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ORIGINAL ARTICLE

Conchal Cartilage Graft versus Titanium Mesh for traumatic Orbital Floor Defect Reconstruction

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ABSTRACT

Background: Various options of traumatic orbital floor defects were used over the past years which may be autologous as bone & cartilage graft or synthetic as titanium mesh and suprafoil mesh. The present work aimed to compare the outcomes of using autogenous conchal cartilage grafts and synthetic titanium mesh for better management of post-traumatic orbital floor defects reconstruction and to determine the most preferable materials for different sizes of the defect.

Methods: This was a non-randomized controlled trial where 18 patients were subdivided in 2 equal groups, (group I) for people treated with conchal cartilage graft where the defect was less than 2 cm^2, and (group II) for people treated with titanium mesh where the defect was more than 2 cm^2. For all patients several parameters were collected involving operation difficulties, radiological manifestations, operation time, early and late follow up, early and late surgical complications, pre and post-operative change in visual acuity and conchal cartilage graft donor site complications.

Results: Both groups showed satisfying results in reconstruction of orbital floor defect with higher operation time mean (2.8 ± 0.43 hrs. vs 2.44 ± 0.4 hrs.) and higher incidence of operation difficulties in group II (p=0.045). Early and late follow up in patients with conchal cartilage graft and titanium mesh showed improvement of signs and symptoms with few complications. All our results were nicely comparable to other results of many research works.

Conclusions: Titanium mesh (for orbital floor defects larger than 2 cm^2) and conchal cartilage graft (for the defects smaller than 2cm^2) were excellent and highly successful in orbital floor defect reconstruction. There are still controversial opinions on which implant material should be used for reconstruction of the orbital floor.

Keywords: Conchal Cartilage Graft; Titanium Mesh, traumatic Orbital Floor defect; Reconstruction

INTRODUCTION

Fractures of the face often involve the orbital floor. Facios maxillary fractures can occur singly or in clusters. The term "blow-out fracture" is used to describe isolated cracks in the medial wall or orbital floor. Fractures most frequently occur on the orbital floor and medial wall.. Out of all the facial fractures, 30-55 percent are orbital fractures [1].

The orbit is made up of the following bones: frontal, sphenoid, ethmoidal, lacrimal and zygomatic. Bones that make up the medial wall include the maxillary, lacrimal, and ethmoid. The backbone is the sphenoid bone. The side wall is formed by the zygomatic bone. Both the frontal and maxillary bones serve as inferior and superior boundaries, respectively. In addition to the two obliques, which are situated on either side of the eye, there are four rectus muscles that encircle the entire eyeball. A decrease in pressure from the extraocular muscles is assisted by the connective tissue and fat around the globe[٢].When it comes to men, orbital floor fractures are more commonly caused by assaults and car accidents, as well as sports injuries, whereas when it comes to women, accidental falls are the most common cause [1]. Orbital floor fractures are characterised by the following evaluations that call for further imaging: inability to look upwards, difficulty looking upwards, evaluation of trigeminal function, infraorbital rim tenderness or step-offs, subcutaneous emphysema, oculomotor function (global position, chemosis, and periorbital ecchymosis), abnormal gross visual acuity, as well as abnormal pupillary light reflex [٢].

If a computed tomography (CT) scan is required to rule out a blowout fracture following blunt orbital trauma, that imaging modality should be used. Standard radiograph When these conditions are present, it may lead one to suspect a fracture in the orbital floor: air-fluid level in the maxillary sinus, soft-tissue teardrop along the roof of the sinus, and subcutaneous emphysema[٢]. If a bone defect is present, the optimum material to repair an orbital floor fracture should be non-carcinogenic, lightweight bearing, easily contourable, radiopaque, infection resistant, and MRI compatible. It should also not transmit any diseases[1]. Reconstructing the orbital floor and rim using autografts, allografts, or alloplastic materials is a contentious topic. Infection, foreign body reaction, and exposure are the most significant consequences of alloplastic materials. The possibility of disease transmission is another major drawback of allografts. The use of donor sites for autologous grafts has been restricted due to donor site morbidity, higher process duration, and graft resorption, however other locations have been documented[1].

In recent years, a variety of reconstructive methods have been utilized, including synthetic materials like titanium mesh and suprafoil mesh, as well as autologous ones like bone and cartilage grafts. So, in this study, we aimed to compare the outcomes of using autogenous conchal cartilage grafts and synthetic titanium mesh for better management of post-traumatic orbital floor

defects reconstruction and to determine the most preferable materials for different sizes of the defect.

METHODS

Patients:This was a non-randomized controlled trial conducted from December 2022 to December 2023. Eighteen patients with orbital floor fractures either isolated or impure fractures which were associated with an orbital rim fracture, involving other skeletal elements: zygomatic, frontal, naso-ethmoidal, or maxillary bones were treated in the Plastic Surgery Department, Faculty of Medicine, Zagazig University Hospitals. Formal consent had been obtained from the patient or relatives for doing the surgery and all patients with photos in our study were asked for permission of appearance of their photos in this study. Zagazig University Institutional Review Board (IRB) approved the study (IRB#10248/22-12-2022).

Cases with the following criteria were included: All patients admitted to Zagazig University Hospital who were between 15 and 60 years old and had surgically indicated orbital floor fractures, either isolated or combined with other facial fractures, were included in the study.

