

Role of Fat Grafting in Correction of Facial Asymmetry in Patients with Sever Contracted Eye Sockets

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ABSTRACT

Introduction: Inability to retain ocular prosthesis along with facial asymmetry are the leading presentations in patients with sever forms of contracted eye sockets (CES). Although reconstruction should address both problems, the majority of the published literature focused only on reconstructing the CES to enable patients retain their ocular prosthesis.

Aim: This study addresses all concerns of patients with severe forms of CES and present an easy and reproducible treatment modality of facial asymmetry utilizing fat grafting.

Patients and Methods: During the interval between February 2012 to October 2015, ten patients with sever CES were included. seven patients were males and three were females. The age ranged from 18 to 26 years. Fat grafting was done as first stage to correct facial asymmetry and build up the foundation. This was carried out with guidance of cone beam CT scan to estimate the amount of fat needed to achieve facial asymmetry. CES release and reconstruction followed at a later stage.

Results: All patients gained retaining capacity for ocular prosthesis and showed satisfaction of the achieved facial symmetry. Multi-regression statistical analysis of recorded data showed significant reliability of the cone beam CT for estimation of the actual volume of fat needed to correct the facial asymmetry through linear regression equation. Pearson Correlation Test showed positive significant correlation between the volume of actual fat injected and number of fat injection sessions.

Conclusion: Reconstruction of severe forms of CES should address both the CES release and the facial asymmetry simultaneously. Fat grafting is an efficient, easy and reproducible technique for camouflaging facial asymmetry associated with these cases. The use of cone beam CT scan assists in objectively estimating the volume of fat grafting needed.

Key Words: Fat grafting – Contracted eye sockets.

INTRODUCTION

The eye globe is a neural tissue that affects the orbital growth and the related tempro-malar area. Orbital exenterations as well as radiotherapy during infancy and early childhood result in undergrowth of the orbit and tempro-malar areas [1,2]. Orbital hypoplasia, contracted eye socket (CES), temporal

hollowing, malar hypoplasia, and adapted occlusal canting; all are delayed complications of anophthalmic radiated orbits during infancy. Yet, the leading presentation for those patients is the facial asymmetry a long with the inability to retain ocular prosthesis [3].

The CES is the eye socket with diminished retaining capacity for ocular prosthesis [4]. Many classifications for CES were proposed by reconstructive and oculoplastic surgeons. In mild to moderate cases CES release with different types of grafts proved to be efficient. Authors favored flap based reconstruction over different grafts' types, in cases of sever CES or after repeated reconstruction attempts [4-9].

Guyuron classification for contracted eye socket patients was used in this study (Table 1). In sever cases of CES; the reconstruction should address the CES release and the facial asymmetry simultaneously. This study highlights the role of fat injection in correction of facial asymmetry during the management of sever CES cases.

Table (1): Guyuron classification for contracted eye socket patients [6].

Grade	
Grade I	Contracted eye socket with normal orbital and periorbital tissue volumes.
Grade II	Contracted eye socket as well as orbital volume deficiency
Grade III	Failed reconstructions of grades I and II or Patients with severe orbital and periorbital deficiencies

PATIENTS AND METHODS

During the interval between February 2012 to October 2015, ten patients with sever CES were included. Seven patients were males and three were

females. In this study, the age of the included patients ranged from 18 to 26 years (mean age $\approx$ 21) (Table 2). All patients presented to the plastic surgery outpatient clinic at Ain Shams University Hospital with history of unilateral orbital exenteration that was followed by radiotherapy. This combined protocol was used for management of unilateral retinoblastoma during infancy. During childhood and adolescence, all patients suffered from diminishing orbital retaining capacity causing difficulty to wear ocular prosthesis. Patients with severe CES that is associated with orbital and periorbital deficiencies [grade III according to Guyuron classification (Table 1)] seeking for correction of the associated developmental facial asymmetry were included in this study.

