Fractured Orbital Wall Reconstruction With an Auricular Cartilage Graft or Absorbable Polyacid Copolymer

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Objective: The objective of the study was to compare the functional and aesthetic results of fractured orbital wall reconstruction with an auricular cartilage graft or absorbable polyacid copolymer.

Materials and Methods: Twenty patients with blow-out orbital fracture/orbital floor associated or not with the medial wall were assessed by the same craniofacial surgical group. All were evaluated preoperatively and postoperatively by an ophthalmologist for diplopia, enophthalmos, exophthalmos, sensitivity, ophthalmic reflexes, intraocular pressure, and visual field.

The patients were subjected to a preoperative facial multislice computed tomographic scan, repeated 6 months after surgery. Eight patients underwent reconstruction with an auricular cartilage graft, and 12 patients, with blade absorbable polyacid copolymer. Subtarsal access was used for all patients.

Results: Two patients showed temporary ectropion, 1 in each group. All patients presented satisfactory ocular function, and all tests revealed good orbital delineation, orbital symmetry, periorbital sinus individualization, and reduction of blow-out.

Conclusions: The blow-out orbital wall reconstruction can be performed with the use of an auricular cartilage or with a blade absorbable copolymer without differences regarding functional or aesthetic complications and sequelae.

Key Words: Orbital fracture, cartilage graft, absorbable copolymer, orbital reconstruction, orbital trauma

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Blow-out medial wall and/or orbital floor fracture, presenting ethmoidal and/or maxillary sinus periorbital fat evagination, enophthalmos, diplopia, decreased ocular mobility, or even attachment, if eyeball extrinsic muscles are plucked or get stuck in these tight bone fragments, requires craniofacial surgery.[1,2]

Different techniques may be used to access the orbital fracture: subtarsal, transconjuntival, or even a nasal endoscopic access.[3,4] Different materials can also be used to correct blow-out and fractured orbital walls, either autogenous or alloplastic material, whether absorbable.[2,5–8] Because there is no consensus about the best material to be chosen, it was decided to compare orbital reconstruction between 2 closely similar patient groups, varying only on the material used.

The aim of the study was to compare fractured blow-out orbital wall reconstruction with an auricular cartilage graft or absorbable copolymer poly-L-lactic acid (82%) and poly-L-glycolic (18%) regarding functional and aesthetic aspects and results.

MATERIALS AND METHODS

This was a descriptive, prospective, randomized study, initiated in September 2006 involving 20 patients with a diagnosis of orbital floor blow-out fracture in association or not with medial wall fracture, who were attended and managed by the same craniofacial surgical team.

Medical care and preoperative evaluation involved the following steps: a specialized craniofacial consultation was requested in the emergency department always including a noncontrast facial computed tomography (CT), and once an orbital fracture was discovered, ophthalmologic evaluation was requested as soon as possible (Table 1).

Surgery was indicated, regardless of the area of the defect, when orbital fracture showed: orbital blow-out and/or decreased ocular mobility, attachment associated with diplopia, enophthalmos, or any significant ocular functional compromise directly caused by the fracture.

The surgical technique was standardized for all patients as follows: subtarsal incision (subciliar), anatomic dissection, and subperiosteal orbital floor dislocation with a wide exposure of the traumatic defect. The orbital defect was obliterated with an ipsilateral auricular cartilage shell or copolymer poly-L-lactic acid (82%) and poly-L-glycolic (18%), heated and molded according to the traumatic defect without any type of fixation.

The 20 patients were randomly divided into 2 main groups based on the reconstruction material used to reshape orbital wall defects. The following data were recorded for all patients: sex, age, type of trauma, orbital fracture topography, other fractures' topography, clinical signs and symptoms, radiologic data, and transitional and permanent sequelae (Tables 2–9).

RESULTS

Eight patients (40%) with orbital fractures were treated using an auricular cartilage graft, whereas twelve (60%) had their orbital walls remodeled using absorbable copolymer material. The mean ages of the patients were 54 years for the grafting group and 42 years for the copolymer group. Six patients in the grafting group (75%) and 11 in the copolymer material group (92%) were men (Table 2).

