Indian Journal of Otolaryngology and Head & Neck Surgery
(Oct–Dec 2022) 74(4):547–554; https://doi.org/10.1007/s12070-022-03127-9

ORIGINAL ARTICLE

Management of Orbital Floor Fractures: Our Experience in 10 Years

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Received: 26 December 2021 / Accepted: 10 July 2022 / Published online: 2 August 2022

Abstract

Purpose Orbital floor Fractures are the most common fractures involving the facial skeleton and usually occurs after traumatic events. The reconstruction of the orbital floor can be performed with different biocompatible materials. The aim of our retrospective study is to analyze the short- and long-term outcomes of surgically treated patients based on the material used to repair the orbital floor.

Methods We enrolled 146 patients hospitalized for orbital floor fractures in the Maxillofacial Surgery Unit of the Federico II University of Naples from 1 to 2010 to July 2020. All the fractured orbital floors were reconstructed with non-resorbable (Titanium Mesh, SynPor, SuPor and MedPor implants) or resorbable (collagen membrane, bovinum pericardium membrane, autologous bone graft) materials.

Results We utilized non-resorbable materials in 56% (82 cases) and resorbable implants in 44% (64 cases). An improvement of the preoperative symptomatology and an aesthetical good outcome was achieved in most cases.

Conclusions Data obtained supports that both resorbable and non-resorbable materials for orbital floor reconstruction are a safe and effective alternatives and offer satisfactory results in functional and aesthetic evaluations.

Keywords Orbital floor fractures · Orbital reconstruction · Non-resorbable implants · Resorbable materials · Aesthetical results

Introduction

Orbital fractures represent 40% of craniofacial injuries [1]. Orbital walls are classified as follows: upper (roof), lateral, medial and lower (floor); the floor is commonly involved in traumatic events due to the extremely thin bone [2].

According to AO Classification [3, 4], orbital floor fractures are defined as: pure blow-out fractures, an isolated floor fractures with preservation of the orbital rim, or impure blow-out fractures, associated with an orbital rim fracture such as in complex orbital zygomatic fractures [5, 6]. Several Authors described the mechanism of orbital floor fractures by proposing two different theories. The hydraulic theory consists of an increase in intraorbital pressure which interrupts the orbital floor whereas the buckling theory states that a direct force impactsto the inferior orbital rim is transmitted to orbital floor [7, 8]. Moreover Patel et al. [9] suggested that a direct trauma to the globe predisposes to a posterior fracture while a trauma involving the orbital rim leads to an anterior fracture. Eno and exophthalmos, diplopia, infraorbital nerve anesthesia, extraocular muscles dysfunction with limitation of ocular movements and obstruction of the nasolacrimal ducts are recognized as sequelae of orbital blowout fractures. Therefore, surgical indication is based on the nature of the fracture, degree of diplopia, changes of globus volume, status of displacement of periorbital tissues, status of lower rectus muscle, and the experience of the surgeon [10–13].

The goals of orbital floor fracture reconstruction are: repositioning of incarcerated or prolapsed orbital tissue, correction of diplopia and displacement of pupillar plane ;

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reconstruction of the defect with an implant to restore the shape of the orbit and the orbital fullness [14–16].

Several materials, such as alloplastic, allogenic and autologous materials, have been used for orbital floor repair [17]. In recent years the trend has been to substitute autologous (bone) grafts with alloplastic materials, that are better tolerated and avoid harvesting donor site morbidity [18]. Regarding the reconstructive technique, there is no unanimous consensus and the decision often depends on surgeon preference, experience, and comfort or on the size of the defect [17–20].

Some Authors [21, 22] classified orbital floor fractures based on dimensional valuation small, with an estimate of the fracture area between 1 and 2 cm^2; medium, if the area is >2 and <2.5 cm^2; and large, if the fracture involves the entire floor, with a fracture area from 2.5 to 4 cm^2.

In literature [1, 2, 18, 23] the use of resorbable materials is indicated for small and medium fractures while non-resorbable implants is mandatory for large fractures. Nowadays alloplastic materials are mainly used to repair orbital floor due to availability, outcomes, cost and tolerability. The aim of our study is to report our 10 years experience in orbital floor fracture reconstruction evaluating surgical approaches and the short and long term outcomes of surgically treated patients based on the material used to repair the orbital floor.