Patients were divided into 2 groups: Group I: 9 patients reconstructed with conchal cartilage graft and Group II: 9 patients reconstructed with titanium mesh.

Patients with bilateral orbital floor fractures, severe panfacial comminution, blindness on the affected side, delayed presentation after 2 weeks, severe comorbidity that exclude the surgery, diplopia, ocular movement limitation due to neurological cause, or patients who refused to do the operation or not co-operative to evaluate ocular function, were excluded from our study.

Methods:All participants were subjected to Complete history taking including personal, complaint, present history with presenting complaint (related to orbital fractures): blurred vision, double vision, cosmetic disorders and neurosensory deficits. Full clinical examination, either general for all systems or local examination: Peri-orbital oedema, ecchymosis, eyelid lacerations, subconjunctival hemorrhage, diplopia, presence of (eno-exo)ophthalmos or hypoglobus, limitation of the extraocular muscles movements, peri-orbital surgical emphysema, bony tenderness and deformities at orbital margins, zygomatic arches, nasal bones and other maxillofacial fractures, and presence of hypoesthesia or paresthesia in the area supplied by infraorbital nerve. Opthalmic examination was done for visual acuity, extraocular muscles movements, globe integrity, and fundus examination.

Radiographic examination:Computerized tomography (CT):Coronal, axial, sagittal and 3D views at (1-2) mm cuts were required in all cases of our study preoperatively and 12 weeks after the operation.Routine laboratory evaluations were done to determine overall health and suitability for general anesthesia.

Technique:

Surgical approach (transcutaneous approach).(Cefotaxime 1 gm vial) was given 2 hours preoperatively to all the patients, and they were given the same antibiotic for 7 days after the operation. Anesthesia:All surgical procedures were performed under general anesthesia with endotracheal intubation and head elevated. Five (5) cc of local anesthetic (2% lidocaine with epinephrine 1: 200,000)

was infiltrated in the lower eyelid and along the inferior orbital rim to achieve a good hemostasis. An incision was made through the lower eye lid either sub-ciliary, sub-tarsal or infra orbital incision using scalpel through the skin.A subcutaneous dissection superficial to the orbicularis oculi was followed inferiorly by the surgeon using either sharp dissection until just inferior to the tarsal plate. A preseptal plane was then followed down to the orbital rim and splitting of the orbicularis oculi muscle till reaching the periosteum was done. The periosteum is incised on the anterior aspect of the inferior orbital rim and elevation proceeds posteriorly onto the orbital floor using a freer elevator and the malleable retractor can be used to continually retract the orbital contents and sub-periosteal dissection is carried out posteriorly to expose the desired portion of the orbital floor. The dissection was done from lateral to medial. The endpoint of dissection was reached when reducing all of the herniated tissue in the orbit and exposing the bone of the unfractured orbit in a circumferential fashion. Once the size and shape of the defect have been assessed, a titanium mesh or conchal cartilage graft was placed above the orbital shelf. A forced duction test was done after the implant has been placed to ensure eye mobility. The released periosteum was reattached to the orbit rim by absorbable suture and skin was approximated by simple interrupted non-absorbable suture.

Early post-operative care: Stitches were removed 7 days after the operation. The patients were advised for head elevation 45° for 7 days Observation of visual acuity, diplopia, enophthalmos, limitation of eye movement or infra-orbital hyposthesia was done.

Follow up: All the patients included in this study were followed monthly for 3 months. Follow up parameters included: Extraocular muscle function, visual acuity, (Eno/exo)phthalmos, diplopia, Scarring and ectropion, extrusion and infection

Radiological assessment: Computerized tomography (CT): Coronal, axial, sagittal and 3D reconstructions at (1-2) mm cuts were done in all cases of our study after 3 months after the operation. All patients were documented pre and post operatively by photos and videos.

Data collection:The following data were collected: Indication of surgery (en/exophthalmos, diplopia, limitation of eye movement or deformity, etc.), radiological manifestations, interval from injury to surgery, the surgical approach (sub-ciliary, sub-tarsal, infra-orbital), size of the orbital floor defect, type and size of the implant, any operation difficulties, operation time, any early or late pot-operative complications, residual diplopia, vertical dystopia or hypoglobus, wound infection and implant extrusion, Ectropion, scarring, scleral show, visual acuity changes pre and post operatively in the affected eye.

STATISTICAL ANALYSIS

All data were collected, tabulated and statistically analyzed using (IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.). Quantitative data were expressed as the mean ± SD & (range), and qualitative data were expressed as number & (percentage).Independent sample T test (T): when comparing between two groups (for normally distributed data). Chi-square

test: was used when comparing between non-parametric data.

RESULTS

Statistically significant increased age (with p value of 0.017) was found in group I patients (39.3 ± 12.3 years) in comparison to group II patients (25.3 ± 9.7 years), In all patients, road traffic accidents were the cause of orbital floor fracture, In group I, 3 patients (33.3%) presented with pure fractures, while 6 patients (66.7%) were associated with other fractures had impure fractures (3 patients (50%) with zygomatico-maxillary complex fractures, 2 patients (33.3%) with lateral orbital wall fractures, 1 patient (16.7%) with frontal bone fractures). In group II, all patients (100%) had impure fractures (5 patients (55,6%) with zygomatico-maxillary complex fractures, 2 patients (22.2) with lateral orbital wall fractures, 2 patients (22.2%) with nasal fractures, 1 patient (11.1%) with frontal bone fracture),description of radiological manifestations in patients with conchal cartilage graft are also demonstrated in (Table 1).