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TABLE 1. Clinical-Radiologic Assessment

	Clinical-Radiologic Assessment	
Specialty	**Preoperative Assessment**	**Postoperative Assessment**
Craniofacial surgery	From the day of trauma up to 1 wk	Monthly until the sixth month
Ophthalmologist	Preoperative consultation	Monthly until the sixth month
Radiology	Facial CT	Control CT 6 mo latter

TABLE 2. Demographic Data

	Demographic Data	
Variables	**Cartilage**	**Copolymer**
No. patients, n (%)	8 (40)	12 (60)
Median age, y	54	42
Male sex, n (%)	6 (75)	11 (92)

TABLE 3. Type of Trauma

	Type of Trauma, n (%)	
Variables	**Cartilage**	**Copolymer**
Fall from one's own height	4 (5)	2 (17)
Physical aggression	3 (38)	3 (25)
Sport	0	3 (25)
Automobile accident	1 (12)	1 (8)
Airplane crash	0	1 (8)
Firearm injury	0	2 (17)

TABLE 4. Topography of Orbital Fracture

	Orbital Fracture Topography, n (%)	
Variables	**Cartilage**	**Copolymer**
Floor	(100)	(100)
Right	5 (63)	7 (58)
Left	2 (25)	2 (17)
Both	1 (12)	3 (25)
Medial wall	1 (12)	4 (34)
Right	1 (100)	3 (75)
Left	0	1 (25)
Both	0	1 (25)

TABLE 5. Other Fractures Recorded in the Patients Studied

	Other Fractures, n (%)	
Variables	**Cartilage**	**Copolymer**
Orbit	8 (1)	12 (1)
Maxilla	7 (88)	12 (1)
Zygoma	4 (5)	7 (58)
Nose	3 (38)	5 (42)
Jaw	2 (25)	1 (8)
Skull	0	1 (8)

TABLE 6. Signs and Symptoms

Preoperative Signs and Symptoms	Cartilage, n (%)	Copolymer, n (%)
Enophthalmos	7 (88)	1 (83)
Loss of sensitivity	3 (38)	5 (42)
Diplopia	2 (25)	5 (42)
Fixing eyeball	1 (13)	1 (8)
Ectropion	0	3 (25)
Laceration of soft tissue	1 (13)	1 (8)
Paralytic mydriasis	0	2 (16)

TABLE 7. Postoperative CT Control

	CT Radiologic Control, %	
Variables	**Cartilage**	**Copolymer**
Orbital individualization	100	100
Resolution of blow-out	100	100

TABLE 8. Temporary Ophthalmic Changes

	Temporary Ophthalmic Changes, n (%)	
Variables	**Cartilage**	**Copolymer**
Palpebral edema	1 (13)	1 (8)
Ectropion	0	1 (8)
Increased intraocular pressure	0	1 (8)

TABLE 9. Definitive Sequelae

	Permanent Ophthalmic Changes, n (%)	
Variables	**Cartilage**	**Copolymer**
Infraorbital trigeminal branch paresthesia	2 (25)	2 (17)
Paralytic mydriasis	0	2 (17)

The type of trauma, topography of orbital fracture, other facial fractures, signs and symptoms, postoperative CT control, temporary ophthalmologic changes, and definitive sequelae are listed in Tables 3 to 9.

Postoperative CT evaluation was performed 6 months after surgery to confirm correct orbital alignment and skeletal symmetry and in particular sinus-orbital individualization, with the absence of sinus-orbital communication confirmed in 100% of cases (Table 7).

Temporary sequels were defined here as those that persisted no longer than 3 months after surgery (Table 8). Definitive sequelae were defined as persisting after the first 6 months of follow-up (Table 9).

DISCUSSION

An orbital fracture can be located on the orbital rims and on their walls. A blow-out fracture occurs when the medial wall or the orbital floor is broken, with a sinus-orbital communication that permits the periocular fat to be introduced into the sinus cavity.[9]

Sometimes, the extraocular muscles may be incarcerated into the fractured wall fragments, producing eyeball fixation or movement limitations and, more rarely, optic nerve lesion with the immediate occurrence or an important risk of amaurosis.[10–12]

Many different materials may be used to restore orbital blow-out fractures. Biologic or alloplastic material may be chosen.[2] In the biologic group, an autogenous absorbable graft may be chosen, such as auricular cartilage shell, nasal cartilage septum, calvarium cortical layer, and even external cortical layer of the iliac crest.[2,5,8]

Among the alloplastic materials, absorbable or inert substances may be chosen. The examples of inert alloplastic materials are titanium mesh, silastic silicone membrane, polytetrafluoroethylene, and absorbable alloplastic structures are materials containing different percentages of poly-L-glycolic acid and poly-L-lactic acid.[6,13,14]

The authors do not use inert, nonabsorbable material in orbital reconstruction. Whenever possible, the authors believe that preference should be given to autogenous and absorbable material considering the principle of not transforming the orbital cavity into

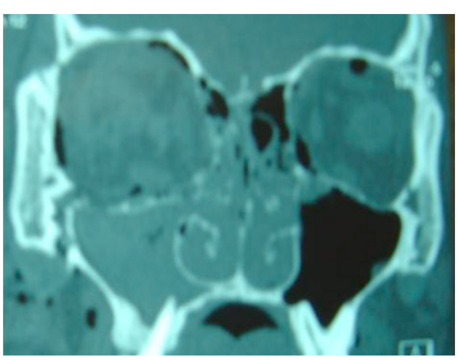

FIGURE 1. Patient 1 with facial CT showing orbital fracture and blow-out.

