Uses of Fat Injection in Ophthalmo-Plastic: The Experience at the Regional Hospital Adolfo Lopez Mateos I.S.S.S.T.E. Mexico City

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Abstract
The fat injection is a simple, inexpensive and reproducible technique, which allows ophthalmo-plastic surgeons to obtain a biologically active substance for use as a filler and regeneration material, for the sculpted facial, with the potential to correct various pathologies, among which we can highlight: Fat atrophy secondary to trauma and scarring, and fat atrophy related to age. We present 8 clinical cases of patients treated with autologous fat for this two indications: atrophic scars and cosmetic use.

Conclusions: Autologous fat grafting is a technique that has the ability to provide all the volume needed for modeling of facial injuries and treatment with long-term success.

Keywords: Fat grafting; Atrophic scar; Sculpted facial; Fat atrophy; Lipofilling

Introduction
There is a wide range of pathologies that cause contour and facial symmetry alteration, which have led surgeons with different specialties to search for fillers materials with therapeutic and reconstructive means, without finding the ideal material with the required reproducibility and results duration. The fat graft, lipofilling, lipo-injection as referred by some authors [1,2], is a technique used globally for facial and body sculpting in reconstructive, regenerative, rejuvenating and cosmetic treatments [3-7]. The first fat graft report is from 1893, made by the German surgeon Gustav Neuber who used fat from the arm to treat scars and adhesions in the inferior orbital border, displaying acceptable results [1,8]. Great progress has been made regarding the technique’s design with the objective of improving the transplanted fatty tissue survival, with no current consensus. In the present work, some results applying fat graft technique to correct facial volume defects are shown.

Materials and Methods
Clinical data from 8 patients (1 Male and 7 Females, older than 10 years); that received fat graft treatment between October 2010 and October 2013 at the oculoplastic department at the regional hospital Lic. Adolfo López Mateos (I.S.S.S.T.E.) is reviewed. Patients were divided in one of two categories: a) cosmetic facial filling due to age related fatty atrophy; and b) facial filling to remodel facial volume and contour defects caused by fibrosis and atrophic scaring due to facial trauma or soft tissue disease. The applied technique to obtain the fat graft was: mesogastric asepsis and antisepsis, left and right flank, the abdominal region for tissue sampling as well as the incision sites are marked with skin marker pen, the incision sites are infiltrated with lydocaine:epinephrine (20 mg/0.005 mg); skin is incised with a no. 11 scalpel, up to subcutaneous tissue, 30 cc of anesthesia dissolution are infiltrated in each flank, anesthesia dissolution was prepared by diluting 7 ml of lydocaine: epinephrine (20 mg/0.005 mg) in 100 ml physiologic solution.

We precede to the fat tissue aspiration, using a 15 cm long Coleman Rome Style I cannula, connected to a 20 ml sterile syringe, until obtaining the fat tissue needed for each particular case.

The content in the syringe is decanted about 15 min to separate the fat tissue from the hematic remains and serum. We expel the blood formed in the lower level of the syringe and with a sterile gauze pad we absorb the serum formed in the upper level. A female-female connector is used to take to a 1 ml syringe the fat graft, which we connect to the Coleman Rome style I cannula that is the one we use to inject in the donador site.

The fat graft technic has small variations according to the reception site:
A. As a cosmetic filling: asepsis and antisepsis is made in the region to be treated and blocking the supraorbital, infraorbital or mentonian nerve of the corresponding region; with a 20g yellow needle, cutaneous incisions are made reaching the subcutaneous level, injecting enough volume to clinically appreciate the erasing of the folds and wrinkles treated with a Coleman rome style I cannula.
B. For the facial sculpture, in secondary to the loss of substance because of fibrosis and scaring, volume and outline defects: Following the asepsis and antisepsis of the region, local anesthesia is applied by blocking the supraorbital, infraorbital or mentonian nerve of the corresponding region, a 7mm cutaneous incision is made to permit the entry of the freer elevator which will let us release the scar from its flanges to deep level. Once the skin is released, the fat tissue is collocated through rome cannules in enough quantity to do a 30 to 40% clinical overcorrection. The procedure ends by closing the cutaneous incision with 6-0 nylon.

