Fat Grafting in Orthognathic Surgery

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Background: Fat grafting is widely utilized in craniofacial surgery. The authors describe a series of consecutive patients who underwent orthognathic surgery with fat grafting by the senior author and review relevant literature in the field; fat grafting technique is discussed in detail. The authors also highlight 3 patients to illustrate postoperative outcomes.

Methods: A retrospective cohort of consecutive orthognathic surgery patients was reviewed. Age, sex, BMI, procedure, area of harvest, location of injection, donor site complications, and need for repeat fat grafting were analyzed. Inclusion criteria included history of orthognathic surgery and concomitant fat grafting performed by the senior author in 2015.

Results: Fifty-three orthognathic surgery patients with concurrent fat grafting were reviewed. The cohort comprised 20 males (37.7%) and 33 females (62.3%). Thirty-three patients (62.3%) underwent Le Fort I operations either in conjunction with genioplasty and/or bilateral sagittal split osteotomies. Twenty-eight patients (52.8%) underwent second operations involving additional fat grafting. The majority of these patients (15/28, 53.6%) received additional fat grafting during ensuing rhinoplasty. There were no donor site complications (ie, infection, wound breakdown) recorded in the authors' patient cohort. Amount of fat injected averaged 13.1 cc (range 5–25 cc). Follow-up generally occurred through the 1-year mark.

Conclusions: Fat grafting is a proven technique to facilitate optimal postoperative wound-healing in orthognathic surgery. The senior author uses Telfa processing and the Coleman system to deliver the fat atraumatically. The authors' cohort of consecutive patients corroborates the benefits of fat grafting in craniofacial surgery; the authors observe wound-healing benefits, enhanced aesthetic outcomes and an anti-inflammatory effect with this technique.

Key Words: Fat grafting, orthognathic surgery, outcomes

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Fat grafting is a powerful tool in plastic surgery. The evolution of this technique is fascinating and has been described extensively.[1] At present, the broad procedural practice standards are derived from the work of Coleman.[1–5] The so-called lipostructure method involves harvesting fat using a 3-mm blunt cannula with a 10 mL syringe at low negative pressure to minimize adipocyte trauma; Coleman advocates for low RPM centrifugation which allows for atraumatic separation of oily, aqueous, and fat components. Placement then involves the use of an 18-G cannula in the recipient site. Further technical descriptions are included later in this manuscript.

The purpose of this paper is to review the benefits of fat grafting during orthognathic surgery; more specifically, we will delineate the biology, harvesting, processing, and technical considerations to maximize aesthetic outcomes, minimize edema, and optimize wound healing. We discuss these concepts in the context of a retrospective review of consecutive patients who underwent orthognathic surgery performed by the senior author.

METHODS

Study Design: A retrospective cohort of the senior author's orthognathic surgery patients was assembled in concordance with the Yale University Institutional Review Board. Recorded metrics included the following: age, sex, BMI, procedure, area of harvest, location of injection, donor site complications, and need for repeat fat grafting. Inclusion criteria included history of orthognathic surgery in 2015 performed by the senior author of this paper.

Fat Grafting Techniques

Recent technical advances in fat grafting have largely been modeled on the work of Sydney Coleman as previously mentioned.[2,3,6–8] He advocates for atraumatic harvest and injection of adipose tissue thereby preserving the lipoarchitecture; such meticulous attention to technique allows for better take of the grafted fat. The senior author implements these well-defined parameters for facial fat grafting in his practice. A No. 11 blade is used to make a small periumbilical incision (Fig. 1A). The surrounding tissue is anesthetized with 0.5% lidocaine and dilute epinephrine. A 10 cc syringe attached to the Coleman harvesting blunt-tip cannula is then deployed using manual negative pressure. Small parcels of fat are suctioned into the cannula through the Luer-Lock apparatus and into the barrel of the syringe (Fig. 1B). The senior author then uses the Telfa-rolling method to prepare the fat before injection based on prior work that indicates greater cell viability and adipose-

