

Plastic & Reconstructive Surgery

Chapter 3

The Versatile Role of Fat Grafting in Restoring Harmony and Symmetry in Facial Plastic & Orthognathic Surgery

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1. Introduction

Facial rejuvenation surgery has evolved from simple excision and tightening to soft tissue repositioning and augmentation. It is important to keep in mind that the face per se is composed of both soft tissues and bony skeleton. Nonetheless, there has been a paucity of approaches that simultaneously address the bony or hard tissue aspects in addition to the soft tissues. A “pan-facial” approach to facial surgery encompassing both the bony and soft tissue components will therefore yield the most favourable outcomes.

Fat grafting first described by Neuber in 1893 [1] has evolved to become an indispensable procedure in the armamentarium of the plastic surgeon due to the abundance of graft material, ease of harvest and the lack of transplant immunological rejection. Modern autologous fat grafting was popularized by Coleman. Autologous fat grafting also carries the advantage of being permanent and can be injected at larger volumes than synthetic fillers. The versatility of fat grafting allows a multitude of applications covering a wide range of aesthetic and reconstructive scenarios.

2. Nasal dorsum augmentation

Augmentation of the nasal dorsum is a frequently requested procedure in Asian rhinoplasty [2]. Augmentation rhinoplasty has traditionally been carried out with alloplasts

(synthetic implants), allogeneous material (obtained from cadavers), or autologous material (harvested from the patient's own tissue; ie. Ear cartilage, nasal septal cartilage, rib cartilage and others) [3,4].

In patients who require a moderate increase in height of the nasal dorsum with minimum downtime, autologous fat grafting offers the perfect solution [5]. This procedure can be performed under local anesthesia with minimal downtime.

The graft retention rate of fat injection rhinoplasty performed in our reported case series of 12 males and 1 female in the nasal dorsum region was 44.54% (range, 21–74%) [5]. The amount of fat injected for nasal dorsum augmentation was 1.67 ± 0.95 mL (range, 0.6–3.3 mL). While there is a need for overcorrection in fat injection for nasal contouring, graft take is often adequate for an excellent outcome [5].



Figure 1: Autologous fat grafting over the nasal dorsum to increase dorsal nasal profile. Single puncture wound on the nasal tip for nasal dorsum augmentation is adequate in most instances. Additional puncture sites to deposit fat around the anterior nasal spine and nasal columella to enhance nasal tip projection may be required. To smoothen the junction between radix and glabella region, another puncture site can be sited at the glabella.



Figure 2: The effect of fat grafting over the nasal dorsum and anterior cheeks. Note the increased definition of the nasal dorsum with subtle volumizing effects over the cheeks.



Figure 3: Lateral profile views featuring the pre and post results. There is discernible improvement of the lateral nasal profile with elevation of the radix. Note that the patient underwent fat grafting over the entire face for more fullness. The skin texture has also improved after fat grafting.

3. Lower Face Aesthetic Contouring

Botulinum toxin type A injections are routinely employed in the treatment of hypertrophied masseter muscles to reduce lower face width. Not infrequently, many patients with hypertrophied masseters also present with facial length deficiency where the faces are wide and short. Autologous fat grafting to the chin can be utilized in such scenarios to lengthen the facial profile and has a superior safety and durability profile super ceding other current soft tissue fillers [6].

The presence of a weak deficient chin may further accentuate the unflattering appearance of a “square” face. Botulinum Toxin A injection to the masseters and fat grafting to lengthen and project the chin act in synergy to treat a “square” face. Botulinum toxin injections while not permanent induces masseter atrophy with an average of 30% muscle bulk reduction after 3 months post treatment. Visible effects are seen within 2 to 3 weeks and maximal effects can be observed in 8 to 12 weeks after injection [6].