Results
The first case is a 54 years old female patient without any significant pathological history, who, in 2011, went through a superior blepharoplasty in both eyes, with 20/30 of visual acuity in both eyes (Figure 1A). The fat graft was made with cosmetic means in April 2013, restoring the glabella volume, inferior palpebral wrinkle and the nasolabial folds, injecting 1.5 ml in each region, observing the wrinkle erasing. The results remained stable during the 6 months of follow-up (Figure 1B). No adverse effects or complications were reported.

The second case is a 58 years old female patient without any significant pathological history, who, in August 2013, went through a bilateral aponeurosis reinsertion, with a visual acuity of 20/40 for the right eye and 20/50 for the left eye (Figure 2A). The fat tissue graft was proposed in the glabella and nasolabial folds and in September 2 ml of graft was applied in each region. Three months after the restitute volume remained without any alteration (Figure 2B). No adverse effects or complications were reported.

**Figure 1**: Woman of 54 years, who receives lipoinjerto with cosmetic indication. A) Pre-surgical, B) 6 months after grafting.

The third case is a 47 years old female patient, without any significant pathological history, with 20/25 of visual acuity for both eyes (Figure 3A). Cosmetic fat graft was applied in April 2013, 1.5 ml in glabella and nasolabial folds, and 2 ml in the premolar y nasoyugal regions. The observed results remain without any significant clinical change in 6 months follow-up (Figure 3B). No adverse effects or complications were reported.

The forth case is a 58 years old female patient, without any significant pathological history, with a visual acuity of 20/40 in the right eye and 20/30 in the left eye (Figure 4A). Cosmetic fat graft was applied in May 2013, 1.5 ml in inferior palpebral wrinkles and marionette lines, and 2 ml in glabella and nasolabial folds. The fifth day post surgery the patient presented with hiperthermia, erithema and pain when touching the abdominal region where the graft was taken from, and a discrete erithema and ecchymosis in the left nasolabial fold and marionette line (Figure 4B).

**Figure 2:** Female of 58 years, who receives lipoinjerto with cosmetic indication.
A) Pre-surgical, B) 3 months after grafting.

**Figure 3:** Female of 47 years, who receives lipoinjerto with cosmetic indication.
A) Pre-surgical, B) 6 months after grafting.
Oral fluoroquinolon was prescribed for 10 days due to cellulitis suspicion. The patient progressed favorably, presenting a moderated graft volume loss, never the less the results that persisted three months afterwards were satisfactory and the graft was not repeated.

The fifth case is a 53 years old female patient, without any significant pathological history, with 20/25 of visual acuity for both eyes (Figure 5A). Cosmetic fat graft was applied in June 2013, 1.5 ml in glabella fold and inferior palpebral wrinkle, and 2 ml in the nasolabial folds, obtaining an important correction in both eyes glabella and inferior palpebral fold, and a discrete restituted volume reabsorption in the nasolabial folds; the image shown corresponds to 5 months after graft (Figure 5B). There were no complications reported, the sixth case is a 48 years old male patient, who had a scar in the left frontal region consequence of a childhood cranioencephalic trauma. Left eye with pseudophakic bullous keratopathy. With 20/40 of visual acuity in the right eye which improved to 20/30 and left eye was hand motion (Figure 6A). The first graft was applied on May 20th 2013, releasing the skin from the scaring flanges that attached it to the periosteum and restituting the volume with about 30% of clinical overcorrection. A month postsurgically, a second procedure was performed due to after observing an important fat tissue reabsorption, having the results seen in the image 6B, which were maintained for 4 months.

**Figure 4:** Female of 58 years, who receives lipoinjerto with cosmetic indication.
A) Pre-surgical, B) to the 5th postoperative day when Complications occurred.