No statistically significant difference was found between both groups as regardtime interval from injury to surgery and operative timewith higher operation time mean (2.8 ± 0.43 hrs. vs 2.44 ± 0.4 hrs.) in group II (Table 2).

There was a high statistically significant smaller implant size of group I patients when compared with group II patients (205.2 ± 20.3 mm^2 vs 341.1 ± 40.2^2 with p value< 0.001),also high statistically significant smaller size of orbital floor defect was found in group I patients when compared with group II patients (143.1 ± 23.4 mm^2 vs257.1 ± 36.3 mm^2 with p value < 0.001), also statistically significant decreased percentage of operative difficulty was found in group I patients when compared with group II patients (p=0.045),•As regard group I there was only 1 patient (11.1%) with difficult complete reduction of the orbital content. As regard group II there was 1 patient (11.1%) with fragmented orbital floor, 1 patient (11.1%) with difficult complete reduction of zygomatico-maxillary complex fracture, 1 patient (11.1%) with difficult complete reduction of the herniated orbital content and 1 patient (11.1%) with difficult complete exposure of orbital floor defect (Table 3). No statistically significant differences were found between both groups as regard early, late follow up data, complications, visual acuity and complications (hematoma or infection) that occurred at donor site of conchal cartilage graft patients (Table 4).

Male patient 16 years old male with right orbital floor fracture who had impure fracture, indication of surgery wasdiplopia and movement limitation in upward gaze, managed using titanium mesh implant. (Figure 1).

Female patient 26 years old male with left orbital floor fracture who had impure fracture, indication of surgery wasdiplopia and movement limitation, managed using conchal cartilage graft implant (Figure 2).

Table (1): Comparisons of demographic data and different parameters between studied groups.

		Group I (N = 9)		Group II (N = 9)		Stat. test	P-value
Age(years)	**Mean ±SD**	39.3± 12.3		25.3± 9.7		**T = 2.67**	**0.017 S***
	Range	16 – 55		16 – 47			
Sex	**Male**	6	66.%	6	66.7%	X^2 = 0.0	1.0 NS*
	Female	3	33.3%	3	33.3%		
		Group I (N = 9)		**Group II (N = 9)**		**Stat. test**	**P-value**
Fracture type	**Pure fracture**	3	33.3%	0	0%	X^2 = 3.6	0.057 NS*
	Impure fracture	6	66.7%	9	100%		
Fracture side	**Right side**	4	44.4%	2	22.2%	X^2 =1.0	0.317 NS*
	Left side	5	55.6%	7	77.8%		
		Group I (N = 9)		**Group II (N = 9)**		**X^2**	**P-value**
Surgery indications	**Enophthalmos**	2	22.2%	6	66.7%	3.6	0.057 NS*
	Diplopia	6	66.7%	6	66.7%	0.0	1.0 NS*
	Movement limitation	6	66.7%	6	66.7%	0.0	1.0 NS*
	Deformity	2	22.2%	2	22.2%	0.0	1.0 NS*

Radiological manifestations in patients with conchal cartilage graft (group I).		**Studied patients (N = 9)**	
Radiological manifestations	**Bone displacement**	2	22.2%
	Soft tissue herniation in maxillary sinus	5	55.6%
	Inferior rectus muscle herniation in maxillary sinus	1	11.1%
	Trap door fracture	1	11.1%

Radiological manifestations in patients with titanium mesh (group II)		**Studied patients (N = 9)**	
Radiological manifestations	**Bone displacement**	4	44.4%
	Soft tissue herniation	3	33.3%
	Inferior rectus muscle herniation	1	11.1%
	inferior displacement of the globe, fragmented part of the orbital floor	1	11.1%

T: independent sample T test. *S: p-value < 0.05 is considered significant.
X^2: Chi-square test. *NS: p-value > 0.05 is considered non-significant.

Table (2): Comparisons of time Interval (in days) from injury to surgery and operative time between studied groups.

		Group I (N = 9)	Group II (N = 9)	Stat. test	P-value
Interval from injury to surgery(days)	**Mean ±SD**	8.0± 3.6	8.0± 2.6	T = 0.0	1.0 NS*
	Range	3 – 13	4 – 12		
Operative time(hours)	**Mean ±SD**	2.44± 0.4	3± 0.43	T = 2.0	0.063 NS*
	Range	2 - 3	5 – 3.5		

T: Independent sample T test. *NS: p-value > 0.05 is considered non-significant.