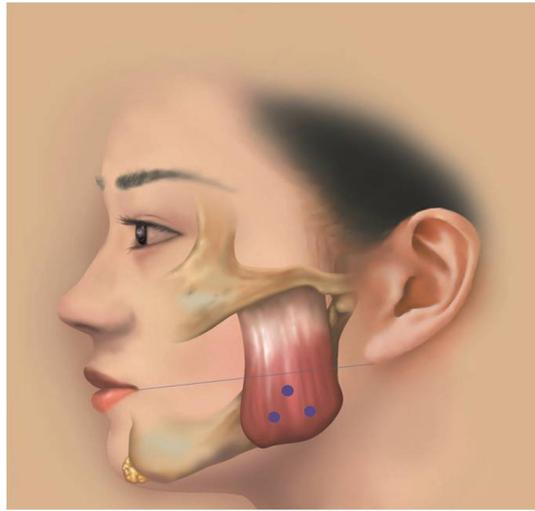


Figure 4: An imaginary vertical line extends from the lobule of the ear to the corner of the mouth or modiolus. Botulinum toxin A injections are administered at the 3 points shown in the diagram on the lower bulk of the masseter totalling 24 Units (8 Units per injection point) for each side of the masseter respectively.

Anterior or vertical chin elongation or both can be carried out with fat grafting. During fat grafting, the chin can be pinched or pushed with one's digits outwards in an anterior, inferior, or anteroinferior vector simulating the ideal chin proportions for that patient. Whilst keeping the chin in that ideal position throughout, fat can be injected evenly into both superficial and deep planes and extended laterally.

The synergistic effect of masseter reduction which reduces the width of the face and the effects of fat grafting over the bony chin to increase chin vertical height plus anterior projection results in a slimmer, slender facial profile.



Figure 5: Preoperative frontal profile exhibiting a wide face and square face. Immediate postoperative appearance after fat grafting of 3 mL into the chin combined with 24 U of botulinum toxin A injection into each masseter. Fat grafting was also performed over the nasal dorsum in this patient. Note the slim slender facial profile achieved by lengthening the lower third of the face.



Figure 6: Same patient seen after 2 years exhibiting durability of the procedure. Botulinum toxin injections can be readministered every 5-6months as needed.



Figure 7: Preoperative frontal profile exhibiting a relative wide face. Immediate on table postoperative appearance after only fat grafting of 1.5 mL into the chin combined with 24 U of botulinum toxin A injection into each masseter. Fat grafting was also performed over the nasal dorsum in this patient. Note the slim slender facial profile achieved by lengthening the lower third of the face.

4. Periorbital rejuvenation

Beauty lies in the eyes of the beholder but the eyes are also windows to the soul. The eyes or rather the periorbital regions are often the first point of gaze when people meet or are introduced to one another. The youthful periorbital region exhibits fullness with a short vertical height of the lid cheek junction. The elongation of the lower eyelid from the cheek (lid cheek junction) is a tell-tale sign of aging, hence reuniting these two areas into a confluent, single complex should be the goal in periorbital rejuvenation.



Figure 8: Preoperative frontal profile depicting a wide face and short chin. Postoperative profile at 6 months showing an improved facial profile.



Figure 9: Preoperative view of a patient exhibiting separation of the lower eyelid from the cheek creating a double contour and a tired look. Postoperative appearance after fat grafting over the periorbital regions and midface provides a single confluent convex appearance that signifies youth. The patient also has a fresher look.



Figure 10: Pre- and post-treatment views of fat grafting over the upper eyelids including scar overlying right upper eyelid, tear troughs and anterior cheeks. The right upper eyelid scar improved after fat injection.

5. Forehead and temporal region augmentation

The forehead and the temples makes up the upper third of the face. Wrinkles, hollowing and skin laxity are major signs of aging in the forehead and temples. Many modalities have been employed to rejuvenate the forehead and temporal regions including forehead lifting, alloplastic implants such as silicone elastomers, fillers, fat grafting and botulinum toxin injections. Nonetheless, fat grafting has been less popular in the forehead due to structural difference of this particular area in the face. For a start, there is little to no subcutaneous fat in the superior 1/3rd to 1/2 of the forehead. There are dense connective fibrous tissues between the skin and the fascial layer of the frontalis making this area rather stiff. In contrast, the lower 1/3rd to lower half of the forehead have well developed subcutaneous fat which in synergy with the galeal fat pads and galeal sliding space allows effortless movements.