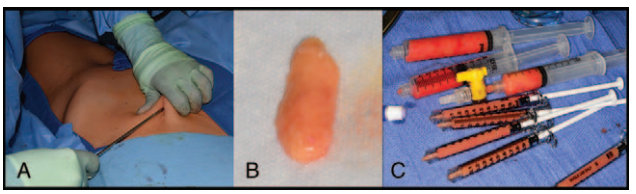

FIGURE 1. (A) Intraoperative photo of atraumatic periumbilical fat harvest using manual aspiration and the Coleman cannula. (B) Harvested fat pictured here after Telfa processing method (see the text). (C) Processed periumbilical fat loaded into 1 cc syringes for meticulous transfer.

TABLE 1. Cohort Demographic and Operative Data

Cohort Data **Cohort n = 53**	
Sex (male:female)	20:33
Age	23.8 ± 11.3 y (range 10–59 y)
BMI	25.8 ± 6.9 kg/m^2 (range 17.0–42.4)
Operation type	
LEFORT I ± Genioplasty/bsso	33 (62.3%)
Other	20 (37.7%)
Area of harvest	
Abdomen	44 (83.0%)
Inner thigh	9 (17.0%)
Amount of fat injected	13.1 ± 4.5 cc (range 5–25 cc)
Ensuing rhinoplasty	28 (52.8%)
Additional fat grafting	15 (15/28, 53.6%)
Donor site complications	0
Follow-up (mean)	1 ± 0.3 y

FIGURE 2. Seventeen-year-old female who presented with mandibular asymmetry, anterior open bite, and impacted wisdom teeth. She underwent bilateral sagittal split osteotomy and genioplasty with concurrent autologous fat grafting. Injection sites were the labio-mental crease, aspects of the chin, nasolabial folds, and cheek. Postoperative photos showing 1-year result.

derived mesenchymal stem cell concentration when compared with centrifugation[9] (Fig. 1C). A blunt infiltration cannula attached to a 1 mL Luer-Lok syringe is then filled with the processed adipose tissue. As described by Coleman, fat is injected in small aliquots as the cannula is withdrawn. Such meticulous attention to technical procedures has been shown to optimize outcomes.[3,8]

RESULTS

Fifty-three patients were reviewed who underwent concurrent orthognathic surgery and fat grafting by the senior author in 2015. Twenty males and 33 females were included. Average age of our cohort was 23.8 ± 11.3 years (range 10–59). Average BMI was 25.8 ± 6.9 kg/m^2 (range 17.0–42.4). Thirty-three patients (62.3%) underwent Le Fort I operations either in conjunction with genioplasty and/or bilateral sagittal split osteotomies. The remaining patients underwent Le Fort I osteotomies, with or without adjunctive procedures. Twenty-eight patients (52.8%) underwent repeat operations involving additional fat grafting. The majority of these cases (15/28, 53.6%) received additional fat grafting during ensuing rhinoplasty. Sites of injection included the labiomental creases, nasolabial folds, cheeks, parasymphysis, lips, and areas of bony step offs noted after the orthognathic procedure. Donor site was either the medial thigh or the abdomen as previously mentioned; fat was harvested from the abdomen in 44 patients (83.0%) and the inner thigh in 7 patients (17.0%). Table 1 summarizes these results.

Using the Coleman technique, fat was aspirated using manual suction and processed on a Telfa roll. Small aliquots of 1 cc were introduced into the aforementioned regions. Infiltration of local anesthetic with epinephrine helped minimize the incidence of bruising, hematoma, and intravascular infiltration of fat. There were no donor site complications (ie, infection, wound breakdown) recorded in our patient cohort. Amount of fat injected averaged 13.7 ± 4.5 cc (range 5–25 cc). Follow-up generally occurred through the 1-year mark. Moreover, all patients reported high satisfaction with the outcomes of their operation. We now present in brief several cases highlighting the use of fat grafting in the senior author's orthognathic surgery practice.