**Figure 5:** Female of 53 years, who receives lipoinjerto with cosmetic indication.
A) Pre-surgical, B) 5 months after grafting.
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In case no 7 we see a 48 years old female patient, with a history of a cranioencephalic trauma 11 years ago, that required the placement of titanium plaques to correct the skull fracture and orbit floor (Figure 7A). In February 2013 the fat graft was applied in the frontal region and the left temporal cavity. However, there was an important fat tissue reabsorption, two more procedures were performed to fully correct the appearance, in June and in August 2013, until a satisfactory volume correction was observed in the treated regions. The surgery plan was complemented with the left superior eye lid aponeurosis re insertion in October 2013, accomplishing the final result shown in the image 7B. There were no further complications.

In case no 8 we find a 14 years old female patient, without any significant pathological history. Patient reported to have contracted chicken pox in October 2010, resulting in a right superior eye lid necrotizing fasciitis with extension in direction to the eyebrow and the right temporal cavity, and right preseptal cellulitis. The reconstruction of the right superior eyelid with complete thickness cutaneous graft was applied in December 2010 (Figure 8A). The fat graft was applied three times: in March 9th 2012, May 21st 2012 and April 3rd 2013, in various amounts, searching for a 140% clinical overcorrection in each session, presenting in the first two occasions a considerable graft tissue reabsorption. Six months post surgical interventions, the third graft could be observed in the image 8B. There were no further complications.

Discussion

There are various classifications for the soft tissue fillers. One of them is based on its duration: temporal fillers including hyaluronic acid, collagen, polylactic acid and the autogenous plasma and permanent fillers such as silicon, PMMA, hydroxyapatite and the autogenous fat.

The ideal injectable filler should last permanently without resulting in any complication, should be removed, in a safe and easy way, as it is biocompatible, has no immunogenic reactions, is not pyrogenic, not infectious and not carcinogenic, it should also be economic. This ideal filler is yet to be found.

Ever since the first reported fat graft performed in 1893, fat graft has evolved significantly. The most noted advances appear in the 1990 decade, when Dr “Sydney” R. Coleman indicates the use of a 17G rome cannule and a 10 cc syringe to obtain fat using low vacuum, and the centrifugation of the obtained material to increase the adipocyte availability. He also suggested the injection of little amounts in several vectors, to accomplish a maximum contact between the graft tissue and its new microenvironment with the mean of helping the vascular input1,9, being this the key to success in the graft fat survival 1 and 10, mentioned in up to 90% by the same author1. Most of the concepts remain unquestionable but one: the fat graft centrifugation.

Nowadays there is polemic between the two main graft fat tissue preparing technics: centrifugation and the decantation11,12. Several reports 13-15 note the mechanic trauma that the adipocyte goes through during the centrifugation and it is believed that this can diminish the graft’s vitality and survival in the receptor. This is why in this study we chose to prepare the tissue using decantation. Another important finding in the fat graft biology was the description of the «stem cells» present in fat tissue, published by Zuc., et al. 2002 16. Since then, several studies have confirmed that the called «mother cells derivate from fat tissue» are involved in the production of new tissue, such as bone, cartilage, blood vessels and nerves1, this is one reason why fat graft can be used in several types of scaring, such as burn scars17.

Dr. Sbarbati and Dr. Galiè described the «niche» theory for the mother cells; these authors note the importance of the roles that have the different transplanted elements can take part in the survivor of the fat draft 18. The word niche, in means of plastic and reconstructive surgery, can be extended to describe the complex relationships in an organism that allow any cell to survive, grow, differentiate, and reproduce1.

In this study the patients were divided in two groups, the first one were those with cosmetic means due to age related fat atrophy, while the second group were those with fat atrophy relating to fibrosis and scaring as consequence of different etiology, obtaining

completely different results, it should be noted that the group with cosmetic indications had more success, getting better cosmetic, with long term stability from the first application, with minimal volume reabsorption, so we can infer that the graft accomplished a successful integration and vascularization. Meanwhile every patient, in the group with atrophic scars, presented an important fat graft reabsorption, requiring up to three applications before reaching the satisfactory long term results.

