolved significantly, especially since the introduction of liposuction by Illouz, which made the collection of fat injected much simpler.[20] In the beginning, the goal was to fill deformities, either congenital or acquired, such as scars, Parry Romberg syndrome, facial hemi atrophy, human immunodeficiency virus (HIV) lipo-dystrophy, and the like.[21,22] Then it was used for cosmetic surgery, initially facial and gluteal contours.[6,21-24] Currently, its use for breast surgery, both reconstructive and aesthetic, is in vogue.[25] At the beginning, several critics of this technique focused on the high percentage of fat absorption, but later, several authors improved the fat preparation technique, the injection procedure, and the plane used to place the fat graft.[26,27] All these advantages have positioned fat as an almost ideal filler because it is autologous, biocompatible, available in sufficient quantities in most patients, integrated naturally by injection, capable of removal if necessary, and potentially permanent.[28] Although the volumetric effect was the initial reason for the use of fat grafting, several authors have described their findings of an improvement in skin quality after the use of this technique.[29] These observations have gained more validity since the discovery of mesenchymal stem cells inside the injected tissue, which gives a regenerative effect (of the fat-grafting technique applied) to the area. These cells can differentiate into different cell types and have an unlimited proliferative capacity. The adipose stem cells provide numerous benefits including stimulation of angiogenesis as well as enhancement and maintenance of the graft's vascularity over time.[30] Lately, several publications have empirically shown the regenerative features of the fat-grafted tissue (e.g., for radio-dermatitis secondary to radiotherapy; for burns, both acute and sequels; and for chronic lower-extremity ulcers).[31,32] In this regard, Mojallal et al published the only available experimental study (in rats) found in the literature to that date.[33] Their study shows dermal histologic changes after fat grafting including increase of injected dermis thickness, increase of collagen fibers, and local neo-vascularization. These authors also were able to show that increasing dermal thickness was not due to the mechanical effect of the cannula (they included a comparison group that did not change with use of the cannula alone) but rather due to the direct effect of the grafted fat. The results of present study determined that the thickness of the treated skin was greater than that of the untreated skin.

CONCLUSION

The clinical views show a very promising outcome, especially where skin texture and elasticity are concerned. The study, however, has been limited to a very small patient population. Furthermore, the time given to consolidate the results of the procedure seems premature. Studies conducted to evaluate the fate of transplanted fat grafts often have had a duration of 15 months to 8 years. In contrast, the results shown in this report represent only about a 4 months period. Therefore, it may be agreed upon that these can be called only preliminary results.

From above study, author demonstrated that AFT procedure is quite efficacious in context of texture, flexibility, mobility, appearance, thickness of scar and mobility of joint involved. It is of small duration preliminary study with small amount of fat aspirate with single implantation. Author have simplified this study with the use of 20-gauge needle rather than using atraumatic cannula and the cost of the procedure is minimum with minimal associated complications. More improvement on larger scale can be achieved if multiple implantations take place. It is with minimal complication which may be treated with antibiotics and pain killers. This study is feasible, efficacious and accepted in the set up to great extent.

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