Materials and Methods

The study was conducted in the Maxillofacial Surgery Unit of the Federico II University of Naples after the submission to the Ethics Committee of the University. Patients fulfilled the following inclusion criteria:

– 18 years old at the time of trauma;

– CT imaging of an orbital floor fracture that occurred no later than 2 weeks;
– No previous surgical treatment in the orbital region;

The exclusion criteria were:

– Absence of orbital floor fracture;
– Patients with major associated neurosurgical pathologies, such as chronic subdural hematomas and subarachnoid hemorrhages;
– Concomitant globe rupture as this could have invalidated the results and in particular the complications of the globe (i.e. dislocation of the globe or infraorbital hematomas);
– Presence of any disease at the time of enrollment that may affect eye motility (i.e. strabismus, myasthenia gravis) or that may cause a total or sub-total lesion of the optic nerve before the trauma (diabetic or hypertensive retinopathy);
– Previous radiotherapy of the orbital region, with possible scarring and damage to the structures of the eyeball not attributable to the traumatic event;
– Adherence to pharmacological therapeutic protocols that could directly or indirectly influence the results of the study.

Pre Surgical Evaluation

All the patients were subjected to a presurgical evaluation and the following data was collected.

Our pre surgical analysis regards the mechanism of the fracture; side of the fracture (right / left) and structure involved according to the AOCMF fracture classification system; visual acuity at the time of treatment expressed as a percentage of vision (if known) or using categories (normal visual acuity / reduced vision / no perception of light); concomitant conditions such as enophthalmos, dyplopia, changes in the sensitivity of the infraorbital nerve, alterations of the lower rectus muscle, alterations of the orbital volume; state of the motility of the globe at the time of treatment; state of the eyelid at the time of initial treatment.

Surgical Procedure

We evaluated the timing of the surgery and the features of the surgical procedures. In particular, all surgical procedures were carried out under general anesthesia and were performed by a team of expert surgeons. Furthermore, the reduction and fixation of all the fractures occurred in accordance with the guidelines of the AOCMF using plates and screws of different thickness and performance, in order to achieve a good functional and aesthetic outcome (CiZeta Modul System 1,6 Micro and Modul System 2,0 Mini).

The surgical approach based on the type of fracture; the implant material for the orbital floor fractures: autologous bone graft / allogenic (e.g. irradiated bone, hard lyophilized, lyophilized cartilage, bovine bone) / metallic alloplastic (e.g. Titanium) / Resorbable Alloplastic materials / Non-resorbable alloplastic implants were analyzed.

Post Surgical Evaluation and Follow Up

All the patients underwent antibiotic and corticosteroid therapy for 7 days. We calculated the mean time of hospitalization and set a clinical and radiological follow-up. The mean period of follow-up was approximately 12–14 months. The outpatient checks were conducted at 1, 3, 6, 12 months with a CT scan examination at 6 months.

Table 1 Main features of 146 patients

Features	Cases	Rates
Age	92	63%
> 18 and < 50 years old	54	37%
> 50 years old		
Sex	105	72%
M	41	28%
F		
Comorbidities	26	18%
- Cardiovascular diseases	13	9%
- Diabetes mellitus	9	6%
- Neurological/psychiatric disorders	4	3%
- Others		

The physical examination aimed to investigate the aesthetic and functional results and eventually sequalae such as diplopia, enophthalmos, eyelid retraction, entropion, ectropion, bleeding, infections, sensitivity disorders. The primary outcome was to evaluate resolution rates of preoperative signs and symptoms while the secondary outcome was to investigate postoperative complications or permanent signs and symptoms based on the materials used.

The correct reduction of fractures and the bone healing were documented radiologically. A Computed Tomography (CT) with slices less than 0.5 mm thick was used as diagnostic tool.

Results

Data of 396 patients from January 2010 to September 2020 was evaluated and 191 patients with satisfactory inclusion criteria were enrolled. The patients were divided into two groups: 1) Non-surgical treatment: 45 patients who had no indication for intervention; who voluntarily refused surgery and who had important comorbidities that contraindicate surgery according to the risk / benefit ratio.

2) Surgical Treatment: 146 patients underwent surgical procedure of which 96 not associated with others fractures (orbital floor isolated fracture).

We analyzed data extracted from all the 146 patients subjected to surgery. Our data was obtained from collection of anamnesis, physical examination, ophthalmological visit, and radiological reports.

Table 1 shows the main features of the sample (age, sex, comorbidities).