Table (3): Comparisons of implant size (in mm^2), and surgical data between studied groups

		Group I (N = 9)	Group II (N = 9)	Stat. test	P-value
Implant size(mm²)	Mean ±SD	205.2 ± 20.3	341.1 ± 40.2	T = 9.03	< 0.001 HS*
	Range	180 - 240	272 – 396		

		Group I (N = 9)		Group II (N = 9)		Stat. test	P-value
Surgical approach	Sub-ciliary	3	33.3%	1	11.1%	X^2 = 3.6	0.165 NS*
	Sub-tarsal	3	33.3%	7	77.8%		
	Infraorbital	3	33.3%	1	11.1%		
Size of the orbital floor defect (mm²)	Mean ±SD	143.1 ± 23.4		257.1 ± 36.3		T = 7.9	< 0.001 HS*
	Range	100 - 182		210 - 320			
Any operation difficulty	No	8	88.9%	5	55.6%	X^2 = 4.0	0.045 S*
	Yes	1	11.1%	4	44.4%		

*HS: p-value < 0.001 is considered high significant.
T: Independent sample T test. *S: p-value < 0.05 is considered significant.
X^2: Chi-square test. *NS: p-value > 0.05 is considered non-significant.

Table (4): Comparisons of follow up data, complications, and visual acuity between studied groups and complications occurred at donor site of conchal cartilage graft patients

		Group I (N = 9)		Group II (N = 9)		X^2	P-value
Early follow up	Enophthalmos	2	22.2%	2	22.2%	0.0	1.0 NS*
	Diplopia	1	11.1%	1	11.1%	0.0	1.0 NS*
	Movement limitation	1	11.1%	1	11.1%	0.0	1.0 NS*
	Deformity	0	0%	0	0%	----	----
Late follow up	Enophthalmos	1	11.1%	2	22.2%	0.4	0.527 NS*
	Diplopia	1	11.1%	1	11.1%	0.0	1.0 NS*
	Movement limitation	1	11.1%	1	11.1%	0.0	1.0 NS*
	Deformity	0	0%	0	0%	----	----
Early surgical complications	Ectropion	0	0%	0	0%	----	----
	Extrusion	0	0%	0	0%	----	----
	Infection	0	0%	0	0%	----	----
Late surgical complications	Ectropion	1	11.1%	1	11.1%	0.0	1.0 NS*
	Extrusion	0	0%	0	0%	----	----
	Infection	0	0%	0	0%	----	----
	Recurrent infra-orbital edema	0	0%	1	11.1%	1.05	0.303 NS*
Change in visual acuity	No	9	100%	9	100%	----	----
	Yes	0	0%	0	0%		

		Conchal cartilage graft patients (N = 9)	
Donor site complications	Hematoma	0	0%
	Infection	0	0%

X^2: Chi-square test. *S: p-value > 0.05 is considered non-significant.