The caveat here is to inject fat in the subgaleal space in the upper 1/3rd to upper 1/2 of the forehead and to inject in the supraperiosteal layer inferior to those regions. Appropriate entry sites and direction of fat grafting is shown in the Figure below.



Figure 11: The preoperative picture shows prominent tear troughs bilaterally with a pronounced Indian band or malar sulcus on the right lower cheek. Fat grafting over the tear troughs and malar sulcus was performed. Additional fat grafting to augment the nasal dorsum and to elongate and project the chin was performed. The postoperative picture shows a slender facial profile and youthful appearance.

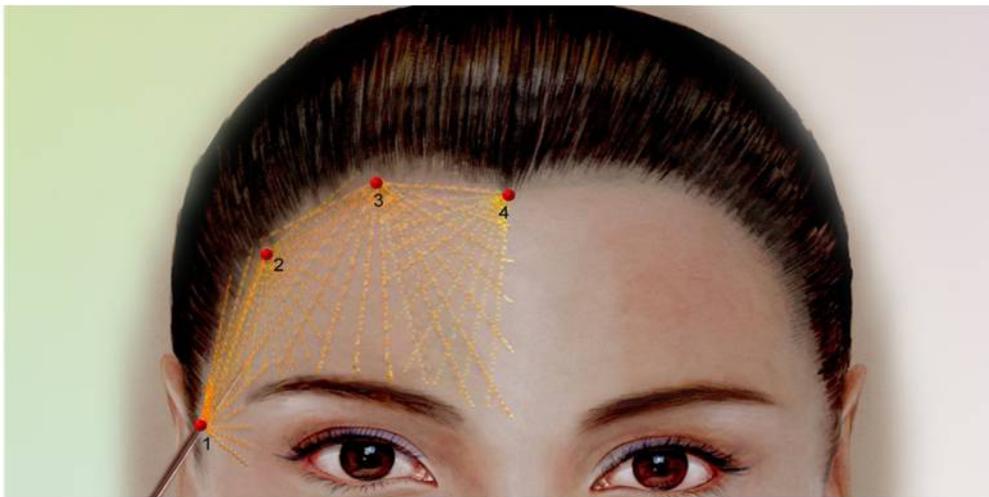


Figure 12: Entry sites depicted in red with directions of injections in yellow. Note that cross hatching is performed for even distribution.



Figure 13: This otherwise beautiful lady presented with tear troughs, bilateral temporal hollowing, a flat forehead contour and flat cheeks lacking projection. Fat grafting was performed sequentially in the midface, tear troughs, temporal region and forehead resulting in a younger more attractive face.

6. Correcting Asymmetry as Sequela in Facial Bone Fractures

Facial fat grafting is also a powerful modality in correcting post traumatic maxillofacial deformities. This patient presented with right zygoma fracture which was treated with Open

Reduction & Internal Fixation (ORIF)



Figure 14: Patient seen at 2, 3 and 4 years follow-up respectively showing durability of fat grafting.



Figure 15: On table pre-operative appearance. Note the depression overlying the right zygoma.