Procedure:

Stage I: Correction of facial asymmetry and building up the foundation:

Facial asymmetry correction was planned using fat grafting. Pre-operatively, cone beam CT facial was used to measure the volume of each hemiface in each patient (Fig. 1). The difference between both volumes was used to estimate the volume of fat needed to achieve facial symmetry. The estimated volume is distributed differentially over the deficient territories as temporal area, upper and lower eye lids, ipsilateral nasal dorsum, malar eminence, and pre-auricular cheek, and gonial areas. This differential distribution of fat volume injection was decided in each patient individually. Preoperative marking of facial areas to be enhanced was done in erect position. Lower abdomen, flanks, medial thighs are areas to harvest fat.

Basic principles for structural fat grafting were applied [10-17]. Fat is injected as parcels along multilayered tunnels to maximize contact with tissues. Using type I Coleman cannula, fat injection is done from two different directions and in three different planes; superficial to the periosteum, deep to the dermis, and in between both planes.

Stage II: Release of the contracted eye socket:

Circumferential release of the contracted eye socket with restoration of adequate conjunctival fornices was done. Through pre-auricular approach with temporal extension; the temporalis muscle flap with an overlaying skin graft is transposed to the orbital cavity. The transposition of the temporalis muscle is done through lateral orbitotomy (Fig. 2).

A symblepharon ring and fenestrated conformer were inserted to the new conjunctival sac. Tarsorraphy was released 10 days post-operative to do

the skin graft first dressing. The symblepharon ring and the fenestrated conformer were reinserted to the conjunctival sac for 6-8 weeks.

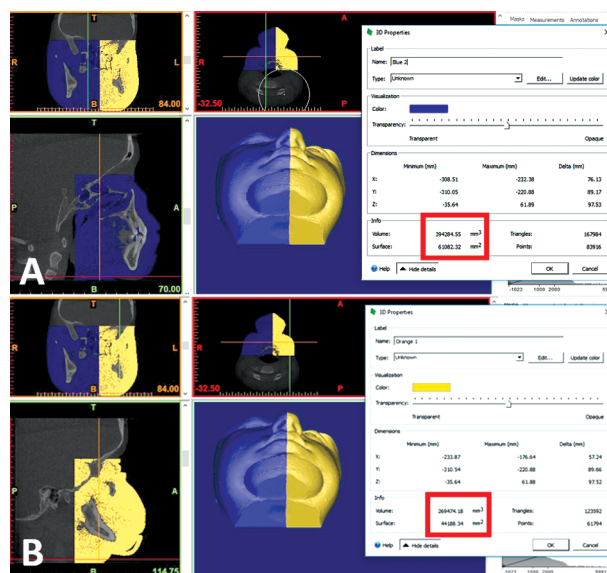


Fig. (1): (A) Cone beam CT facial for 19 years old female patient suffering from left CES with severe facial asymmetry. The normal hemi-face volume is 394284.55 mm³. (B) The left hemi-face volume is 269474.18. The difference is 124810.37 mm³. This means that the volume of fat needed for facial asymmetry correction is 124.8 ml $\approx$ 125 ml. The actual injected fat volume that achieved satisfactory facial symmetry in this patient was $\approx$ 109 ml.

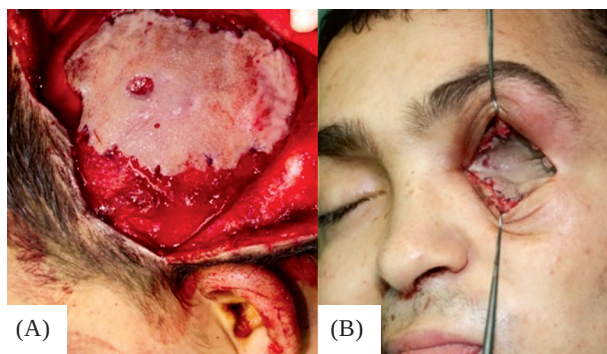


Fig. (2): (A) Twenty years old male patient suffering from left sever CES associated with facial asymmetry, a thick split thickness skin graft was fixed over the Temporalis muscle. (B) Release of the eye socket was done with Temporalis muscle flap transposition.