We also have to highlight that many of our patients obtain a younger look, which can be attributed not only to the volume restitution, but to the improvement of the skin texture and dehydration, explained by the presence of fat tissue mother cells, such as for the growing factors present in the transplanted niche.

With Dr. Sbarbati and Dr. Galie point of view, the two groups could also be classified by using the characteristics of the receptor micro enviroment in a) healthy niche, those who had age related changes19 and b) Ill Niche, those who had a substitution of the niche for a atrophic scar secondary to a pathology. The atrophic scar is in consequence of the inflammatory response to a initial injury, which forms fibrous tissue. Trauma, infection, and old epithelial cysts are processes that can form an atrophic scar as well20.

The scar’s cutaneous nature produces a depressed scar, frequently angular with an inverted center. Although the scar shape can vary, the underlying etiology is always the same: fibrosis. There is a fibrotic injury with fibrosis extention until the dermis and the subcutaneous fat, forming a rigid or semi rigid scar20.

It has been proved the usefulness of fat graft or autogenous fat graft for the trauma induced lipoatrophy treatment, even though up to 50% of the graft can be reabsorbed1.

The most common complications found with fat graft are minor and with an easy management, between which we can mention for facial treatments: ecchimosis, edema, minor outline irregularities, infections, post inflammatory hyperpigmentation, fat reabsorption20 and fat hipertrofia21.

Even though, the autogenous fat graft as a filler material is considered safe, there have been reported cases of vascular occlusions with ocular or vascular brain affected, with important effects like necrosis, blindness, or brain stroke20.

In this study none of this vascular complication were present, never the less there was a case which suggested an infectious process which responded satisfactory to oral antibiotics. Park., et al. in the vascular occlusion reported cases consequence of a facial cosmetic filling injection, divided the arterial occlusion in 3 groups; 1) Ophthalmic arterial occlusion 2) Central retina artery occlusion and 3) retina arterial branch occlusion.

In a retrospectic review in January 2003 to January 2012, 12 patients presented arterial occlusions, 7 belong to group 1, 2 belong to group 2 and 1 to group 3. Every case presented a sudden diminished visual acuity, after a graft was applied.

With respect to the filler used, 7 cases had a fat graft (6 with ophthalmic arterial occlusion and 1 with central retina arteria), 4 cases were infected hyaluronic acid (1 with ophthalmic arteria occlusion and 3 with retina arterial branch), and 1 case was injected collagen with central retina arteria occlusion. The injection sites were: glabella region ( 7 cases, 58.3%), nasolabial wrinkle (4 cases, 33%), and both region (one case, 8.3%).

Although the visual acuity best corrected didn’t show any improvement for the different cases, other eye deficit resulting from the iatrogenic arterial occlusion, such as strabismus, ophthalmomplegia, blepharoptosis and corneal edema, did show certain improvement 22.

The cause of this complications is the accidental injection of the filling into the arteria during the procedures, which can produce anterograde or retrograde embolism in relation to the strength and speed of the filler injection.
In order to diminish the vascular occlusion frequency, several authors mention the next safety rules when doing a fat facial graft: the use of anesthetic solution combined with epinephrine to induce vessel constriction, the use of rome cannules, low pressure injections using 1ml syringe only, and of course the anatomic knowledge of the region being treated.

Conclusion
It can be concluded that the fat graft is a promising alternative for the facial volume defects correction as it is capable of providing all of required tissue and the results are maintained for 6 months in most cases. Finally we should emphasis that the autogenous fat graft technic has a short learning curve and it is easy to reproduce, it is low cost and the patient presents minimal post surgery discomfort.

Ethic responsibilities
People and animal protection. The authors declare that the procedures followed the responsible human experimentation committee ethic norms as based in the World Medical Association and the Helsinki declaration.

Data confidentiality. The authors declare that they have followed the protocols of their working center about the publication of patient’s information

Privacy right and informed consent. The authors have obtained the informed consent of the patients and/or subjects referred in the article.

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