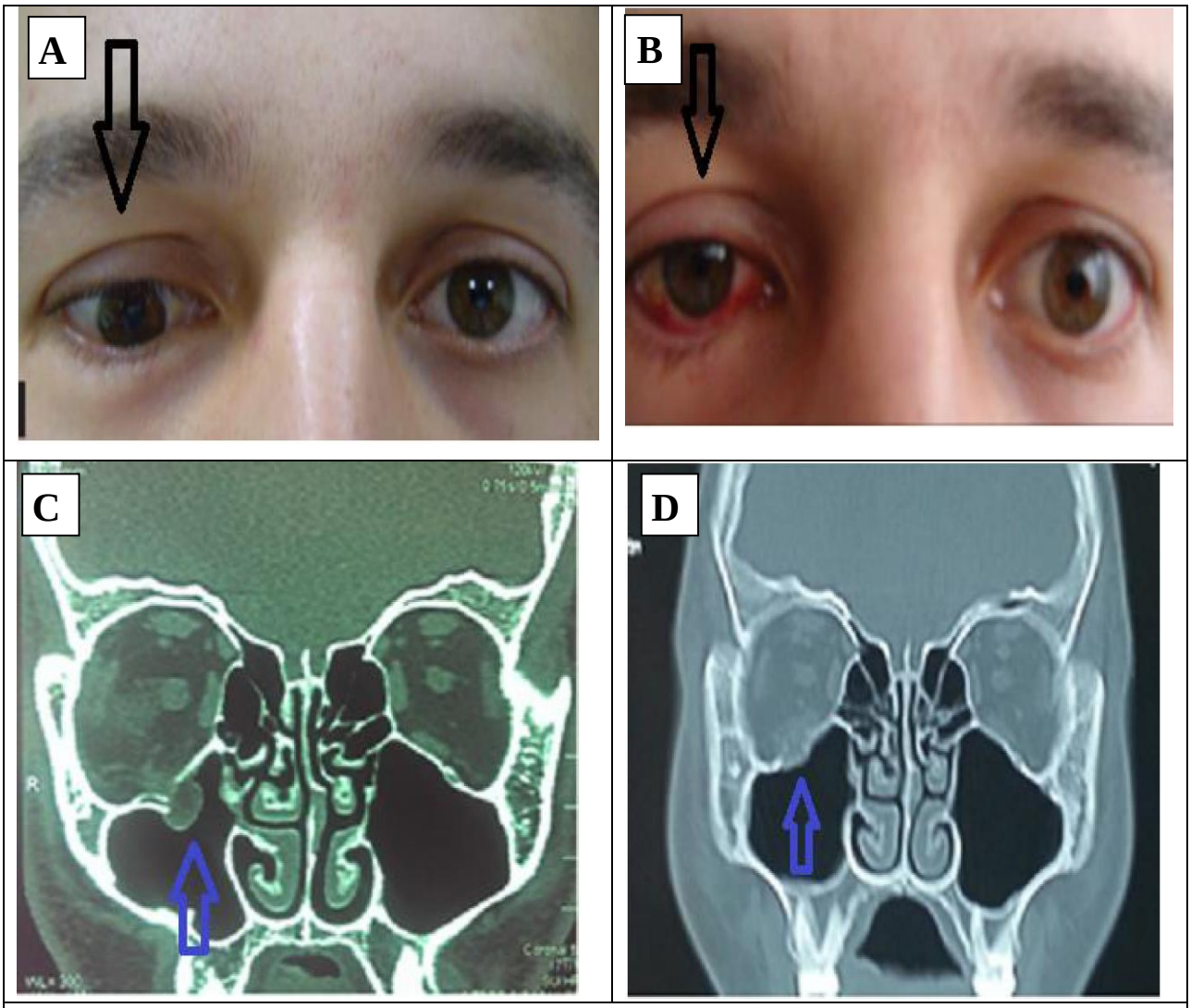

Figure. 1. Case 1(A) pre-operative diplopia and movement limitation in the right eye. (B) post-operative correction of diplopia and eye movement in the same patient (C) pre-operative CT coronal section showing herniation of the orbital content. (D) Post-operative CT coronal section of the same patient after reduction of the orbital content and floor defect reconstruction by titanium mesh.

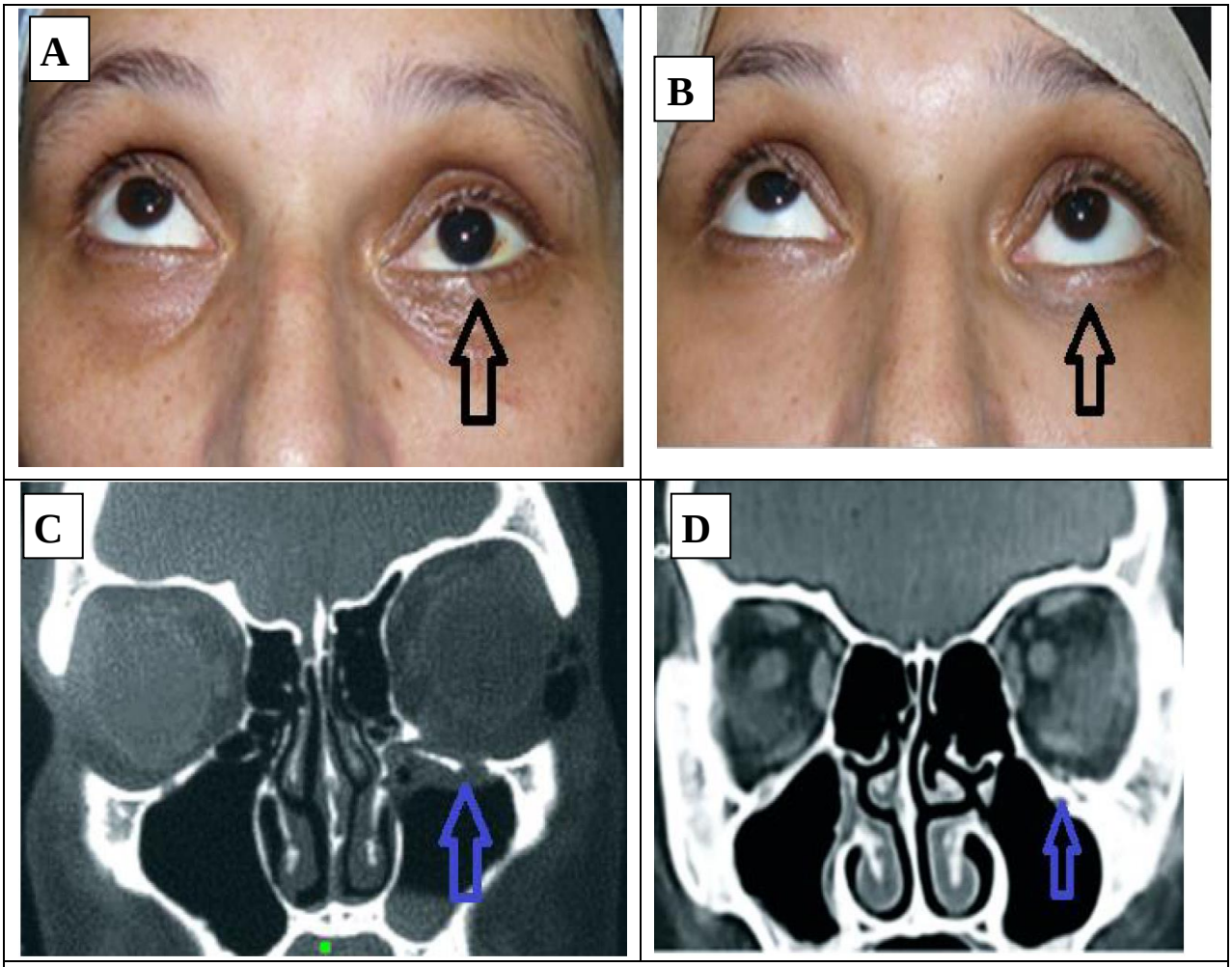

Figure 2. Case 2(A) pre-operative diplopia and movement limitation in the left eye. (B) post-operative improvement of diplopia and eye movement in the same patient (C)pre-operative CT coronal section showing herniation of the orbital content and bone displacement (D)post-operative CT coronal section of the same patient after reduction of the orbital content and floor defect reconstruction by conchal cartilage graft