Stage III: Touch-up procedures:

Touch-up session of fat grafting were done in 6 patients; at least 6 months after the last operation to improve the outcome. Usually, when the amount of fat grafting needed in the first session exceeded 100ml a second session is expected. Touch procedures included session of fat injection and revision of scars. The sex, age, estimated and actual injected fat volumes, and number of fat injection session/s for each patient included in this study are recorded (Table 2).

Table (2): Sex, age, estimated and actual injected fat volumes, and number of fat injection session/s for each patient included in this study.

No.	Sex	Age	Estimated fat volume to be injected*	Actual injected fat volume**	Number of sessions
1	Male	21	98	86	2
2	Male	19	82	77	1
3	Male	18	105	92	2
4	Male	20	92	83	1
5	Male	26	106	99	2
6	Male	23	110	93	2
7	Male	24	94	89	1
8	Female	18	115	101	2
9	Female	19	125	109	2
10	Female	25	112	93	1

* The volume of fat to correct the facial asymmetry as estimated by the Cone Beam CT pre-operatively.

** The actual volume of injected fat that corrected the facial asymmetry.

Statistical methods:

IBM SPSS statistics (V. 24.0, IBM Corp., USA, 2016) was used for data analysis. Data were expressed as Mean±SD for quantitative parametric measures. The following tests were done:

- 1- Comparison between two independent mean groups for parametric data using Student *t*-test.
- 2- Pearson correlation test to study the possible association between each two variables among each group for para-metric data.

The probability of error at 0.05 was considered sig., while at 0.01 and 0.001 are highly significant.

RESULTS

Initial facial edema and bruises resolved in 10 to 14 days post-operative. Three months post-operative, the survived fat gave a reliable result upon which a decision can be made if another touch-up session of structural fat grafting was needed (Figs. 3,4). The eye sockets were released efficiently as proved by the ability gained to wear ocular prosthesis. The patients were satisfied with the aesthetic result of balanced face and correction of facial asymmetry. Improved skin and soft tissue qualities were noticed by both patients and the surgical team.



Fig. (3): Nineteen years old female patient suffering from left CES with sever facial asymmetry. (A & B). The actual fat volumes injected to correct facial asymmetry. (C) The patient was satisfied with three months post-operative result.

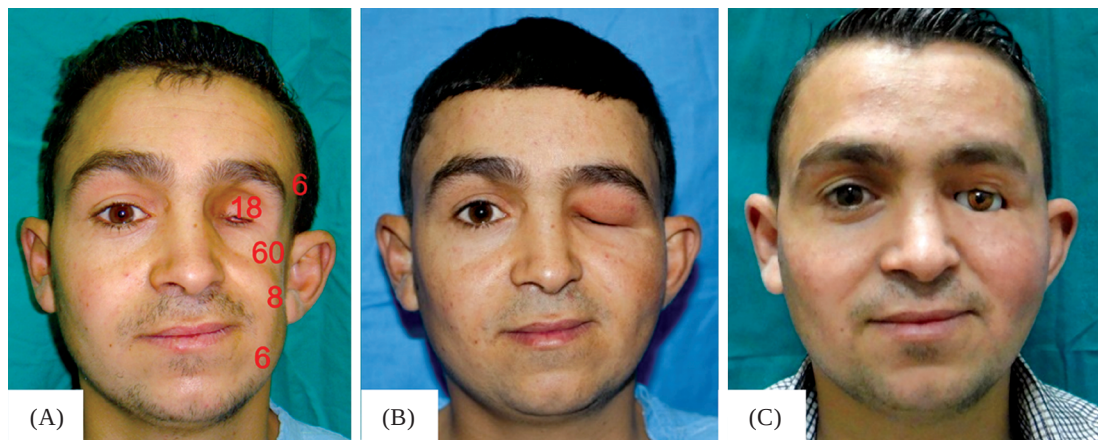


Fig. (4): (A & B) The actual fat volumes injected to correct facial asymmetry. (C) The patient was satisfied with six months post-operative result.

The statistical analysis of data showed significant reliability of the cone beam CT for estimation of the actual volume of fat needed to correct the facial asymmetry in our patients (Fig. 5). Multi-regression analysis was done to execute linear regression equation between actual to estimated volume of fat:

$$[Y = a + bX \text{ Or Actual injected fat volume} = 23.681 + 0.653 \times \text{estimated injected fat volume}]$$

Whereas a = Intercept; b = Slope. (a and b are constant factors elaborated from the Multi-regression data analysis).