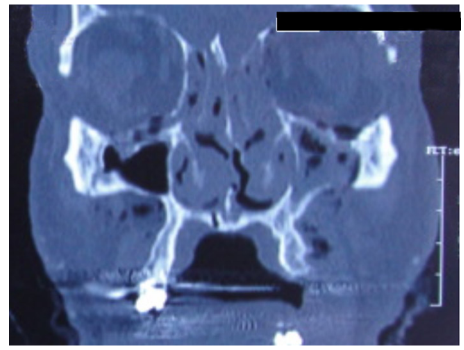

FIGURE 2. Patient 2 with facial CT showing bilateral orbital fracture and blow-out.

a rigid and unbroken structure. It is important to respect the nature of the orbit, whose walls will break in the presence of huge pressure, but with the eyeball preserved as much as possible.[10,15]

An autogenous ipsilateral auricular cartilage graft is well accepted on the orbital floor and in medial wall defects; there is no rejection reaction. The donation scar is hidden behind the ear with an excellent cosmetic result, and if necessary, the other auricular cartilage could be used, and the medical and hospital costs are decreased.[2,5,8]

Castellani and coworkers[8] reported on a series of patients with orbital floor blow-out treated with auricular conchal cartilage in which they observed many advantages from the use of this remodeling option: because the cartilage is only slightly vascularized and requires little blood perfusion, it is technically easier to obtain than bone graft, and because of its natural curve, it is anatomically better suited for orbital defects than septum cartilage. The current study followed most of the principles of the article of Castellani et al,[8] except that we used a posterior auricular incision rather than an anterior one.

Polyacid copolymer is a biocompatible and absorbable material, can be modeled in hot water, and is well accepted by the orbital defect, permitting a fast surgery without other scars in graft donation areas. In addition, it does not require manipulation of any other anatomic area, may be fixed with screws but not necessarily, and if the defect is larger than suspected, it can be applied in an abundant volume[2,7,13,16,17] although with an increased financial cost.

Pietrzak and Kumar[16] studied the hydrolysis characteristics of different copolymers and concluded that, although these compounds are all chemically related, all of them are a combination of

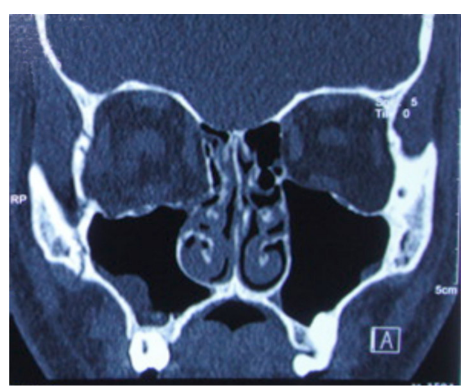

FIGURE 3. Patient 1 postoperative orbital remodeled and individualized.

FIGURE 4. Patient 2 postoperative orbital individualizes from periorbital sinuses.

different proportions of glycolic acid and lactic acid. Thus, these differences can translate into different hydrolysis rates, as observed in patients who showed little absorption of the material over time.[7,16] However, despite this risk, the authors defend their use because their chemical characteristics offer an orbital remodeling alternative that does not transform the orbital cavity into a fixed, unbroken, and rigid structure like the one occurring when nonabsorbable material is used for remodeling, with possible dangers and damage to the eyeball.[5]

Thus, both materials are suitable for orbital reconstruction; however, the authors were not sure whether one could have some advantage over the other regarding the final result. This study aimed to compare the use of these 2 materials by determining their ability to individualize the orbit, separating it from the paranasal sinuses, and also their efficiency in maintaining the anatomy of the orbits, restoring function and aesthetics with the least number of complications (Figs. 1–4).

As shown, all patients reached their goals, as documented by a facial CT 6 months after surgery (Table 7) that highlighted orbital individualization, with separation from the periorbital sinuses and with symmetrical orbital compliance.

In addition to this radiologic observation, medical ophthalmologic evaluation of each patient for 6 months after surgery revealed that complaints caused by fractures such as enophthalmos, diplopia, ocular fixation, and ectropion were resolved, leaving as permanent sequelae unilateral paralytic mydriasis in 2 cases of injury due to firearm assault and infraorbital nerve sensitivity loss in 4 cases of infraorbital nerve laceration (Tables 8 and 9).

CONCLUSIONS

There is no significant functional or aesthetic clinical difference between blow-out orbital fractures remodeled with an autogenous auricular cartilage graft or with absorbable polyacid copolymer material.

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