DISCUSSION

The main aims of reconstructing orbital floor defect are: to restore the continuity of the orbital floor, provide a support for the orbital contents, prevent fibrosis of the damaged walls, and prevent herniation of the orbital contents into the maxillary or ethmoidal sinuses (which causes atrophy of orbital tissues, enophthalmos, and altered movements of the globe). The simple reduction of orbital walls to restore the volume by releasing the orbital and periorbital compartments is usually not enough, because these fractures are often multiple and simple repositioning of the fractured bones in their early anatomical position is not feasible. An implant is therefore necessary to reconstruct the floor of the orbit. The materials available for this purpose are either autogenous grafts or alloplastic materials [3].

In this study we have aimed to compare the outcomes of using autogenous conchal cartilage grafts and synthetic titanium mesh for better management of post-traumatic orbital floor defects reconstruction and to determine the most preferable materials for different sizes of the defect. The choice of both materials arose from the fact that titanium mesh is the most available synthetic material in the Egyptian market with affordable price. The conchal cartilage graft is easy to harvest, thin, moldable, in the same

surgical field with minimal donor site morbidity. Patients with orbital floor defect were subdivided into two groups; 9 patients in each group. **Group I**was managed using conchal cartilage grafts, and **group II** was managed using titanium mesh .Males were predominant in both studied groups. The mean age of patients of both studied groups showed that most patients fall in the category of middle age. Seven et al. [4] andMohamed et al. [5] reported similar results in their patient's population. This can be attributed to the fact that this is the age of joining the work and social activities in our community especially males. RTA was the only cause of fractures in our patient's population. Sugar et al. [6] and Mohamed et al. [7] reported that other causes are present in addition to RTA. The high incidence of RTA as the cause of maxillofacial fractures in our community is a fact that cannot be ignored. The crowded streets and the culture of not following the traffic rules from both the pedestrians and the vehicle drivers are obvious causes in our community.

In the present study, impure fractures were the majority in group I and were the only type of fractures in group II. These findings are nearly similar to Mohamed et al. [5] study who reported that 70% of his cases were of the impure category. This can be explained by the fact the cause of fractures in our patients' population are due to RTA with higher impact of trauma that causes other facial bone fractures. Pure orbital floor fractures are usually due to localized direct trauma to the globe or inferior orbital rim that is usually caused by interpersonal violence or falling.

As regard indications for surgery, diplopia and limitation of eye movement in upward gaze were the predominant indications in both studied groups followed by enophthalmos and deformity. This agrees with Seven et al. [4]andMohamed et al. [7] who reported that diplopia was the predominant indication of surgery. However,Mohamed et al. [5] reported that enophthalmos was the predominant indication of surgery followed by diplopia, limited ocular motility and hypoglobus in that order. In our study, enophthalmos was more common in group II than in group I as well as hypoglobus was only reported in group II. This can be explained by the larger size of the orbital floor defects and that the majority of cases of group II are of the impure type. This obviously will cause increase the orbital volume with subsequent enophthalmous and may be hypoglobus in severer cases. CT examinations were performed on all study subjects before surgery, immediately after surgery, and at final follow up after 3 months. CT radiological examination allowed us to preoperatively identify presence of floor defect, bone displacement, soft tissue and inferior rectus muscle herniation, inferiorly displaced globe, fragmentation of the orbital floor, and trap door fracture. CT also allowed us to confirm post-operative implant position and orbital content complete reduction. It is the gold standard investigation in orbital floor fracture especially coronal view for demonstrating floor defects and soft tissue or muscle herniation, and sagittal view for confirmation of post-operative proper implant positioning over the floor. Although estimation of the area of the fracture defect on CT using geometric formulas is not precise, both views are useful to report a nearly length of the fracture at the time of the initial injury, despite the lack of standardized measurement methods.

According to Reiter et al. [8]a large defect in the CT (variably defined as defect either

greater than 1 cm^2 or involving more than 50% of the floor) solely, is a relative indication for orbital floor defect reconstruction. Unfortunately, calculation of defect size was not done in our study due to unavailability of the software.We performed the reconstruction of the orbital floor within 2 weeks to allow resolution of soft tissue edema that can improve exposure and facilitate dissection. However, when there were radiological as well as clinical manifestation of entrapment of extraocular muscles or soft tissue, surgical intervention was done as soon as possible to prevent fibrosis and necrosis. In one patient, the intervention was performed as early as 3 days after trauma because of trap door orbital floor fracture. In Wi et al. [9]patients who underwent operation within 14 days after trauma had a better reconstruction rate at final follow up than patients who underwent operation over 14 days after trauma. In our opinion, the presence of combined clinical and radiological manifestations of soft tissue herniation in the maxillary sinus justifies the early surgical interference when the condition of the patient allows that. We can say that, CT enhances the correctness of clinical diagnosis. According to Shah et al. [10], the incidence of persistent diplopia in isolated orbital floor fracture when CT shows soft tissue herniation is high. Patients with persistent diplopia associated with evidence of soft-tissue entrapment on computed tomographic (CT) imaging require surgical exploration and repair [11].In our study, the orbital floor defect size in **group I** (<2 cm^2) was significantly smaller than **group II** (>2 cm^2), and patients were non-randomizedly grouped according to these measurements, and as a result there was also significant difference between implants sizes in both groups (**table 9**). The larger floor defect size in **group II** may explain increased incidence of operative difficulties. Complete reduction of the herniated orbital contents, complete exposure of the orbital floor defect, complete reduction of zygomatico-maxillary complex, and fragmentation of orbital floor make it difficult to find stable points for implant placement in the same group(44.4%) when compared with **group I** (11.1%) with consequent increased mean operative time in **group II** more than **group I** to address these problems.