So, the volume of fat needed for correction of facial asymmetry can be calculated pre-operatively using the estimated volume of fat recorded by the cone beam CT using the mentioned equation.

Also, there is positive significant correlation between the volume of actual fat injected and number of sessions among patients. The more the fat needed to correct the facial asymmetry, the more the number of sessions needed to be done (Fig. 6).

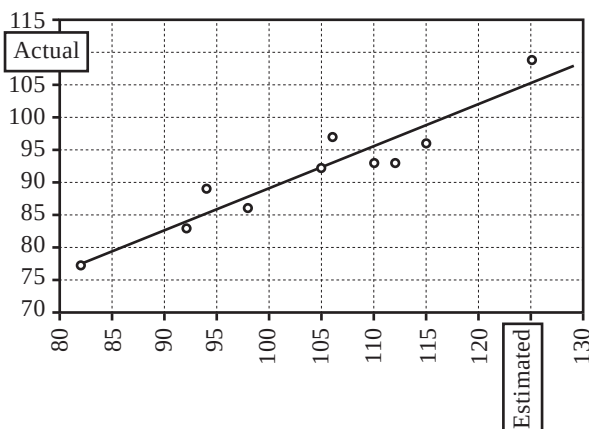


Fig. (5): Linear regression showing positive significant correlation between actual and estimated fat injection among all studied cases.

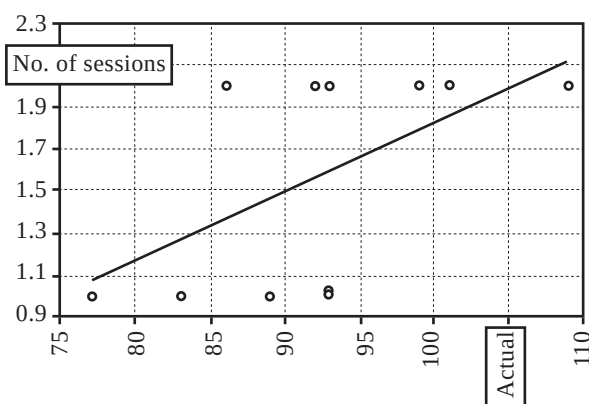


Fig. (6): Pearson Correlation Test: Showed positive significant correlation between the volume of actual fat injected and number of sessions among all studied cases.

Complications as post-surgical cicatricial alopecia, exaggerated temporal hollowing, visible motility at the lateral orbital area during mouth clinching, and frontal branch of facial nerve injury; all were related to temporalis muscle flap transposition during CES release (Table 3).

Table (3): Complications, number of affected patients, and the management offered to those patients.

Complications	Number of patients	Management
Cicatricial alopecia	5 males+2 female	Scar revision
Exaggerated temporal hollowing	3 males+1 female	Session of fat injection
Visible motility at the lateral orbital area during mouth clinching	2 males	Conservative
Weakness of the frontal branch of facial nerve	1 male+1 female	Conservative

DISCUSSION

Complications of orbital exenteration during early childhood include reduced orbital volume and CES. Moreover, it affects the growth of the adjacent facial skeleton resulting in hypoplasia of the malar eminence & mid-face causing significant facial asymmetry with an adapted occlusal cant. The profound facial asymmetry comprises the main concern for patients with severe CES [1,2].

Several grading systems that relate the degree of CES to the proposed proper management have been offered. Many authors applied Krishna grading system in different management algorithms [5,7,8,9]. Although the Krishna grading system for CES cases is widely accepted [4]; it doesn't offer a clear algorithm for management of different grades. In 1992 Guyuron offered a grading system that proposed a clear algorithm for management of different grades of CES based on the availability of different reconstructive options [6]. Nevertheless, in developmental cases of CES; management of the associated facial symmetry was not included in any of the grading systems available in literature.