Pre Surgical Results

Our data showed that the most frequent causes of trauma were car accidents in 44% (64 cases) and accidental falls in 39 cases (27%). In the 65,8% of the cases (96 cases) the orbital floor fracture was isolated; in the others cases it was mainly associated with zygomatic complex fractures in24 cases (48%) and with Nose-Orbit-Ethmoidal fractures (NOE) in17 cases (34%). Regarding the sensitivity alterations of the infraorbital nerve, normoesthesia resulted in 51 cases (35%) while the most common impairment was hypoesthesia in 39 cases (27%).

Orbital floor fractures defect was: small (1–2 cm^2) in 55 cases (37.7%), medium (2-2.5 cm^2) in 35 cases (24%) and large (2.5-4 cm^2) in 56 cases (38.3%).

Diplopia was recorded in 35 cases (23.8%). In 12 of these cases, diplopia mainly appears in the primary position of the gaze. No limitations of ocular motility were found in 80% of patients (116 cases) but, in presence of impairment, the most frequent deficit was combined in 6% (9 cases) and in sursum-version (supraversion) in 4% (6 cases). In most cases, the lower rectus muscle remained in place (76,2%); in 16 cases it was inferiorly prolapsed (< 50% of total length), in 6 cases incarcerated (4%) and in 3 cases ptotic (> 50% of total length). More than half of the cases showed a dislocation of bone fragments in the maxillary sinus in 72% (105 cases) and a maxillary haemosinus (59%); in the remaining cases the fragments were mainly in the lateral wall in 15% (22 cases). Clinically periorbital soft tissue swelling and edema were evident in 35 cases (24%). Alterations of the orbital volume, evaluated with CT scans, were highlighted in 56,8% of cases; in particular pneumo-orbitis in 17% and Hypoglobus in 15% were observed. In 11% of the cases ocular injury resulted in a noticeable vision deficit. Detailed pre surgical results are shown in Table 2.

Surgical Results

The mean timing to surgery was 3 days. Surgical approach to the orbital floor, according to AO classification, was: subciliary in 66% (96 cases), transconjunctival in 20% (29 cases), through previous laceration in 7% (10 cases), subtarsal in 4% (6 cases), endoscopic in 2% (3 cases), infraorbital in 1% (2 cases).

The implant material used to reconstruct the deficit was non-resorbable in 56% (82 cases) and resorbable in 44% (64 cases).

The biomaterials used were: Titanium Mesh 3D synthesis in 30% (44 cases), resorbable alloplastic membrane in collagen Nobelbiocare CREOS (Creos xenoprotect® Matricel Gmbh Germany / 30 × 40 mm) in 28% (41 cases), non-resorbable alloplastic membrane SU-POR (Supor surgical implant® / 30 × 50 × 0.85 mm) in 13% (19 cases), non-resorbable alloplastic Medpor® rigid membrane (Porous polyethylene implants) 30 × 50 × 1 mm in 9% (13 cases), Thin titanium mesh in 7% (10 cases), resorbable Geistlich BioGide® Switzerland in 5% (7 cases), Pericardium membrane of bovine origin / 30 × 25 / 0.2-0-4 mm (Bioteck spa® Arcugnano (VI) Italy) in 5% (7 cases), non-resorbable