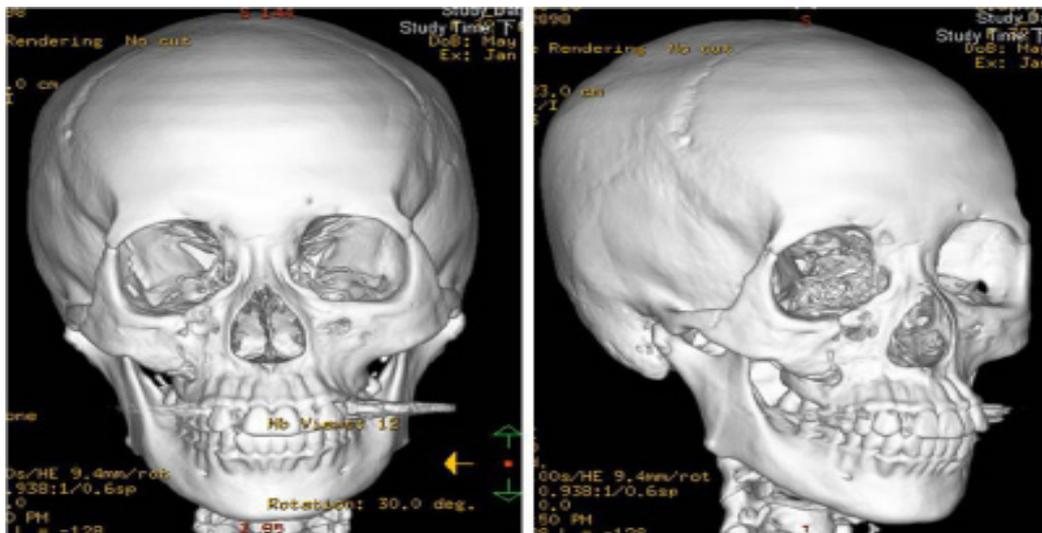


Figure 16: 3D CT Scan showing the extent of the right side zygomatic fracture.



Figure 17: Open reduction & internal fixation with resorbable plates.



Figure 18: However, after surgery the depression overlying the right cheek was still evident. Fat grafting performed 6 months later corrected the deformity.

The following case involves a post facial trauma sequela of conservatively managed left zygomatic fracture with resultant depression over the left side.



Figure 19: Patient re-evaluated in 1 year showing durability of the fat grafting procedure. Notice that the scar has become inconspicuous.



Figure 20: Patient visited the clinic > 1 months after injury. Bony osteotomy was needed to performed the open reduction. However, she did not want bone osteotomy.

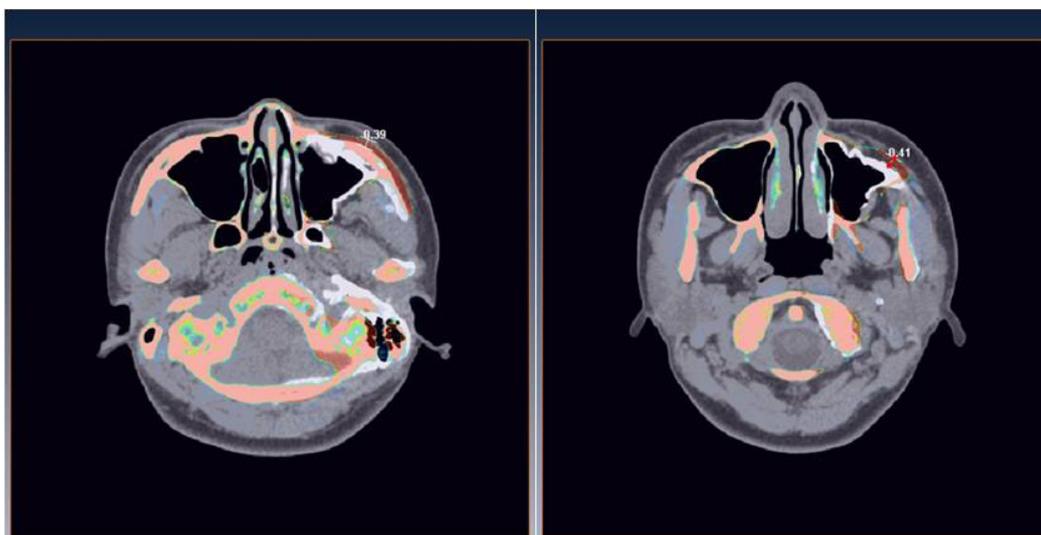


Figure 21: Mirror images on axial CT scan shows a discrepancy of 4mm on comparing the left zygoma with the right zygoma. The alternative is augmentation of depressed cheek.