In 1999, Mu and his co-workers used a single stage surgical procedure to release CES and to correct the related orbito-zygomatic hypoplasia only. The authors used chimeric flap based on the superficial temporal vessels; post-auricular skin paddle with attached tempro-parietal fascial flap. The skin paddle was used to release CES and the fascial flap was used as coverage for hydroxyapatite implant inserted to augment malar hypoplasia. This

study showed clinically satisfactory results for the CES release that enabled patients to wear artificial eye shell. Also, facial symmetry was regained giving the patients balanced facial contouring. Yet, it is technically demanding procedure and the hydroxyapatite implant complications as migration, extrusion and infection can't be excluded [3].

Methods for mid-face augmentation are either correcting the under laying deficient facial bone or adding camouflaging soft tissue. Mid-face bone deficiency can be corrected with on-lay bone grafts. High incidence of bone grafts resorption turned surgeons towards lamellar osteotomies with or without bone grafts [18-21], bone substitutes addition [22,23], and application of distractors [24,25].

For mid-face deficiency correction, adding camouflaging soft tissue is an easier successful strategy. Free flaps were used in many occasions for correction of facial asymmetry associated with craniofacial conditions. Free flaps offer remarkable volume that is successfully used in sever conditions of facial asymmetry [26-29]. Also, free flaps can be used in combination with bone grafts to achieve differential correction in different facial territories [30].

Fat injection is a camouflaging soft tissue. It is autogenous tissue that is available even in thin individuals without the risk of reaction nor rejection. Fat injection repeated sessions are tolerable because of the minimal morbidity, multiple donor areas, and affordable costs especially if compared with other synthetic fillers. The concept of structural fat grafting turned fat injection procedure into a versatile, reproducible technique, that is almost predictable in expert hands [10-17].

In advance cases of CES, the facial asymmetry is the result for deficiencies in multiples facial territories with variable degrees. The mid-face is the most affected territory in such cases. Fat injection offers a differential corrective tool with the ability to inject considerable volumes needed. Regional flaps can be used for single territory augmentation with the disadvantage of limited volume [3]. The free flaps need true segmentation properties to correct different territories in the same session [31], otherwise addition of bone grafts or bone substitutes is the alternative for multiple refashioning procedures [30]. Using free flaps, large tissue volume addition in one cavity increases the incidence gravitational migration or sagging. Moreover, free flaps have components related complications, as increase incidence of seromas in presence of dermal components; or remarkable volume

loss after disuse atrophy with the presence of muscle component [26,32]. Unlike fat injection, free flaps require special surgeon expertise, special equipment, longer hospital stay with close monitoring, possibility of revisions and total loss, higher donor site morbidity, these requirements make free flaps with higher costs if compared with fat injection.

Fat injection carries the benefits of the associated adipose derived stem cells (ADSC). Many preclinical and clinical trials are denoting the corrective effects of ADSC injection on irradiation tissues. Skin, scars, and the under laying soft tissues; all showed improved quality as regards the pliability, color, texture, and even associated tenderness if any [33-39].

Cone beam CT is used to evaluate skeletal structure in craniofacial deformities without soft tissue evaluation convenience, yet it can be used for reconstruction of 3D image of the craniofacial region. The normal hemi-face is used as a reference to estimate the volume of correction needed. In 2010, Yasas and his coworkers implemented stereophotogrammetry systems to evaluate the soft tissue deficiency in cases of hemifacial macrosomia instead of the routine 3D CT studies. Multiple cameras were used to input measurements of the affected hemi-face in comparison to the normal contralateral side as a reference. This technique is not invasive and can be used to follow the results of surgery done, but many standardizations about the photography distance, light intensity, distance are mandatory. The chosen mid-line may be not accurate as the soft tissue is deviated in cases of facial asymmetry. In case of cone beam CT scan, the mid-line is chosen in relation to fixed landmarks on bones with the advantage of lesser radiation dose than routine CT studies [40].

Conclusion:

Reconstruction of severe forms of CES should address both the CES release and the facial asymmetry simultaneously. Fat grafting is an efficient, easy and reproducible technique for camouflaging facial asymmetry associated with these cases. The use of cone beam CT scan assists in objectively estimating the volume of fat grafting needed.

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