In a study done by Castellani et al. [12], they used auricular cartilage to reconstruct the small orbital floor defect up to (up to 2 x 2 cm). The follow up of the cases showed good improvement of clinical signs as diplopia, enophthalmos, tissue entrapment and bone displacement. In their experience, cartilage grafts larger than (2.5 x 2.5 cm) should not be taken, to avoid any iatrogenic deformation of the auricle.

According to Wang et al. [13] titanium mesh is suitable for reconstruction of large sized defects. Mohamed et al. [7] used unilateral conchal cartilage graft to reconstruct orbital floor with defect size up to (1.5 cm^2), and used sutured biconchal cartilage grafts for defect size (1.5-2 cm^2).Mohamed et al. [5] recommended usage of Cartilage graft in small sized defects (less than 2.5 cm^2) and pediatric patients regardless of the defect size, and usage of Titanium mesh in large sized defects (more than 2.5 cm^2). In our opinion, conchal cartilage graft is suitable for small sized defects (<2 cm^2) due to its natural curvature that nicely fits the orbital floor, availability, minimal donor site morbidity. We recommend titanium mesh for large orbital floor defect (>2 cm^2) as it is light, weight bearing, easily contoured, radio-opaque, has low incidence of infection,

availability in our market and affordability. Use of bilateral conchal grafts can be tried to overcome the situation of larger sized defects. It can be a subject of study in the future. Only transcutaneous approach with different varieties were used in our study, sub-ciliary (22.3%), sub-tarsal (55.6%), and infraorbital (22.3%).There were no early surgical complications, but with time, some late surgical complications started to appear as ectropion in 2 cases with sub-ciliary approach, recurrent edema in 1 case with infra-orbital approach. The ectropion following the subciliary approach may be attributed to thin skin flap during dissection which predispose to scar contracture and lower lid retraction. Although infra-orbital approach provides quick and direct way to the orbital floor, it caused Recurrent edema in one patient in our study which resolved spontaneously just by simple eye lid massage. This may be due to its location between thin skin of the eyelid and thicker cheek skin and affection of lymphatics. To reduce these complications in our study, scar was routinely massaged from medial to lateral and from downward to upward after wound healing, and we also used cold bags on the surgery site for the first 2 days then warms bags.

We prefer subtarsal approach as it provided good access to the orbital floor, results minimal almost invisible scarring if put in the subtarsal lid crease and minimal incidence of ectropion because the flap elevated is musculocutaneous. This agrees with Patel et al. [11] who reported that the sub-ciliary incision has been associated with a higher risk of cicatricial ectropion and may lead to significant scarring. In their report, the subtarsal incision generally provided the most direct access to the orbital rim and floor but has been noted to leave substantial visible scarring which was not the case in our series. According to Subramanian et al. [14], the 3 modalities of skin incision provided adequate exposure to fracture site with minimal time difference from skin incision till exposure among the 3 approaches. In their study scar was more visible in infra-orbital incision, and less in sub-tarsal incision and least in sub-ciliary incision. (2/10) of their patients with infra-orbital incision developed prolonged edema. Scar faded over time with the 3 modalities of incision, and also edema resolved within the first month of surgery in the infra-orbital incision group. No ectropion developed in the 3 groups.

There was a significant improvement as regard limited ocular motility, diplopia, enophthalmos and deformity by the use of both titanium mesh and conchal graft. In the current study, persistent enophthalmos was present in 2 patients in **group I** one of them improved after 3 months may be due to remodeling. While in **group II** there was enophthalmos in 2 patients in early and late follow up may be due to large defect size and subsequent fibrosis. As regard diplopia and movement limitation, all cases showed improvement except 1 case in **group I** which preoperatively had soft tissue herniation and 1 case in **group II** which preoperatively had inferior rectus muscle herniation, these findings could be due to subsequent fibrosis as the follow up CT examination showed no soft tissue herniation in the maxillary sinus. All other deformities were addressed and showed good improvement.

There was no significant difference between the 2 groups, even if it was predicted, to find more enophthalmos or diplopia in **group II** due to larger size of the defect and encountered difficulties, but results were satisfying due to good exposure and complete

reduction of the orbital content and stable placement of the implant in both groups.The same findings were reported Mohamed et al. [5]. They reported significant improvement of limited ocular motility & diplopia by the use of both titanium mesh and conchal graft. Enophthalmos was improved in all cases managed by titanium mesh while in patients with large-sized defects managed by cartilage graft, 2 of them showed persistent enophthalmos. This may be attributed to subsequent fibrosis, otherwise, all cases with small-sized defects reconstructed with cartilage graft were totally improved.