Figure 22: 3mm Medpore and autologous fat transfer performed over depression overlying left zygoma. Fat grafting to correct the rest of the 1 mm discrepancy and to smooth peri-implant depression was performed. Simultaneous fat grafting over nasal dorsum, paranasal regions, and left temporal region were performed.

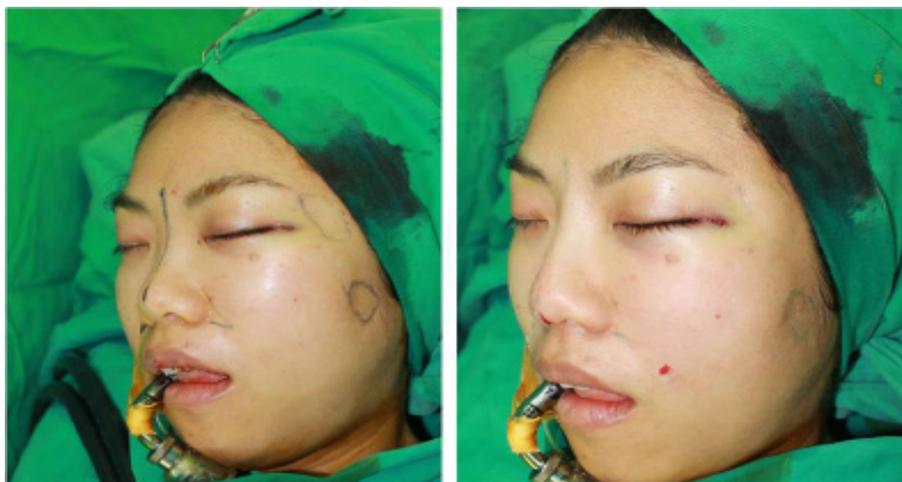


Figure 23: Pre-and post-fat grafting results appreciated directly on table.



Figure 24: Pre-treatment appearance and post-operative results at 1 week, 2 months and 1 year respectively.

7. The Role of Fat Grafting in Orthognathic Surgery & Its Sequela

Orthognathic Surgery is a powerful modality to restore facial harmony by addressing the bony foundation and restoring ideal occlusion status. However, some post-operative cases will have residual deformities that benefit from fat grafting. Performing orthognathic in combination with fat grafting in a single session represents a paradigm leap that allows the surgeon greater control of the outcome and an opportunity to achieve better facial symmetry in one surgery (7). This avoids a 2-stage procedure which is cumbersome and more expensive for the patients. Moreover, the volumization effects of fat grafting in itself is beneficial for the patient.