PATIENT DESCRIPTIONS

1. Seventeen-year-old female who initially presented with mandibular asymmetry, anterior open bite, and impacted third wisdom teeth (Fig. 2). She underwent a bilateral sagittal split osteotomy with rotation and slight setback, genioplasty, and fat grafting to the labio-mental crease, aspects of the chin, nasolabial folds, and cheek. She subsequently underwent septorhinoplasty with fat grafting to cheeks, lip, and midface 8 months later to correct nasal obstruction and nasal deviation.
2. Twenty-five year-old female initially presenting with temporomandibular joint pain, class III malocclusion, and nasal obstruction (Fig. 3). After extensive preoperative planning, she underwent Le Fort I osteotomy with 4 mm of advancement and 5 mm of anterior impaction, and genioplasty; she further underwent subsequent rhinoplasty and septoplasty as part of the same operation. Fat was harvested from the inner thigh and transferred to the face, lips, nose, and areas of genioplasty step-off.
3. Seventeen-year-old female presenting with anterior open bite, class II malocclusion, maxillary hypoplasia, mandibular prognathism (Fig. 4). She underwent a Le Fort I osteotomy, bilateral sagittal split osteotomy, and genioplasty with fat grafting to the lips, labial mental crease, nasolabial folds, and areas of bony step-off. Le Fort 1 osteotomy, bilateral sagittal split osteotomies, genioplasty with shortening, splint using fabrication, fat grafting from abdomen to face, alar cinch, adjacent tissue rearrangement, V-Y advancement adjacent tissue rearrangement.

DISCUSSION

Fat grafting in orthognathic surgery is becoming increasingly common due to its anti-inflammatory and volume enhancing effects. Results from our cohort and featured cases demonstrate the aesthetic and functional utility of fat grafting with minimal morbidity for a variety of orthognathic procedures. None of the patients experienced donor site complications or wound-healing issues and all patients reported high satisfaction with the final results. An average of 13.1 cc of fat was injected per patient, which was harvested from either the lower abdomen or medial thigh. This volume of fat can be efficiently harvested in most patients with a wide range of BMI using the atraumatic and cost-effective techniques described earlier (Fig. 1).

We have previously published the use of fat grafting following major orthognathic surgery to mitigate edema, which is a particularly bothersome facet of recovery.[10–12] We examined the use of fat grafting in a retrospective cohort of fat-grafted versus non-fat-grafted patients who had undergone a Le Fort I ± bilateral sagittal split osteotomies with or without fat grafting between May 2012

FIGURE 3. Twenty-five-year-old female who presented with class III malocclusion, temporomandibular joint pain, and nasal obstruction. She underwent a Le Fort I osteotomy, osseous genioplasty, and septo-rhinoplasty with concurrent fat grafting. Injection sites were the genioplasty step-off, lips, malar, and glabellar areas. Postoperative photos showing 8-month result.

FIGURE 4. Seventeen-year-old female presenting with a class II malocclusion with anterior open bite. She underwent a Le Fort I osteotomy, bilateral sagittal split osteotomy and genioplasty with fat grafting to the lips, labial mental crease, nasolabial folds and areas of bony step-off. Postoperative photos showing 1-year result.

and August 2014.[11,12] All study participants had longitudinal follow-up with 3-dimensional photos at specified time points. Fat was aspirated from either the medial thigh or the lower abdomen using the Coleman cannula on a 10 cc syringe. The volumetric results indicate that postoperative swelling resolved by week 12 in the fat-grafted group versus 10.2% persistent swelling in the non-fat-grafted group. Paracrine anti-inflammatory factors may contribute to these clinical outcomes; this phenomenon has been described in the burgeoning basic science literature on adipose biology.[13] Fat grafting, from this cohort, appears to reduce postoperative edema more quickly and help reach a steady state of facial swelling resolution. Another recent publication from our group examined the use of fat grafting in a cohort of rhinoplasty patients for postoperative edema attenuation.[14] Using Vectra and Geomagic, primary open rhinoplasty patients with multiple postoperative pictures and follow-up up to 1 year were included in this study. This cohort of 40 patients provided quantitative evidence to predict diminishment of edema over time, with near complete resolution at 1 year. Other centers have shown similar outcomes with fat grafting in patients undergoing orthognathic surgery[15] noting improvement in final aesthetic outcomes and patient satisfaction.[16]