There was no change in visual acuity in both studied groups. About the donor site morbidity; which is one of the most important concerns of autogenous grafts, there were no recorded donor site complications in the participating cases in **group I.** According to Mischkowski et al. [15] Cartilage graft harvest from the auricle can be considered as a relatively safe procedure with a favorable aesthetic outcome, as hematoma occurred in just (6.7%) of patients early post-operative period and sensory impairment occurred in (3.3%) of patients only and it was related to the concha. In our study, good aseptic condition and light bandage after taking the graft from the auricle played an important role in prevention the complications.

CONCLUSIONS

There are still controversial opinions on which implant material should be used for reconstruction of the orbital floor. Nevertheless, in this study, the results were assessed statistically to reach the conclusion that titanium mesh (for orbital floor defects larger than 2 cm^2) and conchal cartilage graft (for the defects smaller than $2cm^2$) are excellent and highly successful in orbital floor defect reconstruction. Although the result of this study is very comparable to other studies, we recommend it to be done on a larger patient population. Use of bilateral conchal cartilage grafts can be tried in future studies to increase the liability of its use for large orbital floor defects, so that the study can be randomized.

Conflict of Interest: None.

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REFERENCES

1. Chattopadhyay C, Dev V, Pilania D, Harsh A. Reconstruction of Orbital Floor Fractures with Titanium Micromesh: Our Experience. J Maxillofac Oral Surg. 2022;21(2):369-78.
2. Koenen L, Waseem M. Orbital Floor Fracture. In: StatPearls. Treasure Island (FL): StatPearls Publishing; December 15, 2023.
3. Bayat M, Momen-Heravi F, Khalilzadeh O, Mirhosseni Z, Sadeghi-Tari A. Comparison of conchal cartilage graft with nasal septal cartilage graft for reconstruction of orbital floor blowout fractures. Br J Oral Maxillofac Surg. 2010;48(8):617-20.
4. Seven E, Tellioglu AT, Inozu E, Ozakpinar HR, Horoz U, Eryilmaz AT, et al. Reconstruction of Orbital Floor With Auricular Concha. J Craniofac Surg. 2017;28(7):713-7.
5. Mohamed H, Mabrouk A, Setta H, Amin E. A Retrospective Study that Evaluates Reconstruction of Orbital Floor Fractures with Titanium Mesh and Cartilaginous Graft. EJPRS 2022;46(2): 197-203.
6. Sugar AW, Kuriakose M, Walshaw ND. Titanium mesh in orbital wall reconstruction. Int J Oral Maxillofac Surg. 1992;21(3):140-4.
7. Mohamed E, Setta H, El Shahat A. Comparative Study between Conchal Cartilage Grafts and Split Rib Grafts in the Reconstruction of Orbital Floor Fractures. EJPRS 2018; 42(2): 273-7.

8. Reiter MJ, Schwope RB, Theler JM. Postoperative CT of the Orbital Skeleton After Trauma: Review of Normal Appearances and Common Complications. AJR Am J Roentgenol. 2016;206(6):1276-85.
9. Wi JM, Sung KH, Chi M. 'Orbital volume restoration rate after orbital fracture'; a CT-based orbital volume measurement for evaluation of orbital wall reconstructive effect. Eye (Lond). 2017;31(5):713-9.
10. Shah HA, Shipchandler TZ, Sufyan AS, Nunery WR, Lee HB. Use of fracture size and soft tissue herniation on computed tomography to predict diplopia in isolated orbital floor fractures. Am J Otolaryngol. 2013;34(6):695-8.
11. Patel S, Shokri T, Ziai K, Lighthall JG. Controversies and Contemporary Management of Orbital Floor Fractures. Craniomaxillofac Trauma Reconstr. 2022; 15(3):237-45.
12. Castellani A, Negrini S, Zanetti U. Treatment of orbital floor blowout fractures with conchal auricular cartilage graft: a report on 14 cases. J Oral Maxillofac Surg. 2002;60(12):1413-7.
13. Wang S, Xiao J, Liu L, Lin Y, Li X, Tang W,et al. Orbital floor reconstruction: a retrospective study of 21 cases. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2008;106(3):324-30.
14. Subramanian B, Krishnamurthy S, Suresh Kumar P, Saravanan B, Padhmanabhan M. Comparison of various approaches for exposure of infraorbital rim fractures of zygoma. J Maxillofac Oral Surg. 2009;8(2):99-102.
15. Mischkowski RA, Domingos-Hadamitzky C, Siessegger M, Zinser MJ, Zöller JE. Donor-site morbidity of ear cartilage autografts. Plast Reconstr Surg. 2008;121(1):79-87.
16. FIGURE LIGAND Figure. 1.Case 1(A) pre-operative diplopia and movement limitation in the right eye. (B) post-operative correction of diplopia and eye movement in the same patient (C) pre-operative CT coronal section showing herniation of the orbital content. (D) Post-operative CT coronal section of the same patient after reduction of the orbital content and floor defect reconstruction by titanium mesh.
17. Figure 2. Case 2(A) pre-operative diplopia and movement limitation in the left eye. (B) post-operative improvement of diplopia and eye movement in the same patient (C)pre-operative CT coronal section showing herniation of the orbital content and bone displacement (D)post-operative CT coronal section of the same patient after reduction of the orbital content and floor defect reconstruction by conchal cartilage graft.

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