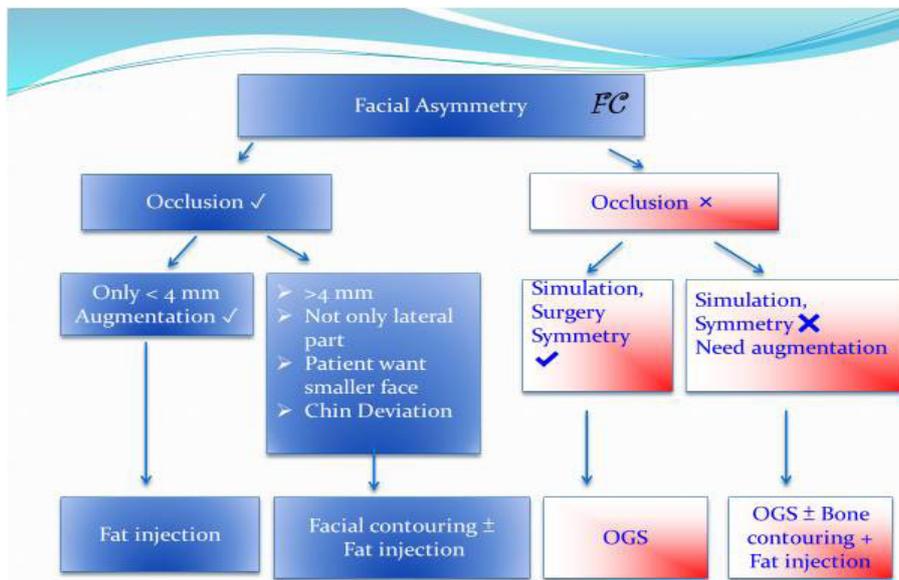


Figure 25: Algorithm for addressing facial asymmetry with fat grafting. Note that Orthognathic Surgery with recalcitrant asymmetry will benefit from fat grafting either directly during the surgery itself or as a secondary procedure.



Figure 26: This young lady had undergone Anterior Segmental Osteotomy (ASO) for correction of facial asymmetry. However, her unprecedented weight loss post-surgery accentuated the right sided cheek depression.



Figure 27: Fat grafting was carried out on the right side of the face with particular attention on the lower third of the face and cheek area. Nasal dorsal augmentation was also performed with fat grafting.



Figure 28: Side by side comparison of pre-operative status and 1.5 years post fat grafting reveals excellent results with restoration of facial harmony although there is some evidence of fat resorption in the right side of the lower face.



Figure 29: Orthognathic surgery was performed to address skeletal asymmetry with notable improvement in facial midline, however after the left rotation of mandible the right cheek looks much smaller.



Figure 30: Fat injection was performed on the left side of the face to improve facial symmetry.

8. Combining Orthognathic Surgery with Fat Grafting in a Single Surgery



Figure 31: These figures depict the evolution of the restoration of facial symmetry from post Orthognathic Surgery and to the finale of post fat grafting. The results speak for themselves.



Figure 32: This patient was planned for Orthognathic Surgery to correct Class III malocclusion and to correct facial asymmetry.



Figure 33: A Pre and immediate post-operative on table result after completion of Orthognathic Surgery, fat grafting & upper blepharoplasty. Fat grafting was performed for lower face contouring. Suture method Asian upper eyelid blepharoplasty carried out as per patient request in the same setting. A more homogenous and symmetrical appearance is achieved on table.

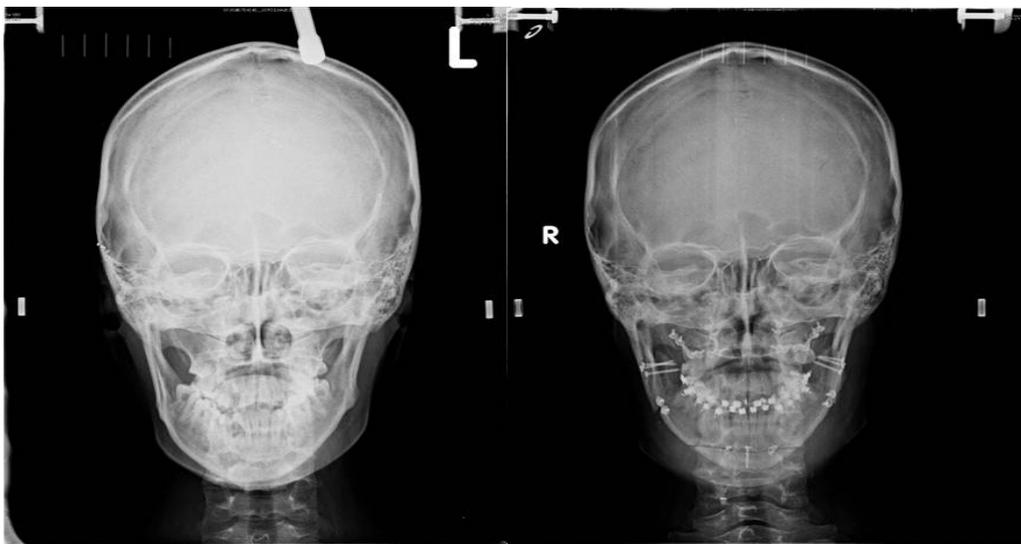


Figure 34: a) Pre-op radiograph delineates bony asymmetry and soft tissue outline. B) Post Orthognathic Surgery and fat grafting. Fat grafting acts to camouflage bony asymmetry. Note the soft tissue outline.