Table 2 Presurgical results

Presurgical Data	Cases	Rates
Cause of injuries	- Road Car accidents 64 cases	- 44%
	- Accidental falls 39 cases	- 27%
	- Interpersonal violence 19 cases	- 13%
	- Road motorcycle accidents 13 cases	- 9%
	- Lipothymia / syncopal episodes 7 cases	- 5%
	- Sports accidents 3 cases	- 2%
	- Other minor causes 1 case	
Classification of the fractures	- Isolated orbital floor fracture 96 cases	-65,8%
	Orbital floor fracture associated to:	-16,5%
	- Zygomatic complex fractures 24 cases	-11,7%
	- Nose Orbit Ethmoidal fractures (NOE) 17 cases	- 4%
	- Lateral orbital wall 6 cases	- 2%
	- Medial orbital wall 3 cases	
Sensitivity alteration of infraorbital nerve	- Absence of alteration or normoesthesia 51 cases	- 35%
	- Reduction of sensitivity or hypoesthesia 39 cases	- 27%
	- Paraesthesia 28 cases	- 19%
	- Anesthesia 19 cases	- 13%
	- Hyperesthesia 6 cases	- 4%
	- Not evaluable in uncooperative patients in 3 cases	- 2%
Diplopia	- No diplopia 111 cases	-76,2%
	- Diplopia in primary position of the gaze 12 case	- 8,2%-
	- Diplopia in the vertical gaze 8 cases	- 5,6%
	- Diplopia in all directions 6 cases	- 4%
	- Diplopia in the upper quadrants 6 cases	- 4%
	- Diplopia in lower quadrants 3 cases.	- 2%
Limitation of ocular motility	- Absence of limitations 116 cases	- 80%
	- Combined deficit in 9 cases	- 6%
	- Sursum-version deficiency 6 cases	- 4%
	- Not evaluable 6 cases	- 4%
	- Inferorversion deficit 6 cases	- 4%
	- Lateroversion deficit 3 cases.	- 2%
Dislocation of fragments	- In the maxillary sinus 105 cases	- 72%
	- In the lateral wall 22 cases	- 15%
	- In the medial wall 9 cases	- 6%
	- Absence of dislocation 6 cases	- 4%
	- I the ethmoid cells 3 cases	- 2%
	- In the infraorbital soft tissue 1 cases.	- 1%
Lower rectus muscle status	- In place 111 cases	- 76,2
	- Inferiorly prolapsed 16 cases	- 11%
	- With probable incarceration but finding doubtful 6 cases	- 4%
	- Incarcerated 6 cases	- 4%
	- Ptotic 3 cases	-2%
	- With a “pinched” appearance 2 cases	- 1,4%
	- Transected 2 cases	- 1,4%
Periorbital tissues status	- Maxillary haemosinus 86 cases	- 59%
	- Periorbital soft tissue swelling and edema 35 cases	- 24%
	- subcutaneous emphysema 25 cases	- 17%
Orbital volume alterations	- Absence of alterations 63 cases	- 43,2
	- Pneumo-orbitis 25 cases	- 17%
	- Hypoglobus 22 cases	- 15%
	- Enophthalmos 19 cases	- 13%
	- Infraorbital fragments 7 cases	- 5%
	- Multiple aerial nuclei 6 cases	- 4%
	- Significant reduction (>20% of total volume) 2 cases	- 1,4%
	- Microbubbles 2 cases.	- 1,4%

alloplastic Synpor (SynPOR Porous polyethylene implants) / ti® orbital Fi Mesh PI 30 × 30 × 0.85 mm) in 2% (3 cases), autologous bone graft in 1% (2 cases). For large defects, non-resorbable materials as titanium were used. For small and medium defects we used non-titanium alloplastic material.

Table 3 Postsurgical Results

Data	Cases	Rates
Fracture reduction or fixation complications	- Absent 104 cases - Screws loosening (repair of orbital floor fractures with titanium mesh fixed with screws or autologous bone graft fixed with plate and screws) 16 cases - Malposition of the implant 13 cases - Iatrogenic fractures 10 cases - Malposition of the screws 3 cases	-71% -11% - 9% - 7% - 2%
Other Complications	- Ectropion and entropion 9 and 7 cases respectively - Eyelid retraction in 10 cases - Infections of surgical site 12 cases - Conjunctival chemosis 7 cases - Enophthalmos 7 cases - Surgical wounds dehiscence 6 cases - Exophthalmos and lagophthalmos 3 cases each - Hypoglobus 3 cases - Retinal lesions 3 cases - Optic nerve lesions 2 cases	-11% - 7% - 8% - 5% - 5% - 4% - 4% - 4% - 2% - 1%
Infraorbital Nerve status	- Normoesthesia 101 cases - Hypoesthesia 15 cases - Paraesthesia 13 cases - Anesthesia 10 cases - Hyperesthesia 4 cases - Direct lesions to the infraorbital nerve 3 cases	-69% -10% - 9% - 7% - 3% - 2%
Diplopia	- No diplopia 130 cases - Diplopia in primary position of the gaze 47 cases - Diplopia in all directions 3 cases - Diplopia in the vertical gaze 2 cases - Diplopia in the upper quadrants 2 cases - Diplopia in lower quadrants 2 cases.	-89% -4,8% - 2% -1,4% -1,4% -1,4% -1,4%
Lower rectus muscle status	- Successful repositioning 144 cases - sursum-version deficiency 2 cases	-98,6% - 1,4%