While the focus of this manuscript is on orthognathic applications of fat grafting, it is important to consider the versatility of this technique in craniofacial and aesthetic surgery. Our group has previously published promising results from fat grafting in related realms such as cleft lip repair.[17,18] Clauser et al documented the aesthetic and functional benefits of facial fat grafting in patients who had undergone orthognathic surgery or reconstruction for facial trauma, facial burns, or congenital conditions (ie, cleft lip/Treacher Collins) in a series of papers.[19–23] They note subjective improvement in facial morphology, function, quality, and texture of skin in the majority of their patients. For these reasons, fat grafting is widely employed as part of the aesthetic surgeon's armamentarium to promote facial rejuvenation and volume enhancement.[24,25]

Del Vecchio and Rohrich[26] advocate that not all fat grafting is the same; balancing time efficiency and effectiveness of the technique are important considerations in small versus large volume fat grafting. Emerging data regarding adipose biology suggests that there may be an optimal fat lobule size to maximize fat graft take; the balance between preservation of stromal elements in small grafts and impaired diffusion with possible central necrosis in larger grafts warrants further study.[26] Yoshimura et al[27] advocate for the use of cell-assisted lipotransfer in which stromal vascular

fraction acts as a scaffold for the graft containing adipose-derived mesenchymal stem cells. Further translational work by Kolle et al[28] reveals that enrichment of fat grafts with autologous adipose-derived stem cells improves fat graft take and size 121 days after implantation; these findings were confirmed with magnetic resonance imaging. Previously published data indicates that the lower abdomen and inner thigh may have higher processed lipoaspirate adult mesenchymal stem cell concentrations.[29]

The often-cited clinical benefits of fat grafting likely arise from the regenerative potential of adipose-derived stem cells. Studies indicate that there are as many as 5000 adipose-derived stem cells per gram of fat.[8] In a typical adipose lipoaspirate, these stem cells are intermixed with several other cell types including pericytes, fibroblasts, endothelial cells, and preadipocytes as part of stromal vascular fractions.[30] Coleman has written extensively on the benefits of fat grafting including skin quality improvement, softening of wrinkles, pore size and pigmentation attenuation, and scar resolution.[2,3,8] Brown et al[31] offer a compelling basic science review of the future implications of fat grafting for aesthetic and reconstructive surgery; further developments in biomaterial scaffolds could provide the groundwork for more extensive vascularized autologous soft tissue reconstruction with adipose-derived stem cells. Smaller aliquot lipotransfers are widely used in current clinical practice and have been effective in treating radiotherapy-induced tissue damage.[32] Zielins et al[33] conducted a more recent review of surgical techniques and discussed potential benefits of adipose-derived stem cells to increase graft retention; the modified Coleman technique in particular has been shown to preserve intrinsic structural properties of adipose tissue.[34] This structural environment has proven particularly important to harness the regenerative potential of these stem cells.[35,36] Prior work also indicates the availability of mesenchymal stem cells across all age groups—from infants to the elderly—with similar osteogenic paracrine activity.[37,38]

CONCLUSIONS

Fat grafting in orthognathic surgery is a safe and effective tool to enhance postoperative wound healing, combat inflammation, and promote optimal aesthetic outcomes while minimizing edema. In this manuscript, we have discussed the senior author's techniques, presented a retrospective cohort of consecutive patients, and included brief case discussions of 3 patients to illustrate the clinical utility of fat grafting.

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