Figure 35: Lateral view radiographs before & after Le Fort 1 rotational advancement, Bilateral Segmental Split Osteotomy (BSSO) & advancement genioplasty.



Figure 36: Before & after appearance following combined Orthognathic Surgery (OGS), fat grafting & blepharoplasty. Persisting asymmetry directly after OGS can be addressed directly on table by bony adjustments and camouflage techniques by fat grafting. Moreover, most patients with mandibular prognathism also present with midface soft tissue deficiency. The medial cheek fat augmentation imparts a more youthful overall appearance. Upper blepharoplasty performed simultaneously further camouflages the eye canting and asymmetry.

9. Concepts of Fat Grafting in Orthognathic Surgery

The premise of fat grafting as an adjunct procedure to cosmetic facial bone or orthognathic surgery is that bone is analogous to that of brick or mortar which is solid; whereas fat is analogous to cement which can be moulded prior to setting. Both properties are complimentary to one another and both work in synergy to build a house with a strong foundation.



Figure 37: Bony work is analogous to brick or mortar whereas fat grafting is akin to cement that can be moulded prior to setting. Both work in synergy to build a house with strong foundations.

One of the chief complaints following orthognathic surgery is that of cheek hollowing. Although occlusion and facial profile is often markedly improved, the deflation of cheeks can be distressing for some patients.



Figure 38: Cheek hollowing is a common sequela following Orthognathic Surgery.



Figure 39: Note the fullness of the cheeks giving a plump youthful appearance after fat grafting in the latter picture.

When bony framework is altered; facial soft tissue may become deflated at certain key areas for example the cheeks. When some bricks are removed as an analogy, the foundation of the house is compromised necessitating cement to be placed and set to restore the core or foundation once again.

It is hence advantageous to perform fat grafting over the face during orthognathic surgery to smooth out asymmetries, to plump up soft tissue that become ‘deflated’ after orthognathic surgery and last but not least if there are ample fat to spare- overall facial rejuvenation can be achieved by fat grafting over frontotemporal, nasolabial, nasojugal folds and over the nasal dorsum.

10. Orthognathic surgery with Aesthetic Fat Grafting



Figure 40: Patient with maxillary protrusion presenting for orthognathic surgery. In this case a maxillary setback was planned and performed. Note also frontotemporal hollowing, an evident nasojugal groove, nasolabial folds that are beginning to deepen and lack of zygoma fullness- all signs of facial aging.



Figure 41: Pre- & post maxillary setback radiographs.



Figure 42: Not much swelling noted post-surgery Day 1 after combined Orthognathic Surgery and fat grafting.



Figure 43: Follow-up in 3 and 6 months respectively reveal a totally changed, rejuvenated facial profile.



Figure 44: Up close comparison pre-op & 6 months post-op appearance. Note the restoration of facial youth and harmony by addressing both hard and soft tissues.



Figure 45: With combination of fat injection and orthognathic surgery, the facial symmetry is much improved with only one surgery.

11. Discussion & Conclusion

Fat grafting is an extremely versatile tool that can be a complimentary adjunct to various facial plastic and orthognathic surgery procedures. Fat grafting is safe and carries a low morbidity rate.