Post Surgical Results

In 67% of the cases no complications were highlighted. In the other cases, the most frequent complications were loose screws (repair of orbital floor fractures with titanium mesh fixed with screws or autologous bone graft fixed with plate and screws) in 11% of cases and malposition of the implant in 9% of the cases. Infections of surgical site and surgical wounds dehiscence were observed in 12 cases (8%) and 6 cases (4%) respectively. Other important postsurgical complications were ectropion and entropion in 11% of cases (9 and 7 cases respectively), eyelid retraction in 7% of cases and enophthalmos in 5% cases. Repositioning of the lower rectus muscle was successful in all cases with preserved ocular motility in all patients except for 2, which continued to present sursum-version deficiency. 16/35 patients continued to report postsurgical diplopia: in particular, diplopia was mainly recorded in the primary position of the gaze in 43% of cases (7 cases) and in all directions in 18% of cases. The recorded resolution rate of Infraorbital Nerve alterations was 52,6%, 45 patients continued to feel sensory disorders. In particular hypoesthesia in 10% of cases and paresthesia in 9% of cases were observed. Anesthesia and hyperesthesia were rare (10 cases and 4 cases respectively). Moreover, retinal lesions in 3 cases (2%) and optic nerve lesions in 2 cases (1%) were observed as permanent sequelae.

Detailed postsurgical results are shown in Table 3.

Table 4 Resolution rates of preoperative symptoms after one month of follow-up

Signs and Symptoms	Preop cases	Postop cases (1 M)	% of Resolution
Subconjunctival hemorrhage	124/146	3/146	97,6%
Periorbital ecchymosis and edema/ Subcutaneous emphysema	60/146	5/146	91,7%
Hypoglobus	22/146	3/146	86,4%
Enophthalmos	19/146	7/146	63,1%
Diplopia	35/146	16/146	54,3%
Infraorbital nerve alterations	95/146	45/146	52,6%
Limitation ocular motility	30/146	2/146	93,3%
Displacement Lower Rectus muscle	35/146	0/146	100%
Maxillary Haemosinus	86/146	4/146	95,3%
Ocular injury	16/146	5/146	68,8%

The complete resolution rates of preoperative symptoms at one month follow-up is reported in Table 4. This was calculated through the ratio between the number of patients still presenting symptoms after surgery and the total of symptomatic patients in pre-operative time.

The specific complications and permanent signs and symptoms after surgery, according to the type of implant, are shown in Table 5. Both isolated orbital floor fractures and orbital floor fractures associated with other fractures are considered.

In most cases, postoperative diplopia was observed where non resorbable alloplastic materials were used, while infraorbital nerve disorders still remained after use of titanium meshes. Infections were mainly observed in case of use of non-resorbable alloplastic materials.

Discussion

The aim of this study is to provide an overview on both epidemiological and surgical results on orbital floor fractures. Publications have [24] reported that males are the most affected sex : our analysis shows that the male represents 72% of the total cases, with an average age of 46 years.

Table 5 Specific complications and permanent signs and symptoms after surgery according to the type of implant

Complications or permanent signs and symptoms post-surgery	Titanium Mesh (tot 54 cases)	Resorbable alloplastic (Creos, pericardium bovinum – tot 55 cases)	Non Resorbable Alloplastic (SynPor, SuPor and MedPor implants – tot 35 cases)	Autologous bone graft (tot 2 cases)
Diplopia (16 cases)	3/16	5/16	8/16	0/16
Enophthalmos (7 cases)	1/7	3/7	2/7	1/7
Exophthalmos / lagophthalmos (6 cases)	3/6	0/6	3/6	0/6
Ectropion/entropion or eyelid retraction (26 cases)	12/26	5/26	9/26	0/26
Limitation ocular motility (2 cases)	1/2	0/2	1/2	0/2
Infraorbital Nerve Alterations (45 cases)	19/45	17/45	8/45	1/45
Malposition of the implantation (16 cases)	6/16	3/16	7/16	0/16
Dehiscence of surgical wounds (6 cases)	3/6	2/6	1/6	0/6
Screw loosening (16 cases)	16/16	0/16	0/16	0/16
Iatrogenic fractures (9 cases)	9/9	0/9	0/9	0/9
Infections (12 cases)	2/12	3/12	7/12	0/12

This data is related to the etiology of the traumatic event. Most of the patients were young males involved in road accidents (44% of cases). In males, the peak of incidence registered has been between 20 and 30 years, while for the female between 35 and 45 years. In cases of fractures associated with syncopal episodes or lipothymia, females were mostly involved, with an incidence peak between 45 and 65 years. For women, accidental falls were recorded primarily at home [24, 25].

Surgical indications for fractures depend on the size, severity of lower rectus muscle displacement, presence of diplopia, enophthalmos, hypoglobus, and infraorbital nerve anesthesia [26]. We noted that in most patients with presurgical enophthalmos, the fracture involved the orbital key zone (Hammer's area), a bulging zone in the posteromedial wall of the orbit [27]. Diplopia and displacement of the pupillary plane, compared to non-traumatized eye, are potential complications that could persist or appear after orbital fracture surgery. This is a result of concussion and fibrosis or incarceration of tissue that could produce ischemia and long-term muscles function alterations. Cranial nerve damage is less frequent [12, 28].

Regarding the postoperative results, our data was compared with that of the most current literature [29] that evaluated complications and permanent signs and symptoms after surgery based on the materials used. Most (7/12–58,3%) of the surgical site infections were recorded after the use of non-resorbable alloplastic materials, compared to titanium mesh and resorbable materials that are highly biocompatible. Titanium has low resorption potential, high osseointegration rate and offers rigid support to the orbit [30, 31]; however, it can cause a fibrotic reaction [32–34]. Consequently, after its use, in accordance with literature, complications such as different pupillary height and enophthalmos are rarely reported while residual diplopia has been observed. Moreover, titanium is a rigid material that must be fixed with the use of screws, thus complications such as implant malpositioning, iatrogenic fractures and loss of screws have been highlighted [35].

The use of autologous bone for internal reconstruction of the orbit has therefore become widespread. Several donor sites have been used, such as the mandibular symphysis and branch [36], the iliac spine [37] and commonly the calvaria [38, 39] due to the low risk of infection. Our case donor site was the mandibular branch. The most worrying limit of autologous bone grafts is a slow resorption which often results in an enophthalmos [40]. We observed one of the seven postoperative cases of enophthalmos with the use of autologous bone graft.

Another important consideration is that the lowest resolution rate of preoperative symptoms, found in our study, concerns alterations of the infraorbital nerve. Several authors showed that transient infraorbital nerve alterations are common after orbital floor fractures [25, 40, 41] due to compression of the nerve in the collapsed canal, or irritation of the nerve by sharp fragments of bone. The persistence of

symptoms related to this nerve may depend on inadequate decompression, permanent injury due to trauma, or surgical adhesions [42, 43]. Complications and persistent post-operative symptoms and signs were analyzed by a team of maxillofacial surgeons, ophthalmologists and neurosurgeons. However the description of the management of complications is not a topic of this study.

Limitations of our study is its retrospective nature. Moreover, there were no defined criteria on the use of specific implants: and indications for each type of implant were not based on unanimous criteria of fracture size or type. According to literature, the features that guided the choice were [21–24]: defect size; involvement of multiple walls; adaptation to orbital contours; risk of infection restoration of initial volume; prevention of displacement; risk of further trauma restriction of ocular motility; late repair versus early repair; surgeon's comfort level with the different materials. Usually when a loss of substance greater than 50% occurred, we used non-resorbable materials, despite the possible complications, to obtain optimal aesthetic and functional outcomes and the restoration of a support surface for the eyeball. Rigid materials, in fact, are more suitable for the large defects repair wheras resorbable materials are more malleable and comfortable for the reconstruction of small defects [17, 18, 29, 44]. According to literature, for small and medium defects we used non-titanium alloplastic material.

Unfortunately, another limit of our study is the absence of a statistical analysis that confirm the results validity.

Conclusions

Data obtained from our study supports the results of previous studies conducted within our department and confirm the andress of literature in field of orbital floor reconstruction. Among the various biomaterials, titanium mesh and resorbable collagen membranes have shown to be equally as safe and effective and related to fewer complications for the treatment of orbital floor fractures. These materials avoid the use of non-resorbable alloplastic implants and autologous grafts that have a higher association with morbidity. The choice of the implants depends on size of fracture, on the patients features and on the level of surgeon's comfort.

Declarations

Conflict of Interest The authors declare no conflict of interest.

Founding The authors declare that no funds, grants, or other support were received during the preparation of this manuscript.

Institutional Review Board Statement "The study was conducted according to the guidelines of the Declaration of Helsinki and approved by the Institutional Review Board of Federico II University of Naples.

Informed Consent Statement An informed consent was obtained from all the subjects involved in the study. The patients in this project consented to the use of all photographs and illustrations for the purposes of educational content. The signed consent forms are on file at the Maxillofacial Department of Federico II University of Naples, Naples, Italy, containing identifying patient information and signatures. These data are available upon specific request.

Ethical Approval No ethical approval was needed. Signed patient consent was all that was required by the hospital.

Consent to Participate Signed patients consents were obtained for surgical procedures and to participate to study.

Consent to Publish All authors have viewed and agreed to the submission.

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Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s12070-022-03127-9.