In nasal dorsum augmentation, the authors are aware of the popularity of various fillers that are more convenient than the use of autologous fat grafting. However, repeated injections of fillers do lead to granulomas and persistent erythema which can be difficult to manage [8-10]. The longevity of nasal augmentation is determined by foreign body reaction around the injected filler [10]. In patients who require a moderate increase in height of the nasal dorsum with minimum downtime, autologous fat grafting offers the perfect solution [5]. This procedure can be performed under local anesthesia with minimal downtime.

Triangular and heart shaped facial profiles are favoured and women with such facial profiles are perceived to be more attractive than those with square shaped faces particularly in Asian cultures [11-12]. A prominent mandibular angle and muscle hypertrophy contributes

to the unsightly appearance of a square face. Traditionally, treatment of a square face would involve bony contouring via mandibular angle resection. The use of botulinum toxin for the treatment of masseter hypertrophy has also been well documented [13-15].

Many patients with hypertrophied masseters also present with facial length deficiency where the faces are wide and short. The presence of a weak deficient chin may further accentuate the unflattering appearance of a “square” face. Botulinum Toxin A injection to the masseters and fat grafting to lengthen and project the chin act in synergy to treat a “square” face [6].

Asian facial profiles are wider and flatter than their Caucasian counterparts. Hence, fat grafting over the buccal and lateral aspect of the lower third of the face may highlight the ‘heaviness’ of the Asian face rather than improving it. The key point is to limit the augmentation on the outer malar region which can exacerbate the appearance of wide and flat facial profile. Therefore, strategic placement of fat grafts along the anterior chin and cheek and pre-jowl sulcus counterbalances the wide and flat properties in such faces to create a more attractive facial profile. Periorbital and forehead/temporal region augmentation further highlights the upper face features and provides a smoother, more rounded quality to the face.

In both post traumatic facial fractures and in orthognathic surgery; many a patient will be left with residual soft tissue discrepancy after surgery. Such cases with resultant facial asymmetry benefit tremendously from fat grafting. Autologous fat grafting does not significantly prolong the operative time and carries minimal complications and donor side morbidity. Large volume of fat can be easily accessed and the fat grafts obtained are 100% biocompatible.

Fat grafting can be carried out simultaneously with orthognathic surgery, rhytidectomy, facial fracture reduction & fixation etc. It is however imperative that patients need to be aware that repeat grafting sessions may be necessary to achieve the desired volumization. In order to maximize graft take, the fat harvested has to be carefully handled atraumatically and transferred to the recipient site as tiny tissue particles which then have the best chance of developing a blood supply and survival. The authors currently utilize the Microautologous Fat Transplantation (MAFT) Gun with an 18G blunt needle to deliver homologous fat particles as small as 1/60 ml. By implementing autologous fat transfer principles for patients with facial asymmetry, the craniofacial and aesthetic surgeon can thus correct both skeletal and soft tissue discrepancies via a pan-facial approach to achieve improved postoperative facial symmetry.

The advantages of facial fat grafting can be summarized as follows:

1. It is a minimally invasive procedure with a relatively short operative time. Surgical equipment needed to carry out fat grafting are inexpensive.
2. Minimal recipient & donor site morbidity. Puncture wounds are adequate for both harvest of fat and for fat grafting. Donor sites are readily and easily accessible for harvest.

3. Fat graft is entirely biocompatible with no allergic or autoimmune reactions and graft take is permanent/long lasting.
4. Fat has abundant stem cells and other regenerative properties that can modulate wound healing & scar formation, improve texture of the skin and impart a “brightening” or “whitening” effect.
5. Fat grafting can be combined with other minimally invasive procedures such as botulinum toxin injections, chemical peeling etc.
6. Fat grafting carried out in conjunction with other surgical procedures such as orthognathic surgery, facial bone contouring surgery and other reconstructive surgical procedures not only corrects the patients’ residual soft tissue deficiencies, but also directly improves the aesthetic result and increases patients’ satisfaction.
7. Fat graft harvest from the donor site via liposuction also treats the localized lipodystrophy with resultant improved contours which is an added bonus for the patient.

12. References

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